Epidemiological characterization of maternal mortality due to COVID-19 in Brazil

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Resumo: This study aims to describe the epidemiological characterization of maternal mortality due to COVID-19 in Brazil in 2020 and 2021. An ecological study of retrospective and descriptive epidemiological design, with a quantitative approach, supported by literature review. Data collection used secondary data from the Mortality Information System, Live Birth Information System, and the Brazilian Obstetric Observatory of COVID-19; the population of the study is pregnant and puerperal women with confirmed diagnosis or death by COVID-19, considering the years 2020 and 2021. The data were tabulated and analyzed using the Software Statistical Package for the Social Sciences (SPSS) version 16.0. 10.15% of the cases of COVID-19 evolved to death, with the predominant epidemiological characterization: brown women, 30-39 years old, 8-11 years of schooling, and in the third trimester of pregnancy. The North region had the highest maternal mortality rate. The epidemiological information of this study is crucial for developing strategies to protect women, contributing to the reduction of maternal mortality and achieving the Sustainable Development Goals.

➤ **Keywords:** Maternal mortality. COVID-19. Epidemiology.

Received on: 09/11/2023 Revised on: 06/02/2024 Approved on: 09/07/2024

DOI: http://dx.doi.org/10.1590/S0103-73312025350116en

Editor: Jane Russo Reviewers: Marina Nucci and Natalia Fazzioni

Introduction

The reduction of maternal mortality is a global challenge, being agreed as one of the Sustainable Development Goals (SDGs) to reduce the Maternal Mortality Ratio (MMR) to a maximum of 70 maternal deaths per 100,000 live births. However, the Federal Government together with the Institute for Applied Economic Research (IPEA), adapted the 2030 Agenda Goals to the national reality, thus assuming the goal of reducing 51.7% of MMR by 2030, which corresponds to 30 maternal deaths per 100,000 live births (UN, 2015; IPEA, 2019).

High MMR values are indicators of poor socioeconomic conditions, low education and difficulty in accessing quality health services, especially for women. In Brazil, MMR remained stable from 1987 to 1996, but increased in 1997 and 1998 after changes in the Death Certificate and the implementation of state committees on maternal death, indicating a possible improvement in case detection. There was a reduction in maternal mortality, related to the improvement in the quality of obstetric care, with hypertension, hemorrhage, puerperal infection and abortion as the main direct obstetric causes (Brasil, 2023).

The concern with maternal mortality in Brazil dates to times before the COVID-19 pandemic and intensified with the arrival of the virus, resulting in setbacks in the advances in access to health services achieved in recent years. Before the pandemic, the country faced significant challenges, such as lack of beds, supplies and adequate access to health services in several regions. This contributed to a high number of maternal deaths. In addition, the difficulty of access to prenatal and obstetric health care, especially in remote or deprived areas, further exacerbated the situation, making the target for reducing maternal mortality even more distant. With the pandemic, the situation worsened because pregnant women were identified as a risk group due to their higher susceptibility to respiratory infections. According to the Pan American Health Organization, Brazil was among the three countries responsible for half of all maternal deaths attributed to COVID-19 in the Americas and the Caribbean, highlighting structural factors that influenced these worrying results (PAHO, 2021).

COVID-19 is a severe acute respiratory syndrome caused by the coronavirus of severe acute respiratory syndrome 2 (SARS-CoV-2). It had its onset in Wuhan, China on 31 December 2019 when the first cases of pneumonia were reported. Viral

genome sequencing was announced on 7 January 2020, with China sharing the genetic sequence with WHO on 12 January through an international database Global Initiative on Sharing All Influenza. The cases have spread globally, with first records in the Americas on January 23, 2020. The initial spread of the disease was associated with a live animal and seafood market in Wuhan, and by January 2020, the disease had already spread to other continents. On 30 January 2020, the WHO declared an International Public Health Emergency, subsequently declaring the pandemic on 11 March 2020. Symptoms, similar to those of influenza or pneumonia, include cough, dyspnea, sore throat and fever (WHO, 2020; Zhu *et al*., 2020).

The research addresses the worsening challenges and inequalities in access to health services during the onset of the COVID-19 pandemic in Brazil, resulting in interruptions in the care of pregnant women and puerperal women and contributing significantly to maternal deaths in 2020, with MMR reaching 71.97 and reaching 113.18 deaths per 100,000 live births in 2021. The study aims to investigate the epidemiological characteristics of maternal deaths caused by COVID-19 in Brazil, seeking to understand the interferences of sociodemographic and epidemiological variables, to fill knowledge gaps and provide insights to guide health policies, clinical practices and professional training, aiming at the effective reduction of maternal mortality in pandemic contexts.

Methodology

An ecological study of retrospective and descriptive epidemiological design, with a quantitative approach, supported by literature review. The population was composed of women with a confirmed diagnosis or who died in the pregnancy-puerperal period due to COVID-19, in 2020 and 2021.

To allow for expanded and multifactorial analyses, the following variables were used:

- Sociodemographic: Regions (North, Northeast, South, Southeast, Midwest) and at national level; Age group (10-14 years, 15-19 years, 20-29 years, 30-39 years, 40-49 years, 50 years or more); Race/ color (yellow, white, indigenous, parda, black, ignored); and Schooling (None, 1-3 years, 4-7 years, 8-11 years, 12 years and more and ignored).

- Related to death: Moment of the pregnancy-puerperal cycle (1st trimester of gestation, 2nd trimester of gestation, 3rd trimester of gestation, puerperal period or not identified).

Secondary public domain data from the Mortality Information System (SIM), Live Birth Information System (SINASC) and Brazilian Obstetric Observatory of COVID-19 (OOBr-COVID-19), collected from March to July 2023, were used, maternal deaths in 2020 and 2021 in women over 10 years of age, excluding those aged nine or younger. We did not consider women of childbearing age due to significant values in the age group of 50 years or more.

The data collected was tabulated using the software Microsoft Excel for Windows, version 2016. The Statistical Package for the Social Sciences (SPSS) version 16.0 was used to analyze the information that constituted the quantitative database of the study, for the input of information and analysis resulting from the crossing of variables. To calculate the MMR, the number of maternal deaths is divided by the total number of live births in a given period and geographical area, multiplied by 100 thousand (PAHO, 2002).

The study was approved by the Ethics and Research Committee of the Federal University of Mato Grosso do Sul (CEP-UFMS CAAE: 60894322.4.0000.0021), requested the waiver of the Informed Consent Form (TCLE).[1]

Results

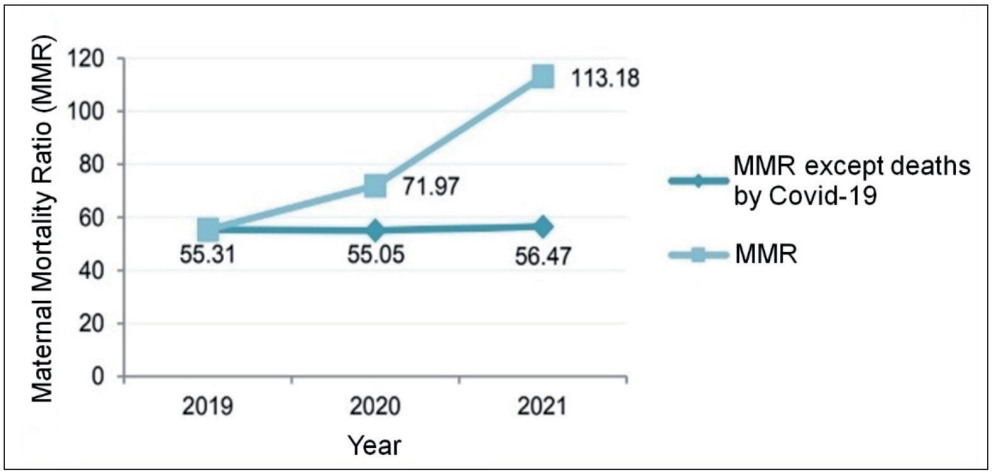
Maternal mortality ratio

In 2020, 6,922 maternal cases of COVID-19 were registered in Brazil and 462 (6.67%) died. There were 1965 maternal deaths due to general causes, 23.51% caused by COVID-19. In 2021, 12,576 maternal cases of COVID-19 were registered, 81.7% more than the previous year, and 1,518 (12.07%) died, almost double the percentage of the previous year. There were 3,030 maternal deaths in 2021, 54.19% more than the previous year and 50.09% caused by COVID-19, directly impacting on MMR (Tables 1 and 2).

When observing the annual progression lines from 2019 to 2021, it is observed that even when estimating MMR without considering deaths due to COVID-19,

MMR would have decreased only 0.47% (55.05) in 2020 compared to 2019 (55.31), already in 2021, it would remain above, having an increase of 2.58% (56.47).

Figure 1. Real Maternal Mortality Ratio and estimated Maternal Mortality Ratio excluding deaths from COVID-19 in Brazil from 2019 to 2021

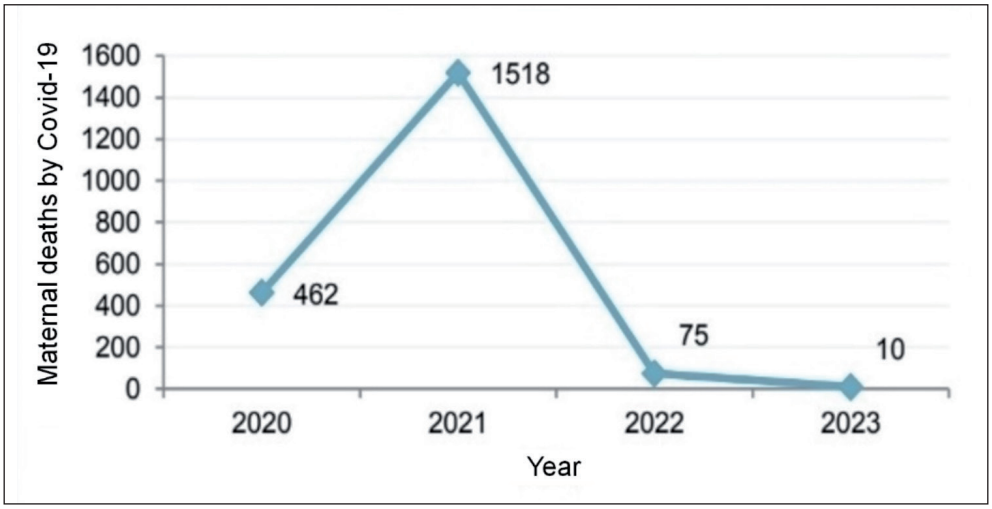


Source: own elaboration (2023).

The North has the highest MMR from 2019 to 2021, the Northeast second in 2019 and 2020 and the Midwest in 2021 (Figure 3).

The analysis of MMR for 2022 faces a challenge due to the unavailability of maternal and live birth death data in SIM and SINASC. However, it is possible to draw some conclusions based on partial information. In 2022, there was a remarkable record of 75 maternal deaths attributed to COVID-19. This represents an impressive 95.05% reduction compared to the previous year. In addition, when analyzing the first half of 2023 compared to the same period in 2022, we observed another sharp drop, this time by 73.3%. In this interval, 10 maternal deaths attributed to COVID-19 were recorded (Figure 2).

Figure 2. COVID-19 maternal deaths in Brazil from 2020 to 2023



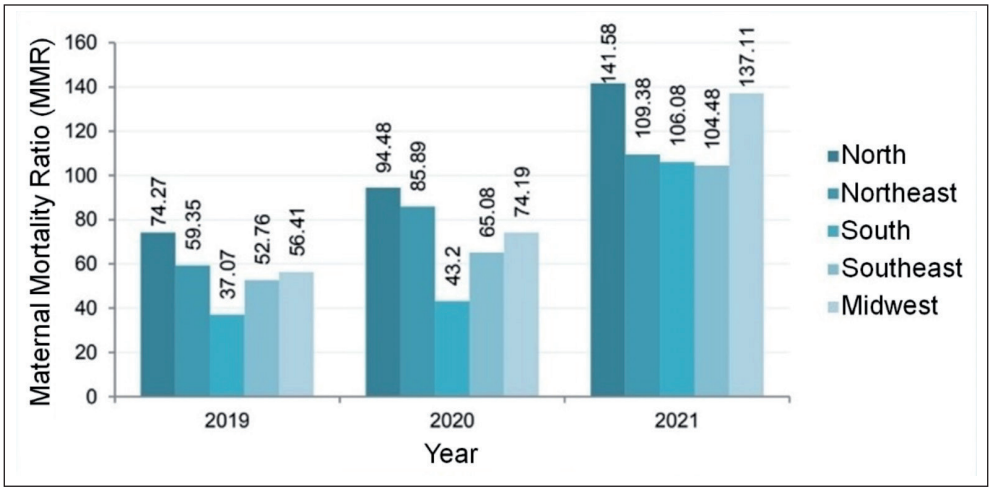
Source: own elaboration (2023).

When we analyze MMR in the context of different regions of Brazil over a three-year period, spanning the year preceding the onset of the COVID-19 pandemic and the two subsequent years, we observe crucial trends and patterns in maternal health. It is observed that the Northern Region maintained the highest MMR in the period considered, in the years 2019, 2020 and 2021 the MMR was respectively 34.28% (74.27), 31.28% (94.48) and 25.1% (141.58) above the national rate. The Northeast region stood out in second place, with the highest RMM in the years of 2019 and 2020, being 7.32% (59.35) and 19.35% (85.89) above the national rate, respectively, and in 2021 the second place was occupied by the Midwest region, with 21.15% (137.11) above the national rate and ranked third in both 2019 and 2020, with 1.99% (56.41) and 3.09% (74.19) above the national rate.

The South Region had the lowest MMR in 2019, 32.97% (37.07) below the national rate and in 2020, 39.97% (43.2) below the national rate, in the following year in 2021 being behind only the Southeast Region with 7.69% (104.48) below the national rate, indicating a scenario of greater safety and lower risk for pregnant women compared to the average for the entire country. The analysis of this indicator is crucial, since it provides an accurate analysis of estimates of deaths in relation to the number of live births in the period under consideration. This approach is necessary because the simple analysis of raw data on maternal deaths is not feasible

due to the remarkable disparities in the number of births in different Brazilian regions. This allows us to better understand the real impact of maternal health measures, regardless of demographic variations in different geographic areas.

Figure 3. Maternal mortality ratio by Brazilian region from 2019 to 2021



Source: own elaboration (2023).

Maternal cases of COVID-19 from 2020 to 2021

In the years covered by the study, the highest number of cases of COVID-19 was recorded in pregnant women and puerperal women aged 30-39 years (43.58%), as well as in the Northeast (41.7%), South (44.6%), Southeast (47.13%) and Center-West (42.6%), in the North the highest record was in the age group of 20-29 years (45.03%). In contrast, the lowest number was recorded in the age group of 10-14 years (0.42%), as well as in the Southeast (0.17%) and Midwest (0.19%). In the North (0.21%) and Northeast (0.72%), the lowest numbers were recorded in the age group of 50 years or more. In the Southern Region, the same value was recorded for both the age group 10-14 years (0.17%) and the age group 50 years or older (0.17%) (Table 1).

For the color/race variable, 44.50% of cases were recorded among brown women, and it was also more prevalent in the North (79.74%), Northeast (70.08%) and Midwest (49.82%) regions. In the South (80.08%) and Southeast (45.56%), white women prevailed. The lowest number of cases was recorded in yellow women (0.77%), as well as in the North (0.97%) and South (0.41%). In the Northeast (0.3%), Southeast (0.07%)

and Midwest (0.67%) regions, indigenous women were the least prevalent. There was 14.18% of the records with the race/color field ignored, and the Midwest with 24.95%.

As for the period of registration of the case, most were in the third trimester of pregnancy (49.27%) and in all Brazilian regions: North (48.62%), Northeast (53.07%), South (51.01%), Southeast (46.13%), Center-West (50.68%). The lowest number of cases was recorded in the first quarter (7.33%), as well as in all regions: North (7.99%), Northeast (6.07%), South (7.65%), Southeast (7.88%), Midwest (6.89%). The records with the ignored period totaled 4.06%, being 5.6% in the Northeast region.

Schooling of 8-11 years of study was in 23.25% of the cases, also prevalent in all regions: North (33.91%), Northeast (18.92%), South (26.91%), Southeast (22.69%) and Midwest (18.01%). The least prevalent records were found in those without any schooling (0.33%), as well as in all regions: North (0.71%), Northeast (0.77%), South (0.17%), Southeast (0.09%) and Midwest (0.15%) (Table 1).

There were 56.39% records with the period ignored, and the Midwest with 68.11%. There was no record of cases divided by the variable civil status in OOBr-COVID-19.

Table 1. Maternal cases of COVID-19 according to age, race/color, death period and schooling in 2020 and 2021 by Brazilian region

Variables		North	Northeast	South	Southeast	Centes-west	Brazil
Age group	10-14	27	32	5	13	5	82
	15-19	314	415	170	372	181	1,452
	20-29	1,065	1,707	1,220	2,799	1,076	7,867
	30-39	840	1,772	1,301	3,504	1,081	8,498
	40-49	114	292	212	669	178	1,465
	50 or more	5	31	5	77	16	134
Race/color	Yellow	23	33	12	55	28	151
	White	187	358	2,333	3,387	508	2,723
	Indigenus	103	13	20	5	17	158
	Brown	1,886	2,978	258	2,291	1,264	8,677
	Black	97	133	125	531	87	1,173
	Ignored	69	734	165	1,165	633	2,766

continue...

Variables		North	Northeast	South	Southeast	Centes-west	Brazil
Period	1st quarter	189	258	223	586	175	1,431
	2nd quarter	481	667	619	1,704	602	4,073
	3rd quarter	1,150	2,255	1,486	3,430	1,286	9,607
	Puerperium	425	831	511	1,450	377	3,594
	Ignored	120	238	74	264	97	793
Schooling	Nenhuma	17	33	5	7	4	66
	1-3 years	187	155	129	189	64	724
	4-7 years	375	333	317	456	109	1,590
	8-11 years	802	804	784	1,687	457	4,534
	12 or more	197	222	300	695	175	1,589
	Ignored	787	2,702	1,378	4,400	1,728	10,995
	Total	2,365	4,249	2,913	7,434	2,537	19,498

Source: own elaboration (2023).

Maternal deaths by COVID-19 from 2020 to 2021

The highest number of deaths was recorded in the age group 30-39 years (51.21%), as well as in all Brazilian regions: North (52.15%), Northeast (47.7%), South (54.8%), Southeast (52.55%) and Center-West (49.04%). In contrast, the lowest number was recorded in the age group of 10-14 years (0.05%), as well as in the Northeast (0%), Southeast (0.12%) and Midwest (0%). In the North and South regions, the same value was recorded in the age group of 10-14 years and in the age group of 50 years or more, both with 0% of the records (Table 2).

For the color/race variable, 47.52% of deaths were recorded among brown women, prevalent in the North (82.01%), Northeast (68.7%) and Midwest (49.52%) regions. In the South (76.09%) and Southeast (43.11%) regions, white women prevailed. The lowest number of deaths was recorded in indigenous women (0.65%), as well as in the Northeast (0.21%), Southeast (0%) and Midwest (0.95%). In the North (1.07%) and South (0.39%), yellow women were the least prevalent. There was 10.2% of the records with the color/race field ignored, and the Midwest with 16.19%.

Table 2. Maternal deaths by COVID-19 according to age group, race/color, death period and schooling in 2020 and 2021 by Brazilian region

Variables		North	Northeast	South	Southeast	Centes-west	Brazil
Age group	10-14	0	0	0	1	0	1
	15-19	17	20	8	32	10	87
	20-29	96	157	80	244	74	651
	30-39	145	218	136	412	103	1,014
	40-49	20	59	27	82	22	210
	50 or more	0	3	0	13	1	17
Race/color	Yellow	3	7	1	2	4	17
	White	23	59	191	338	58	669
	Indigenus	8	1	2	0	2	13
	Brown	228	314	28	267	104	941
	Black	11	19	13	87	8	138
	Ignored	5	57	16	90	34	202
Period	1st quarter	12	23	8	45	8	96
	2nd quarter	54	86	56	159	55	410
	3rd quarter	97	153	107	305	88	750
	Puerperium	104	175	76	252	49	656
	Ignored	11	20	4	23	10	68
Schooling	None	3	6	0	1	0	10
	1-3 years	20	18	15	31	5	89
	4-7 years	43	41	31	79	5	199
	8-11 years	101	97	70	220	49	537
	12 or more	33	27	25	76	20	181
	Ignored	90	290	118	412	139	1,049
	Total	278	457	251	784	210	1,980

Source: own elaboration (2023).

As for the period that women were at the time of death, the majority was in the third trimester of pregnancy (37.87%), as well as in the South (42.62%), Southeast (38.9%) and Midwest (41.9%). In the North (37.41%) and Northeast (38.29%), postpartum women prevailed. The lowest number of cases was recorded in the first quarter (4.84%), as well as in all Brazilian regions: North (4.31%), Northeast (5.03%), South (3.18%), Southeast (5.73%) and Midwest (3.8%). The records with the ignored period totalled 3.43%, being 4.76% in the Midwest region.

Regarding schooling, it was not possible to align the variable with the evolution of the case, by the year of death. Thus, the total number of maternal deaths by COVID-19 was analyzed until the first half of 2023, with 2,065 records, being 75 from 2022 and 10 from 2023.

Schooling from 8 to 11 years was recorded in 26% of the deaths, also more prevalent in all regions: North (34.82%), Northeast (20.25%), South (27.02%), Southeast (26.86%), Midwest (22.47%). The least prevalent records occurred in the records without any schooling (0.48%), also prevalent in all regions: North (1.03%), Northeast (1.25%), South (0.12%), Southeast (0.12%) and Center-West (0%) (Table 2).

The records with the ignored period totaled 50.79%, being the Center-West with the largest number of these records (63.76%). There was no record of cases and maternal deaths by COVID-19 divided by the variable civil status in OOBr-COVID-19.

Discussion

Pregnant women with COVID-19 faced more pronounced respiratory problems compared to women without the virus, including a broad spectrum of severity from mild symptoms such as cough and fever to severe cases requiring mechanical ventilation and sepsis. In addition, the diagnoses of pregnant women with COVID-19 have implications for the health of newborns, who faced complications (Thomas el al., 2020; Furlan *et al*., 2020).

Michels, Marin, and Iser (2022) highlight maternal deaths related to COVID-19 not limited to high-risk pregnant women. The barriers arose due to the prioritization of symptomatic patients of COVID-19, which caused delays in seeking hospital care, including for pregnant women initially considered at low risk. These situations could have been avoided with timely prenatal consultations, highlighting the importance of regular follow-up during pregnancy.

The quantitative results reveal a worrying trend of increase in maternal cases of COVID-19 in Brazil over the years, with a significant growth in the number of cases and deaths in the period studied. In 2021, the incidence of maternal deaths from COVID-19 more than tripled compared to the previous year with an alarming impact on the maternal mortality rate. In addition, the study revealed a direct impact on MMR after the onset of the pandemic, with a substantial increase observed in 2020 and an even greater peak in 2021. Highlighting the urgent need for prevention, monitoring and care strategies for pregnant women during pandemics caused by respiratory viruses, in order to mitigate the risks associated with COVID-19 and ensure maternal health.

The North and Midwest regions emerge as the areas with the highest maternal mortality rates in 2021, suggesting significant challenges in the provision of maternal health care in these regions. The variations in mortality rates between regions reinforce the need for specific policies directed to each geographical area, in order to achieve the goals set by WHO and ensure a safer scenario for mothers throughout the country.

When analyzing the increase in maternal deaths in 2021 compared to 2020, despite the reduction in relation to the pre-2020 periodpandemic, it is possible to attribute these data to the consideration that pregnant women may have adhered more strictly to social isolation and hygiene measures for COVID-19 prevention19, which may have caused delays in the search for care due to the appearance of signs that required immediate intervention. In addition, the Brazilian health system was not prepared for all pregnant women to become at high risk, requiring greater attention while the health system was already overburdened by the general population (Michels; Marin; Iser, 2022).

Brazil did not implement universal testing for pregnant women, and underreporting and lack of diagnosis of COVID-19 should be considered. In addition to maternal deaths due to COVID-19, maternal deaths were also recorded for the general cause, well above what was expected because of the difficulty in accessing health services due to the restriction to respiratory symptomatic, for example, which may have triggered the worsening of various morbidities that can cause maternal death, as the main causes of maternal death in the world: infections, hypertension and hemorrhages (Carvalho-Sauer *et al*., 2021).

The absence of data for 2022 limits the analysis, but the partial information available suggests a notable reduction compared to the previous year. Partial data from the first half of 2023 indicate a more pronounced reduction in maternal mortality related to COVID-19, 73.3% less than in the same period of 2022.

The variations of MMR in different regions of Brazil over three years reveal a complex and diverse scenario. During the pre-pandemic period until the two initial years of greatest impact of COVID-19, the Northern Region remained the largest MMR, with values substantially higher than the national average in all years. The South, in turn, showed the lowest rates in 2019 and 2020, but lost its position in 2021 to the Southeast. These regional variations highlight the need for differentiated approaches to address maternal health challenges in different parts of the country, considering socioeconomic, health and geographic factors specific to each region.

Orellana *et al*. (2022) analyzed the geographic variations of maternal mortality and explored the trajectories of MMR during the phases of the pandemic, emphasizing that the excess of maternal deaths observed cannot be attributed exclusively to the health crisis, reflecting pre-existing social conditions, such as social inequalities and limited access to health services, especially in the poorest regions and poor management of the health crisis.

The demographic characteristics of pregnant women and puerperal women diagnosed with COVID-19 show a series of remarkable patterns. The most affected age group was 30-39 years. Regarding color/race, brown women accounted for the largest proportion of cases. The lowest number was recorded in yellow and indigenous women. Regarding the period, the third trimester of pregnancy prevailed, with minimal variations in the different regions, while the lowest number of cases was recorded in the first trimester; 8-11 years of study predominated and those without any schooling totaled the lowest number of registrations in all regions.

The high index of records with information ignored in several variables suggests the need for improvements in data collection and recording. These results highlight the importance of considering demographic characteristics when developing effective strategies for preventing and treating COVID-19 or other respiratory pandemics that may affect pregnant women and women who have recently given birth, to address regional and socioeconomic disparities.

The analysis of maternal deaths caused by COVID-19 provides important insights into the demographic characteristics of the pandemic. The most affected

age group was 30-39 years, prevailing in all Brazilian regions. Regarding color/race, brown women accounted for the majority of deaths, while indigenous and yellow women registered the lowest number.

The above data contest a specific study conducted in the state of Ceará, Northeast Region, in mid-2020, which points out the highest number of deaths of 20-34 years old in brown and white women, therefore, with differentiated analysis of this research, considering that the study was conducted shortly after the installation of the pandemic (Francelino *et al*., 2023).

Most deaths occurred in the third trimester of pregnancy and the lowest number was recorded in the first trimester. La Verde *et al*. (2021) report that most of the deaths from COVID-19 in 2021 occurred in the postpartum period. Knowledge of the exact time of death is fundamental to identify trends and patterns related to clinical conditions, better understanding the ramifications of the pandemic and other diseases. In addition, accurately recording the gestational period is vital to improve the health care of pregnant women, helping to identify risks, complications and needs during different stages of pregnancy.

The schooling of 8-11 years was predominant in deaths, with minimal variation in the regions, with women without schooling being less prevalent. A significant proportion of the data presents information that is ignored, 56.4% of the schooling records were ignored in the cases, while 50.8% in the deaths. It is important to improve the collection and recording of information, given that incomplete registration makes it difficult to develop strategies based on sociodemographic factors.

Although they presented regional variations, the cases and maternal deaths caused by COVID-19 represented a series of similar patterns, with the age group of 30-39 years prevailing in brown women with schooling of 8-11 years, in the third trimester of pregnancy. The lack of registration of cases and maternal deaths by COVID-19 divided by the variable civil status, indicated a limitation in this aspect of the analysis.

As regards the racial issue, the analysis by Dantas-Silva *et al*. (2023) highlights that it is black women who face more substantial maternal challenges. The striking influence of social factors is highlighted, implying the presence of an underlying bias.

The beginning of vaccination against COVID-19 in Brazil in January 2021 occurred gradually and uncoordinated. The delay in including pregnant and puerperal women in the priority groups contributed to the progressive increase

of deaths from COVID-19. This scenario contrasts with the rapid spread of the gamma variant of the virus. Due to the remarkable excess of maternal deaths during the first quarter of 2021, it is plausible to consider that a more agile approach in the vaccination of pregnant and postpartum women, along with an acceleration in the general immunization of the population, could have minimized the direct impact of the pandemic on maternal mortality (Bellos; Pandita; Panza, 2021).

Maternal deaths caused by COVID-19 had an impact on health indexes, however, other outcomes were described as impacting the health of pregnant women, puerperal mothers and newborns (Di Toro *et al*., 2021; Qeadan *et al*., 2021).

Bellos, Pandita and Panza (2021), Zaigham and Andersson (2020) and La Verde *et al*. (2021) complement the above-mentioned authors on the symptoms observed in pregnant women at the time before delivery, with significant fever, cough and dyspnea. In newborns, fever, dyspnea and vomiting. Furlan *et al*. (2020) cite low birth weight and non-reassuring heart rate as adverse effects of COVID-19 in newborns.

Di Toro *et al*. (2021) and Bellos, Pandita and Panza (2021) agree that the risk of vertical transmission of COVID-19 is low. Even so, newborns have complications cited by Simbara, Nazarpourb and Sheidaeic (2023), addressing that in addition to the known immediate adverse effects such as premature birth and maternal mortality, the long-term effects on the fetus are not clear, but can directly impact on growth and development, as already known in other respiratory infections.

Regarding the risk factors presented, multivariate analysis of a study showed that age above 35 years, obesity and diabetes prevailed, and in addition to clinical factors, black ethnicity and difficulty accessing health services are widely reported (Menezes *et al*., 2020). Obesity, diabetes and cardiovascular disease were prevalent as risk factors (Takemoto *et al*., 2021; La Verde *et al*., 2021).

Regarding clinical aspects, pregnant women present a higher proportion of leukocytosis, thrombocytopenia and have lower proportion of C-reactive protein increased compared to non-pregnant. The most prevalent complications are postpartum hemorrhage, premature labor, prematurity and vertical transmission (Jafari *et al*., 2021).

Menezes *et al*. (2020) and Takemoto *et al*. (2020) agree that it is possible to identify risk factors in pregnant and puerperal women due to COVID-1919; however, they clarify that the study of social determinants play an essential role in the development of health strategies directed to this group. Scheler *et al*. (2022), Leung and Paiva

(2021) and Gonçalves, Franco and Rodrigues (2021) performed the comparison of maternal deaths occurred in the first and second wave of COVID-19, in the period of 2020 and 2021, respectively, corroborating the information presented in this study, of a substantial increase in maternal deaths identified in 2021.

The analysis of quantitative data together with literature was crucial in the research and comprehensive understanding of the COVID-19 phenomenon in pregnant women and postpartum mothers. While the qualitative data offered detailed information about experiences, perspectives and contexts, the quantitative data provided a solid statistical basis that allowed generalizations and trends identification of epidemiological patterns in pandemics that may occur. The combination of these methods enriched the research, providing a more holistic view and deeper understanding to identify gaps in knowledge, generate new hypotheses and improve intervention strategies or public policies.

Final considerations

By stating that the maternal mortality rate, which was in global decline, increased after the onset of the COVID-19 pandemic, it was observed that several socioeconomic and clinical factors contributed to this increase. First, maternal deaths directly caused by COVID-19, followed by maternal deaths resulting from worsening caused indirectly by the pandemic in pre-existing diseases. These factors are directly linked to pre-existing social conditions, such as inequality and difficulty of access to health services by some populations, being intensified by the sanitary crisis that has been installed by the lack of preparation in the incalculable impact caused by the pandemic.

The epidemiological characterization of maternal mortality due to COVID-19 in Brazil presented regional variations, however, the maternal cases of COVID-19 and maternal deaths caused by COVID-19 represented a series of similar patterns, in which the age group of 30-19 prevailed39 years old, in brown women with schooling of 8-11 years and who were in the third trimester of pregnancy. The North region, followed by the Northeast, recorded the highest RMM in 2020, and again the North region followed by the Midwest in 2021.

On the other hand, yellow and indigenous women were identified in the age group of 10-14 years and 50 years or more, without any schooling and who were in

the first trimester of pregnancy, representing the lowest share of deaths. The South region represented the lowest MMR in 2020 and the Southeast in 2021.

There is a need for new studies that correlate the post-critical period of the pandemic and decrease in MM rates, especially regarding advances in health services to cope with the pandemic, such as the expansion of precautionary measures and vaccination.

Unfortunately, maternal mortality still represents a significant challenge in Brazil, moving away from the acceptable levels of maternal deaths established by the MDGs. It is imperative to design and implement measures aimed at reducing this sad statistic. This includes the promotion of family planning, high-quality prenatal care and a strong focus on excellence in health services to minimize maternal mortality rates. These actions should be accompanied by the presence of highly qualified health professional teams to deal with obstetric emergencies and provide effective follow-up in the postpartum period. In addition, it is vital that governments implement robust public health response strategies, especially when dealing with pandemics such as those caused by respiratory viruses. In this context, the epidemiological information on pregnant and puerperal women represented in this study play an essential role in formulating effective strategies for protecting this vulnerable group.

The analysis of epidemiological characterization plays a crucial role in the fight against maternal mortality. Understanding the risk factors, trends and determinants affecting pregnant women and postpartum women is fundamental to guide effective health policies and specific interventions. By identifying the vulnerabilities and challenges that this group faces, it is possible to allocate resources more specifically, improve access to adequate health care and implement effective preventive strategies especially in light of public health crises. Therefore, the study of epidemiological data is a valuable tool in the search to reduce maternal mortality to an acceptable number, promoting safe and healthy motherhood for all women.

It is concluded that the consolidation of public policies to strengthen women's health during pregnancy and ensure adequate postpartum follow-up is essential. The government plays a central role in this process, allocating resources, regulating health services and developing effective strategies. Investing in education for pregnant women, access to quality health services, promote prenatal and postnatal care practices, as well as preventing complications, is essential to reduce maternal

mortality. Promoting gender equity and women's empowerment is also key, allowing pregnant women to have a voice, autonomy and access to adequate health care. This contributes to a healthier and more equal future, benefiting society as a whole.[2]

References

BELLOS, I.; PANDITA, A.; PANZA, R. Maternal and perinatal outcomes in pregnant women infected by SARS-CoV-2: A meta-analysis. *European Journal of Obstetrics & Gynecology and Reproductive Biology***,** v. 256, n. 1, p. 194-204, 2021.

BRASIL. *Saúde materna e* COVID: panorama, lições aprendidas e recomendações para políticas públicas. Brasília, DF: Fundo de População das Nações Unidas (UNFPA Brasil), 2023.

CARVALHO-SAUER, R. C. O. *et al.* Impact of COVID-19 pandemic on time series of maternal mortality ratio in Bahia, Brazil: analysis of period 2011–2020. *BMC Pregnancy Childbirth,* v. 21, n. 423, p. 1-7, 2021.

DANTAS-SILVA *et al*. Mulheres negras brasileiras correm maior risco de complicações da COVID-19: uma análise do REBRACO, uma coorte nacional. *Revista Brasileira de Ginecologia e Obstetrícia*. Rio de Janeiro, v. 45, n. 5, p. 253-270, 2023.

DI TORO, F. *et al.* Impact of COVID-19 on maternal and neonatal outcomes: a systematic review and meta-analysis. *Clinical Microbiology and Infection*, v. 27, n. 1, p. 36-46, 2021.

FRANCELINO, P. *et al.* Perfil da Mortalidade Materna por COVID-19 no Ceará, no Período de 2020. *Jornal Internacional de Pesquisa Ambiental e Saúde Pública,* v. 20, n. 4645. p., 1-10, 2023.

FURLAN, M. C. R. *et al.* Gravidez e infecção por Coronavírus: desfechos maternos, fetais e neonatais – Revisão sistemática. *Revista Cuide-se*. Três Lagoas, v. 11, n. 2, p. 1-15, 2020.

GONÇALVES, B. M. M.; FRANCO, R. P. V.; RODRIGUES, A. S. Maternal mortality associated with COVID-19 in Brazil in 2020 and 2021: Comparison with non-pregnant women and men. *Plos One,* v. 16, n. 12, e0261492. p. 1-15, 2021.

INSTITUTO DE PESQUISA ECONÔMICA APLICADA. *ODS 3 - Assegurar uma vida saudável e promover o bem-estar para todas e todos, em todas as idades.* Brasília: IPEA; 2019. Available at: https://www.ipea.gov.br/portal/images/stories/PDFs/livros/livros/190829_cadernos_ODS_objetivo_3.pdf. Access on: Apr. 11, 2023.

JAFARI *et al.* Clinical characteristics and outcomes of pregnant women with COVID-19 and comparison with control patients: A systematic review and meta-analysis. *Revista Médica de Virologia,* v. 31, e2208, p. 1-16, 2021.

LA VERDE *et al.* Maternal death related to COVID-19: A systematic review and meta-analysis focused on maternal co-morbidities and clinical characteristics. *International Journal of Gynecology & Obstetrics*, v. 153, n. 1, p. 212-219, 2021.

LEUNG, C.; PAIVA, K. M. Is pregnancy a risk factor for in-hospital mortality in reproductive-aged women with SARS-CoV-2 infection? A nationwide retrospective observational cohort study. *Int J Gynecol Obstet*., v. 157, n. 1, p. 121-129, 2021.

MENEZES *et al.* Risk factors for adverse outcomes among pregnant and postpartum women with acute respiratory distress syndrome due to COVID-19 in Brazil. *International Federation of Gynecology and Obstetrics,* v. 151, n. 1, p. 415-423, 2020.

MICHELS, B. D.; MARIN, D. F. D'A.; ISER, B. P. M. Aumento da taxa de mortalidade materna entre as admissões para parto em gestantes de baixo risco gestacional no Brasil: Efeito da pandemia do COVID-19? *Revista Brasileira de Ginecologia e Obstetrícia,* v. 44, n. 8, p. 740-745, 2022.

OBSERVATÓRIO OBSTÉTRICO BRASILEIRO. *SRAG: Síndrome respiratória aguda grave em gestantes e puérperas*, 2021. Available at: http://obserbatorioobstetrico.shinyapps.io/covid_gesta_puerp_br. Doi: http://doi.org/10.7303/syn44142724.

ORELLANA, J. *et al.* Excesso de mortalidade materna no Brasil: Desigualdades regionais e trajetórias durante a epidemia de COVID-19. *Plos One,* v. 17, n. 10. p. 1-15, 2022.

ORGANIZAÇÃO DAS NAÇÕES UNIDAS. *Transformando nosso mundo: a Agenda 2030 para o Desenvolvimento Sustentável.* Nova York: ONU; 2015. Available at: https://nacoesunidas.org/pos2015/agenda2030/. Access on: Apr. 4, 2023.

ORGANIZAÇÃO MUNDIAL DA SAÚDE. *Doença do coronavírus 2019 (*COVID-*19): relatório de situação 51.* Genebra: Saúde Mundial Organização. 2020. Available at: https://apps.who.int/iris/bitstream/handle/10665/331475/nCoVsitrep11Mar2020-eng.pdf. Access on: Apr. 11, 2022.

ORGANIZAÇÃO PAN-AMERICANA DA SAÚDE. *Diretoria da OPAS pede que países priorizem mulheres grávidas e lactantes na vacinação contra* COVID-*19.* Brasília, 2021. Available at: https://www.paho.org/pt/noticias/8-9-2021-diretora-da-opas-pede-que-paises-priorizem-mulheres-gravidas-e-lactantes-na . Access on: Apr. 7, 2023.

ORGANIZAÇÃO PAN-AMERICANA DA SAÚDE. Indicadores básicos de saúde no Brasil: conceitos e aplicações/Rede Interagencial de Informações para a Saúde. Brasília, 2002.

QEADAN *et al.* The risk of clinical complications and death among pregnant women with COVID-19 in the Cerner COVID-19 cohort: a retrospective analysis. al. *BMC Pregnancy and Childbirth,* v. 21, n. 305, p. 1-14. 2021.

SCHELER, C. A. *et al.* Maternal Deaths from COVID-19 in Brazil: Increase during the Second Wave of the Pandemic. *Revista Brasileira de Ginecologia e Obstetrícia***,** v. 44, n. 6, p. 567-572. 2022.

SIMBARA, M.; NAZARPOURB, S.; SHEIDAEIC, A. Avaliação dos resultados da gravidez em mães com infecção por COVID-19: uma revisão sistemática e meta-análise. *Revista de Obstetrícia e Ginecologia*, v. 43, n. 1, p. 1-21, 2023.

SISTEMA DE INFORMAÇÃO SOBRE MORTALIDADE. *Óbitos de Mulheres em Idade Fértil e Óbitos Maternos - Brasil*. Available at: http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sim/cnv/mat10uf.def. Access on: Apr. 2, 2022.

TAKEMOTO, M. L. S. *et al.* Clinical characteristics and risk factors for mortality in obstetric patients with severe COVID-19 in Brazil: a surveillance database analysis. *BJOG*, v. 127, n. 1, p. 1618-1626. 2020.

THOMAS, B. *et al.* Maternal and perinatal outcomes and pharmacological management of COVID-19 infection in pregnancy: a systematic review protocol. *Systematic Reviews*, v. 9, n. 1, p. 1-7, 2020.

ZAIGHAM, M.; ANDERSSON, O. Maternal and perinatal outcomes with COVID-19: A systematic review of 108 pregnancies. *Acta Obstet Gynecol Scand*., v. 99, n. 1, p. 823-829, 2020.

ZHU, N. *et al*. Um novo coronavírus de pacientes com pneumonia na China, 2019. *New England Journal of Medicine*, v. 8, n. 328, p. 727-33, 2020.

Note

[1] This research is the result of a master's dissertation from the Postgraduate Program in Health and Development in the Central-West Region (PPGSD) at the Federal University of Mato Grosso do Sul (UFMS).

[2] J. A. Alencar: conception, delineation of ideas, epidemiological design, collection, analysis and interpretation of data and writing the article. P. R. H. O. Bastos: research orientation and critical review of the article's text and content.

Resumo

Caracterização epidemiológica da mortalidade materna por COVID-19 no Brasil

Objetiva-se descrever a caracterização epidemiológica da mortalidade materna por COVID-19 no Brasil em 2020 e 2021. Estudo ecológico de delineamento epidemiológico retrospectivo e descritivo, com abordagem quantitativa, apoiado por revisão bibliográfica. A coleta de dados utilizou dados secundários do Sistema de Informação de Mortalidade, Sistema de Informação sobre Nascidos Vivos e o Observatório Obstétrico Brasileiro da COVID-19, sendo a população do estudo gestantes e puérperas com diagnóstico confirmado ou óbito por COVID-19, considerando os anos de 2020 e 2021. Os dados foram tabulados e analisados através do *Software Statistical Package for the Social Sciences* (SPSS) versão 16.0; 10,15% dos casos de COVID-19 evoluíram a óbito, sendo a caracterização epidemiológica predominante: mulheres pardas, de 30-39 anos, escolaridade de 8-11 anos e no terceiro trimestre de gestação. A Região Norte teve a maior razão de mortalidade materna. As informações epidemiológicas deste estudo são cruciais para o desenvolvimento de estratégias de proteção às mulheres, contribuindo para a redução da mortalidade materna e o alcance dos Objetivos do Desenvolvimento Sustentável.

➤ **Palavras-chave:** Mortalidade materna. COVID-19. Epidemiologia.