



Evolution of maternal mortality and impact of Covid-19 in the Northern Region of Brazil: an analysis from 2012 to 2021

A evolução da mortalidade materna e o impacto da Covid-19 na Região Norte do Brasil: uma análise de 2012 a 2021

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ABSTRACT

To analyze the behavior of the maternal mortality ratio from 2012 to 2021 in the North Region of Brazil. Population-based descriptive ecological study and time series, from 2012 to 2021, with secondary data from the Northern Region of Brazil, available on the Monitoring Panel for Maternal Mortality and Live Births. Between 2012 and 2019, in the North Region, the average maternal mortality ratio was 72.19, but, with the covid-19 pandemic, it increased considerably, being 92.16 in 2020 and 164 in 2021. Roraima presented higher maternal mortality in the pandemic, in February 2021 (705.65). That year, the collapse of the health system in Amazonas affected the maternal mortality ratio, which was 436.90 in February 2021. Covid-19 collaborated with the increase in maternal mortality, highlighting interstate inequalities and vulnerabilities in prenatal care, hospital, and socioeconomic infrastructure in the North Region, especially in Roraima and Amazonas.

Keywords: Pregnancy Complications; Covid-19; SARS-CoV-2; Maternal and Child Health.

RESUMO

Analisar comportamento da razão de mortalidade materna de 2012 a 2021, na Região Norte do Brasil. Estudo ecológico descritivo de base populacional e série temporal, de 2012 a 2021, com dados secundários da Região Norte do Brasil, disponíveis no Painel de Monitoramento de Mortalidade Materna e Nascidos Vivos. Entre 2012 e 2019, na Região Norte, a média da razão de mortalidade materna foi 72,19, mas, com a pandemia de covid-19, elevou-se consideravelmente, sendo 92,16 em 2020 e 164 em 2021. Roraima apresentou a maior mortalidade materna na pandemia, em fevereiro de 2021 (705,65). Nesse ano, o colapso do sistema saúde do Amazonas impactou a razão de mortalidade materna, que foi 436,90 em fevereiro de 2021. A covid-19 colaborou com o aumento da mortalidade materna, evidenciando desigualdades interestaduais e vulnerabilidades na assistência pré-natal, na infraestrutura hospitalar e socioeconômica da Região Norte, especialmente em Roraima e Amazonas.

Palavras-chave: Complicações na gravidez; Covid-19; SARS-CoV-2; Saúde materno-infantil.

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INTRODUCTION

Maternal death is defined as the death of a woman during pregnancy or up to 42 days after the end of pregnancy, regardless of the duration and location of the pregnancy¹. The maternal mortality ratio (MMR) is the indicator used to measure the mortality rate or coefficient: it is the ratio between the number of maternal deaths per 100,000 live births (LB)². This is an important health indicator and can reveal the health conditions of the population, the capacity of the health system to respond to health needs, in addition to providing information on the quality of access and structure of the care network³.

Maternal mortality is currently understood as an indicator of social development because it combines complex social determinants, which is why it was included in one of the goals to be achieved in the Millennium Development Goals (MDGs), signed by more than 180 countries with the United Nations between the years 2000 to 2015^{4–6}. Brazil was unable to reach the proposed target by 2015, of reducing maternal mortality by 75% and agreed, in 2015, through the Sustainable Development Goals (SDGs), the reduction to 30 maternal deaths per 100,000 LBs by the year 2030^{6,7}.

Lopatiuk⁸, when analyzing maternal mortality during the covid-19 pandemic, shows the psychosocial impact of this event, emphasizing that motherhood has an affective, cultural, and social meaning for that woman and her family. Therefore, maternal death has important family and collective effects, and cannot be seen only as a biological fact⁸.

Even though the core of this study is to present an epidemiological overview, it is worth mentioning that coping with maternal death must also consider social, economic, access, equity, and comprehensive care issues. In this way, knowledge about epidemiological data can be a first step towards raising the awareness of managers, professionals, and the population

itself, in the search for social control to demand public policies that are sensitive to the reality of each location⁹.

In an analysis carried out between 1990 and 2019, a 49% reduction in the MMR was found in Brazil and a predominance of maternal death from indirect causes in about 60% of the Brazilian states¹⁰. From 1996 to 2018, the MMR stagnated in Brazil, which will probably make it impossible to meet the target by 2030¹¹.

Added to this, the emergence of the pandemic caused by the new coronavirus (SARS CoV-2), which brought the biggest public health crisis of the 21st century. The coronavirus-19 disease (covid-19) is of a severe viral respiratory nature and has demonstrated clinical epidemiological characteristics of rapid dissemination and the ability to infect the general population. The onset of the emergency occurred in Wuhan, Hubei province, China, in December 2019, spreading across Asia; and, on March 13, 2020, the World Health Organization (WHO) declared it a pandemic^{12,13}.

In general, covid-19 presents a clinic that varies from asymptomatic to severe acute respiratory syndrome (SARS) and death. In Brazil, the highest lethality of the disease was registered in the year 2021, of 2.9%, with an incidence of 6,935 cases per 100,000 inhabitants¹⁴.

The covid-19 pandemic profoundly affected health systems and potentially perinatal outcomes, also resulting in a consequent increase in maternal deaths from indirect obstetric causes^{15–17}. In Brazil, in 2020, a number of maternal deaths (pregnant or puerperal women) 3.4 times higher than those recorded in other countries in the world were recorded. Data referring to records until June 2020 showed that the maternal mortality rate in the Brazilian population was 12.7%, with a higher number in the puerperal period than during pregnancy¹⁸.

A study evaluating maternal death records from February to September 2021, in the in-hospital context, showed that the maternal

mortality rate was 7.5% and that the risk of maternal death was higher in self-identified black/brown women and residents of the North Region of Brazil. There, the rate was 15%, while the South Region recorded the lowest number of maternal deaths¹⁹.

Socioeconomic inequalities between Brazilian regions are also evident in the country's health indicators²⁰. When observing the MMRs by Brazilian regions in 2019, the North Region accounted for 82.5 maternal deaths for every 100,000 LBs, compared to 38.3 in the South Region. The North Region also recorded three of the five Brazilian states with the highest MMRs in 2019. Pará, Roraima and Amazonas had MMRs of 96.1, 91.9 and 84.8 maternal deaths per 100,000 LBs, respectively²¹.

In 2008, the Ministry of Health (MS) stated that "the availability of information based on valid and reliable data is an essential condition for an objective analysis of the health situation". In this way, health indicators act as references for adapting management and resources, in addition to promoting new public policies²².

Considering both the epidemiological, socioeconomic, and demographic differences between the Brazilian regions and even between the states of the North Region regarding the concern related to the impact of covid-19 on maternal mortality, the objective of this study was to analyze the behavior of maternal mortality rates in the period from 2012 to 2021, in the North Brazilian Region.

METHODOLOGY

This is a population-based descriptive ecological study of the time series type, whose units of analysis were constituted by the seven states of the Northern Region of Brazil, namely: Acre, Amapá, Amazonas, Pará, Rondônia, Roraima and Tocantins. The study was based on the analysis of ten-year secondary data from

the period 2012 to 2021, based on information available in the Maternal Mortality Monitoring Panel and the Live Birth Monitoring Panel of the Department of Health Analysis and Surveillance of Non-Communicable Diseases of the MS Health Surveillance Secretariat.

The variable under analysis is the MMR, whose calculation is based on WHO determinations; and, in this study, the aforementioned Federal Units were considered. For this, the data were organized in an electronic spreadsheet in Excel software. Descriptive analysis was performed based on the absolute difference between ratios and temporal analysis through polynomial regression of MMR, between the years 2012 to 2021. Brown's exponential smoothing model was used to analyze the time series from 2012 to 2021, with 95% confidence interval. All analyses were performed using the IBM Statistical Package for the Social Sciences (SPSS) program, version 26.0.

The data in this research is in the public domain, with unrestricted access and without identifying individuals. Thus, submission to the Research Ethics Committee/CONEP system was not necessary, respecting the provisions of Art.1, Item III of Resolution 510/2016 of the National Research Council, which deals with regulatory standards for research involving human beings.

RESULTS

In Brazil, 15,953 maternal deaths were recorded between 2012 and 2021, while in the North Region there were 2,466 maternal deaths, representing 15.5% of deaths in the country. In Figure 1, the temporal analysis of the North Region was presented; and it was observed that, in the years 2020 and 2021, the increase in MMR is well above that expected for the region. The considerable increase in MMR was also evidenced in all states of the North Region (Figure 1).

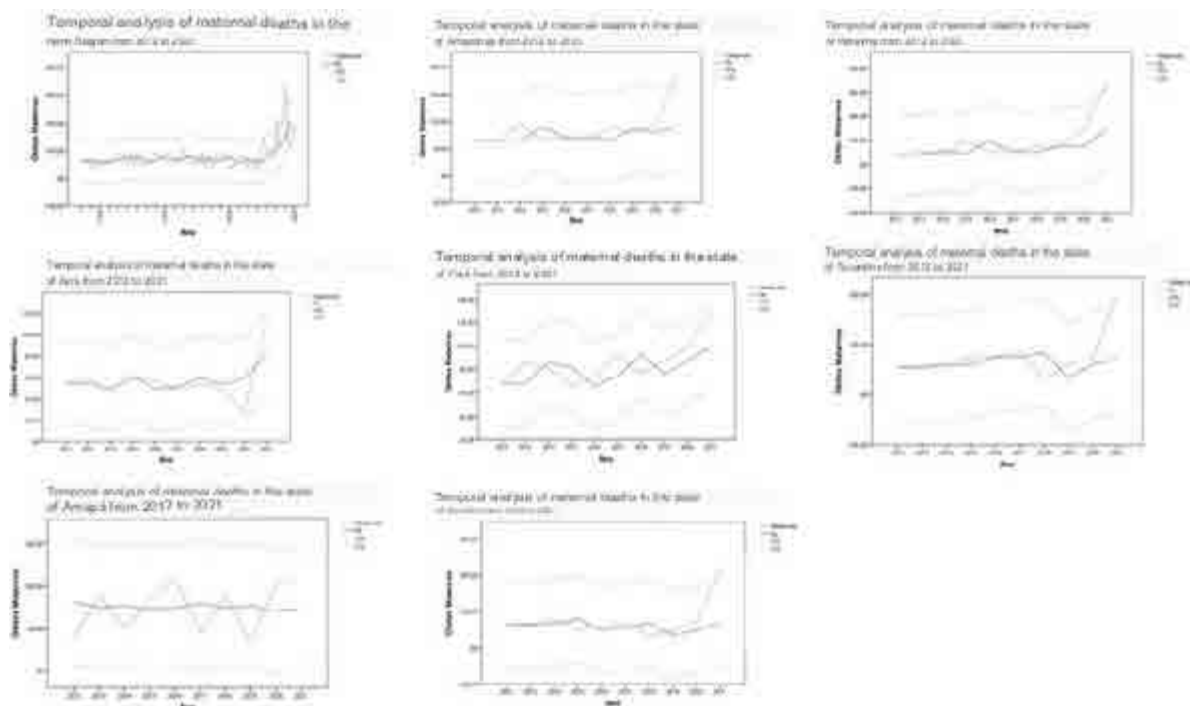


Figure 1. Temporal analyzes of maternal deaths in the states of the North Region, in the years from 2012 to 2021*.

*ULC: Upper limit/ LCL: Lower limit.

Source: Maternal Mortality Monitoring Panel and Live Births Monitoring Panel of the Department of Health Analysis and Surveillance of Noncommunicable Diseases of the Ministry of Health Surveillance.

From 2012 to 2019, Brazil averaged 57.46 maternal deaths per 100,000 LBs; in comparison with 2020 and 2021, an increase of 10.4/100 thousand LBs and 60.9/100 thousand LBs was identified, respectively. The North Region recorded, from 2012 to 2019, an average MMR

of 72.19/100,000 LBs. In 2020, MMR increased to 92.16/100k NVs; and, in 2021, the rate was 164.17 maternal deaths per 100,000 LBs, which represented a significant growth in the MMR, considering the years of the covid-19 pandemic (Figure 2).

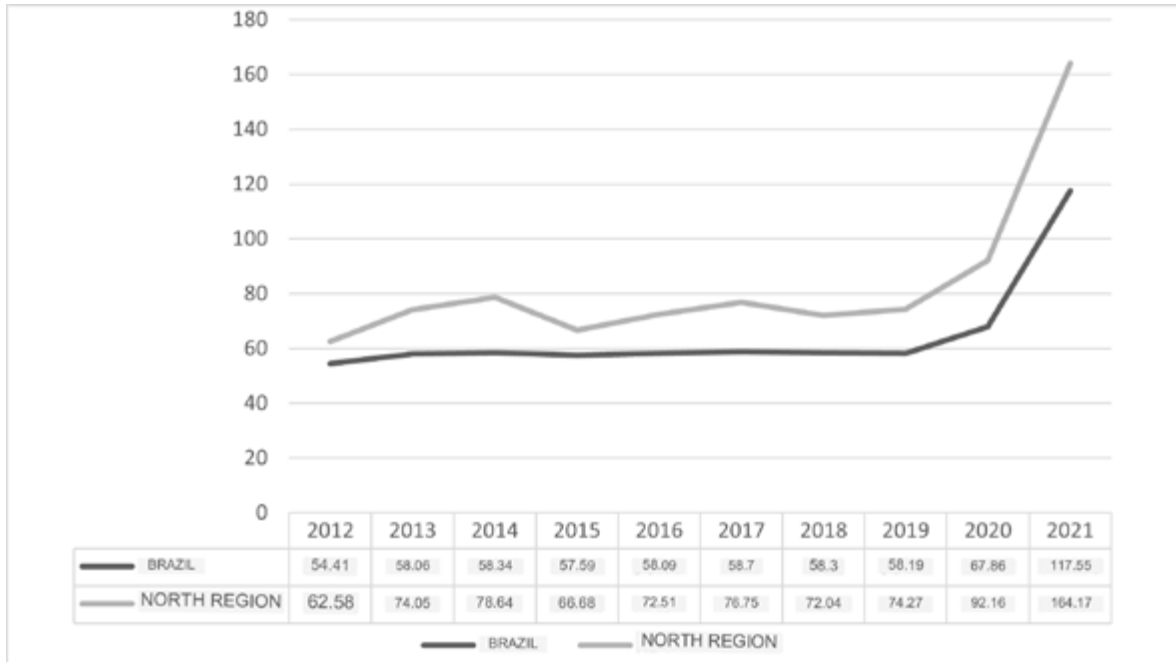


Figure 2. Maternal mortality ratio in Brazil and in the North Region, from 2012 to 2021.

Source: Maternal Mortality Monitoring Panel and Live Births Monitoring Panel of the Department of Health Analysis and Surveillance of Noncommunicable Diseases of the Ministry of Health Surveillance.

Compared to 2019, Brazil recorded an increase of 116.6% in MMRs in 2020 and 202% in 2021. From 2019 to 2020, the MMR increased by 124% in the North Region; and, from 2019 to 2021, the growth was 221%, that is, more accentuated than Brazil. The respective rates or

ratios of maternal mortality were also estimated for each state in the North Region. The largest were observed in the years 2020 and 2021, in the state of Roraima, with an increase of 194% in 2020 and 452% in 2021 compared to 2019 (Figure 3).

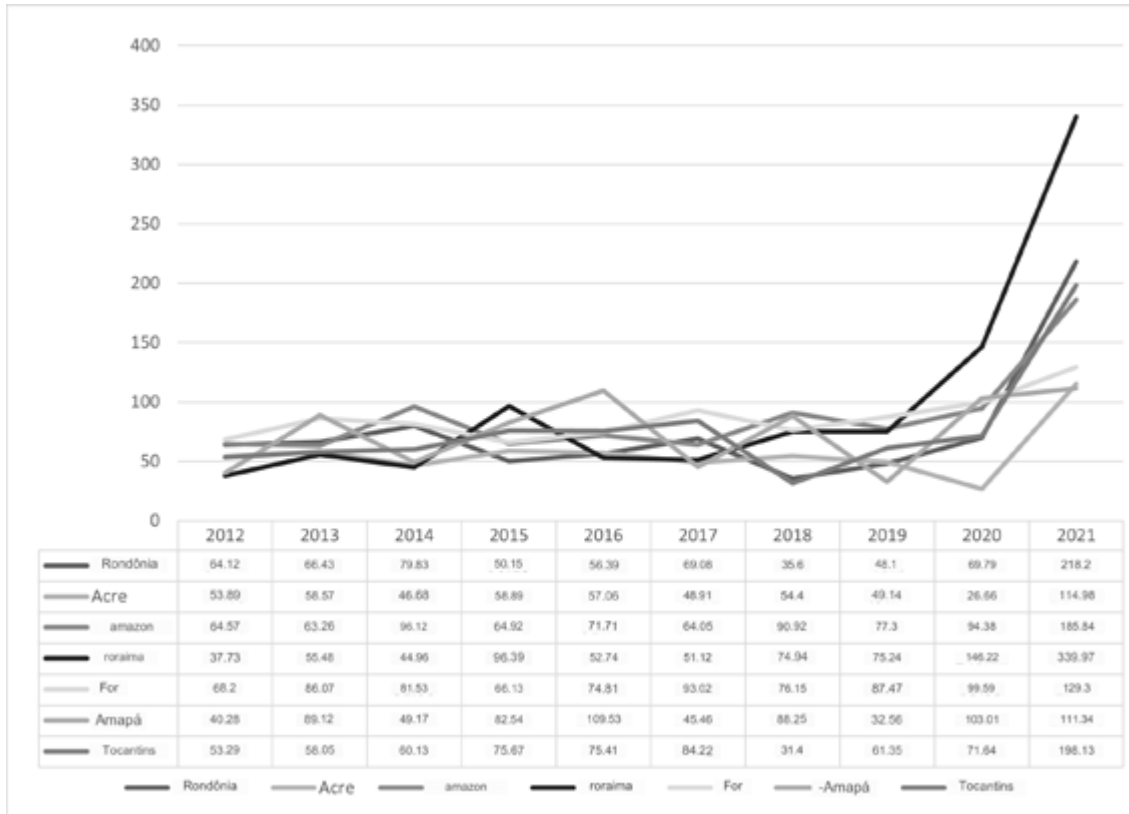


Figure 3. Maternal mortality ratio of states in the North Region from 2012 to 2021.

Source: Maternal Mortality Monitoring Panel and Live Births Monitoring Panel of the Department of Health Analysis and Surveillance of Noncommunicable Diseases of the Ministry of Health Surveillance.

Among the states in the North Region, only Amapá showed an increase in MMR between May and July 2020, while all other states had growth in rates, registering a higher MMR in June

2020. In 2021, the months of February and March of 2021 had the highest MMRs in all states in the North Region (Table 1 and Table 2).

Table 1. Maternal mortality ratio in the states of the North Region from January to December 2020

	Rondônia	Acre	Amazonas	Roraima	Pará	Amapá	Tocantins
JAN	49.55	0	93.02	246.71	71.7	79.81	54.32
FEB	99.11	80,65	15.5	82.24	80.66	79.81	0
MAR	46.17	0	48.34	85.69	79.22	0	56.24
APR	43.67	0	122.04	79.49	126.58	251.05	98.57
MAY	43.07	77,1	298.76	185.19	170.39	257.73	135.44
JUN	350.53	81,7	144.35	374.53	124.99	0	306.59
JUL	46.79	0	150.35	572.52	93.51	167.93	143.61
AGU	133.27	76,16	31.24	274.47	98.33	0	146.91
SEP	92.94	0	47.07	0	99.15	252.68	0
OCT	47.64	0	77.71	0	157.62	157.11	52.41
NOV	49.8	0	93.49	84.75	43.09	0	51.92
DEC	0	0	83.06	88.26	65.17	90.17	109.29

Source: Maternal Mortality Monitoring Panel and Live Births Monitoring Panel of the Department of Health Analysis and Surveillance of Noncommunicable Diseases of the Ministry of Health Surveillance.

Table 2. Maternal mortality ratio in the states of the North Region from January to December 2021

	Rondônia	Acre	Amazonas	Roraima	Pará	Amapá	Tocantins
JAN	93.98	0	387.35	0	123,61	85.18	110.01
FEB	350	263.16	436.9	705.65	103,96	0	115.34
MAR	456.62	226.59	284.69	341.88	140,07	310.32	246.06
APR	136.18	0	125.73	172.41	200,87	82.58	333.97
MAY	357.62	300.75	61.19	425.53	128,38	243.11	369.69
JUN	350.53	81.7	144.35	374.53	124,99	0	306.59
JUL	46.99	0	137.2	530.5	86,1	162.07	152.83
AGU	97.99	0	75.83	177.15	111,44	0	103.15
SEP	0	80.26	30.44	328.95	116,77	78.31	48.59
OCT	47.15	87.18	77.22	168.63	76,23	157.6	150.68
NOV	49.12	0	79.68	185.19	79,48	150.6	151.59
DEC	0	0	188.82	0	102,31	98.72	113.51

Source: Maternal Mortality Monitoring Panel and Live Births Monitoring Panel of the Department of Health Analysis and Surveillance of Noncommunicable Diseases of the Ministry of Health Surveillance.

In 2020 and 2021, 2,287 cases of SARS due to covid-19 in pregnant and postpartum women in the North Region were registered in the Information System for the Epidemiological Surveillance of Influenza (SIVEP-Flu), of which 1,707 have a record of evolution. In these two years, 274 maternal deaths due to covid-19 were reported in the North Region of Brazil.

The MMR by SARS in Brazil and in the North Region during the years 2012 to 2019 showed stability and small variations. In 2020, with the emergence of a new virus from the coronavirus family, SARS-CoV-2, which infected

humans causing covid-19 and which has the possibility of developing SARS in its clinical spectrum, an increase in the MMR curve by SARS in Brazil and in the North Region. In 2020, the MMR by SARS in the North Region was below that found in Brazil; and, in 2021, this scenario changed when the MMR in the North reached 98.68 maternal deaths caused by SARS per 100,000 LBs. This growth occurred especially because of the cases of covid-19, which corresponded to 92.93% of maternal deaths due to SARS due to covid 19 in the year 2021 (Figure 4 and Figure 5).
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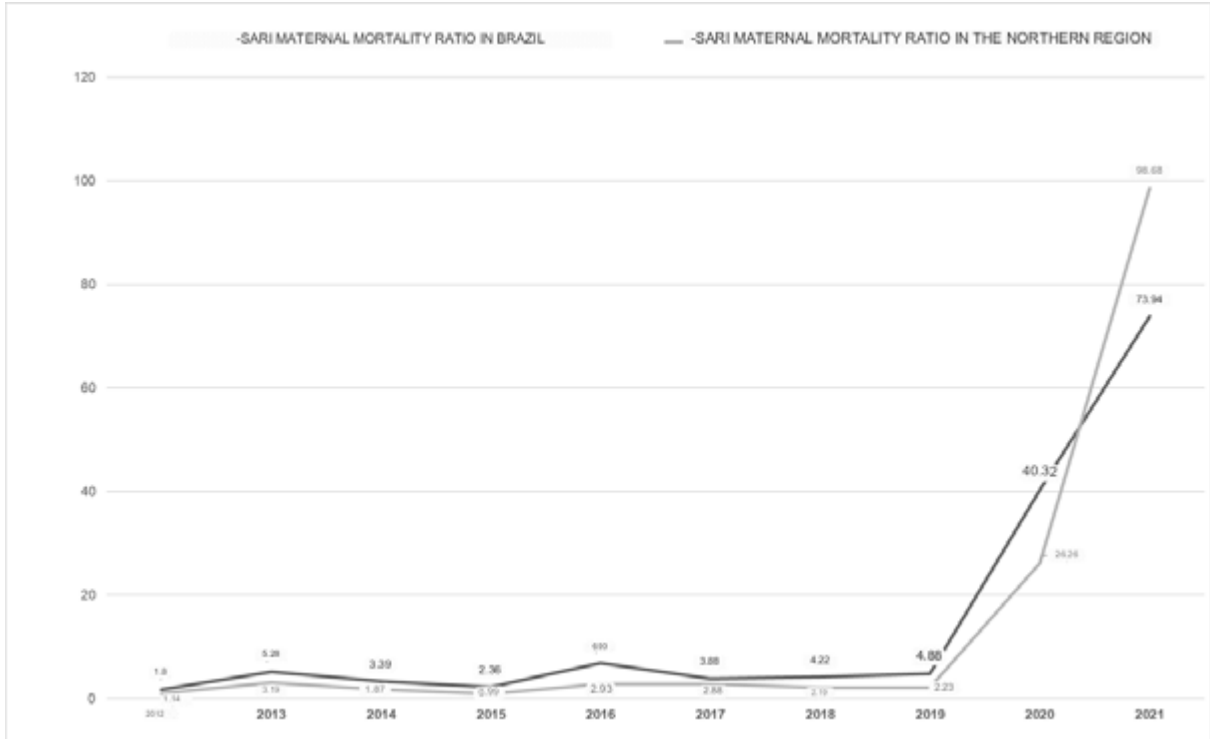


Figure 4. Maternal mortality ratio due to severe acute respiratory syndrome (SARI) in Brazil and in the North Region, between 2012 and 2021.

Source: Maternal Mortality Monitoring Panel and Live Births Monitoring Panel of the Department of Health Analysis and Surveillance of Noncommunicable Diseases of the Ministry of Health Surveillance.

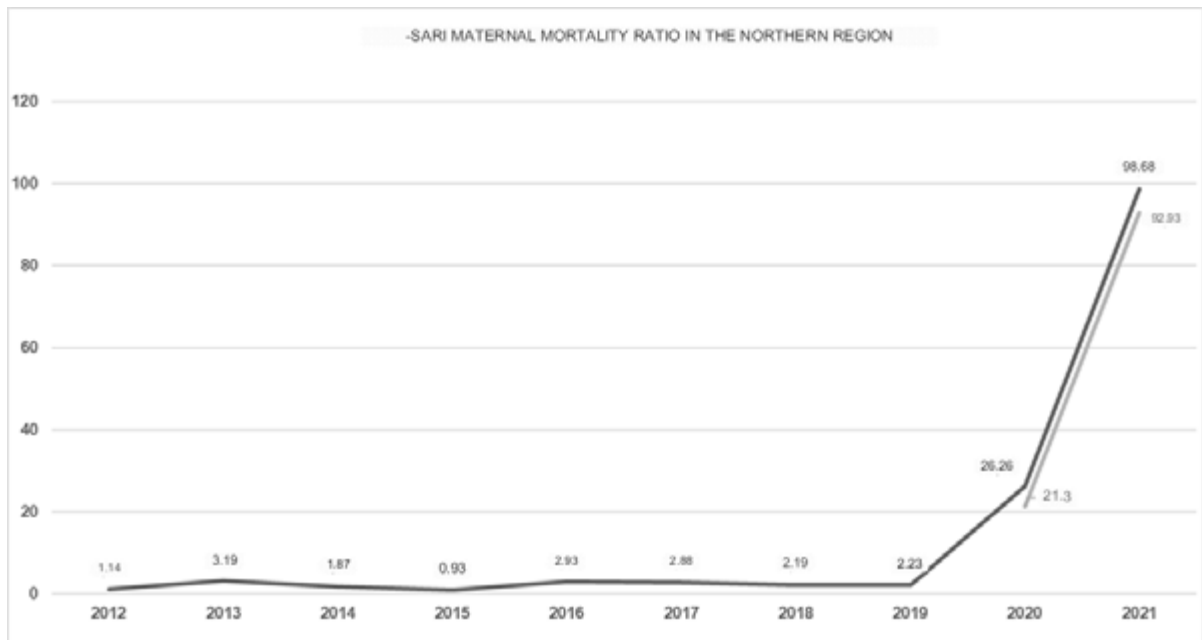


Figure 5. Maternal mortality ratio due to severe acute respiratory syndrome (SARI) and SARS due to covid-19 in the North Region between 2012 and 2021.

Source: Maternal Mortality Monitoring Panel and Live Births Monitoring Panel of the Department of Health Analysis and Surveillance of Noncommunicable Diseases of the Ministry of Health Surveillance.

DISCUSSION

During the years 2012 to 2019, it is observed that the MMR in Brazil remained stable; and, in 2020 and 2021, there was an increase in these rates, as they were years of emergency from the covid-19 pandemic. The North Region of the country, between 2012 and 2019, presented a stable MMR, however, with values above the national average; and also recorded a sharp increase in rates in the years 2020 and 2021, with important interstate differences.

As it reflects the levels of health and socioeconomic development of the population²³, a high MMR is associated with lower economic development in the region, less access to health services in general and ineffectiveness of maternal and child health services at all stages: family planning, pre-natal and puerperium^{3,23}. In the North Region, high MMR rates are associated with the population's precarious access to health systems compared to the Southeast Region, due to lower levels of the Human Development Index (HDI) and higher levels of social inequality in the Gini Index²⁴.

More precarious access to health in populations residing in the North and Northeast regions was created historically, since the implementation of the Unified Health System (SUS), in which there was, mainly, the expansion of Primary Care. In the South and Southeast regions, there is a concentration of medium and high complexity equipment, especially in their capitals and metropolises²⁰. Such inequalities and technology monopolies not only influence the flow of patients when treatments that require more complex services are needed, but also affect the profile of residents and the density of health professionals, especially physicians, perpetuating this cycle of lack of assistance²⁵.

During the years 2020 and 2021, with the crisis of the covid-19 pandemic, the MMR increased, overloading the Brazilian public health system, and consequently affecting more

economically fragile regions of the country, such as the Brazilian North Region. Before the pandemic, in the period from 2012 to 2019, a decrease in the percentage of adequate prenatal care (with a minimum of six consultations) was already observed in Brazil, from 73% to 70.7%, respectively²⁶. Already in the first five months of the covid-19 pandemic, there was an equivalence of the MMRs when compared to those of the pre-pandemic period²⁷.

Later, however, it was found that pregnant women with covid-19 were more likely both to be admitted to Intensive Care Units (ICU) and to receive treatment with invasive ventilation and had a higher risk of death when compared to non-pregnant women²⁸. Situations in which women develop potentially lethal complications during pregnancy, childbirth or the puerperium and survive due to qualified health care or by chance characterize the maternal Near Miss²⁹, which is associated with high rates of MMR, particularly in Brazil, due to the difficulty in transport to reference centers²⁴.

Thus, in the pandemic period, the high demand for specialized services for pregnant women and the consequent delay in transport to these highly complex services, due to the overload of health systems and the lack of beds in the ICU centers, caused the MMR to increase^{28,30}.

Furthermore, it was observed that the Brazilian municipalities with the highest rate of infection by covid-19 in the obstetric population and the highest maternal mortality were those with the worst social indicators, as well as the greatest socioeconomic inequalities, denouncing the inequity in access to health services³¹.

In the North Region, the highest MMR rate in the years 2020 and 2021 is associated with rapid progress in the number of cases and deaths. While in Brazil the time between the first confirmed case and the first death was stipulated as one month, in Amazonas this time window was only 11 days, being the state with the second highest rate of interiorization of the SARS-CoV-2

virus. in the country, second only to Rio de Janeiro³². The other states in the North Region, such as Amapá and Roraima, also showed a rapid increase in the number of deaths.

In fact, the state of Roraima had the most significant increase in MMR in the years 2020 and 2021, compared to the other states in the North Region. A study showed that, in the first year of the pandemic, 2020, 60% of the tests carried out for covid-19 were positive in the state of Roraima. It is noteworthy that, in the state capital, Boa Vista, a large part of the population did not follow the health recommendations. The city is experiencing a reality of great economic vulnerability, informal work, and unhealthy conditions in shelters for Venezuelan migrants. Associated with this, there is a lack of doctors and hospital infrastructure. This panorama may have aggravated the state of the health, social and economic crisis, influencing the alarming MMR found in the two worst years of the pandemic³³.

A study in Rondônia, when analyzing maternal mortality from 2014 to 2019, showed that deaths occurred mostly in brown women with low education, with direct obstetric complications as the major cause of death in the period of the puerperium. These factors are closely related to prenatal care and postpartum care³⁴.

The state of Rondônia was one of those with the highest mortality rate and incidence of mortality in the entire country, as well as the state of Amazonas. Thus, the overload of the health system, as well as the social, economic and structure and organization challenges of the health system, can justify the increase in maternal deaths³⁵.

It should be noted that the study by Buss et al.³⁶ suggested that the state of Amazonas had achieved “herd immunity”, taking into account that 76% of the population had already been infected by the SARS-CoV-2 virus by October 2020. This work was widely publicized in the media, culminating in the discouraging of measures to prevent covid-19 by local authorities³⁷. The

result of this was the collapse of public and private health systems in Manaus, with its apex on January 14, 2021, when several patients died due to the unavailability of oxygen in the Amazonian capital³⁸.

Analyzing Tables 1 and 2, it is clear that the peaks of maternal deaths coincide with the peaks of the number of cases of each variant of covid-19. The first wave, which started in March 2020 and peaked in early May, was marked by the prevalence of the B.1 variant (B.1.1.28), a situation that lasted until December of that year, when it was replaced by the second lineage.

The decrease in the number of cases of the B1 variant coincided with the adoption of social distancing measures during the first wave. However, with the relaxation of measures and the emergence of a new lineage of B.1 (B.1.195), cases return in a crescent, reaching their new peak together with the MMR in the North Region, in the month of July 2020³⁹.

The B.1 lineage was identified in the state of Amazonas on December 4, 2020, leading to an exponential increase in the number of cases of covid-19, which reached its peak in February 2021, culminating in the collapse of health systems in the North Region and with the oxygen crisis in the Amazon³⁹. Table 1 shows that this wave kept the MMR high until April 2021, when it started to regress. The increase in the number of cases during the second wave and the high rate of internalization of the virus caused Amazonas to face a shortage of ICU beds and supplies, also influencing the behavior of the MMR³².

In Latin America²⁸, the highest number of deaths in pregnant women with covid-19 was observed in the postpartum period, mainly due to severe acute respiratory syndrome. This trend was observed in this study, as shown in Figure 4, with an increase in MMR by SARS in the period 2020 and 2021, both in Brazil and in the North Region. In the cut of the North Region shown in Figure 5, it is verified that, in the period from 2020 to 2021, the MMR by SARS due to covid-19 behaves almost

identically to the curve of indeterminate SARS, proposing a significant influence of covid-19 on deaths by SARS.

In this way, it is clear that the federal government's goal of 30 deaths per 100,000 LBs by the year 2030, to contribute to the WHO Sustainable Development Goals, is far from the current reality, especially after the impact of the pandemic. The high rate of maternal mortality and maternal *Near Miss* in Brazil is still mainly due to preventable causes; to change this scenario, the entire health system must be able to meet the demands of pregnant and puerperal women during prenatal care, childbirth, and the postpartum period^{4,16}.

Three years after the beginning of the covid-19 pandemic, this study corroborates the results of the literature, indicating the worrying consequences of the installed crisis and the increase in maternal deaths in the country, with its interstate differences. Studies also show that vaccination, with mRNA vaccines, is a safe prevention strategy, with reduced risk to the fetus, but that it still presents challenges for its widespread adherence by pregnant women in the country, whether due to the need for a medical prescription or the support of some physicians to the anti-vaccine movement, by spreading *fake news*, despite scientific evidence⁴⁰.

The limitations of this study are related to the use of secondary data, since underreporting of maternal mortality exists, associated with the low quality of maternal death records and the absence of declaration of causes of death. The North Region has the highest frequency of underreporting and the lowest number of surveys^{23,41-42}. By training health professionals to feed the databases and advancing reporting systems, underreporting could be reduced.

Despite the limitations, the results of this study can contribute to the understanding of the evolution of maternal mortality in the states of the Northern Region. By observing the pattern of maternal mortality over ten years, with

the exaggerated increase in the first two years of the covid-19 pandemic, we sought to promote a discussion on more assertive strategies to reduce maternal death in cases of epidemics/pandemics. In particular, the importance of prenatal care was considered, the need for hospital infrastructure that ensures qualified care for pregnant and postpartum women and actions that promote preventive measures, such as vaccination.

CONCLUSION

Despite the notable decrease in the MMR between 2012 and 2019, the levels remain far from the target of 30 maternal deaths per 100,000 LBs, established for 2030, mainly in the states of the North Region, which have indicators above the national average. The covid-19 pandemic contributed to the exponential increase in maternal mortality, highlighting and expanding regional inequalities.

So that there is a greater control of this mortality and effective reduction of the MMR, it is necessary to advance in the reporting systems, as well as changes in the entire care network. Thus, with the reduction of underreporting, it will be possible to draw a more reliable profile of maternal mortality and direct resources and strategies, in addition to strengthening and training the Health Care Network so that it is prepared to deal with obstetric complications in pandemic situations.

Finally, the panorama outlined by the data in this study can serve as a basis for raising awareness among managers, for evaluating actions and programs to prevent maternal mortality, considering the impacts of the pandemic and also the history of each state in the North Region. In addition, the discussions presented here demonstrate that maternal health promotion actions in the North Region must consider the population's low level of education, the strengthening of social control to

claim comprehensive care, with a view to better structural conditions of the Health Network for prenatal, childbirth and puerperium Care.

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