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Maternal Mortality From Covid-19 Among Adolescents And Associated Factors In Brazilian Regions

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Abstract:
Objective: To analyze factors associated with maternal mortality due to COVID-19 among pregnant and postpartum adolescents in Brazil's regions, from 2020 to 2022. Methods: This cross-sectional study examined deaths from Severe Acute Respiratory Syndrome (SARS) caused by COVID-19, as recorded in the Influenza Epidemiological Surveillance System (SIVEP-Flu). The dependent variable was maternal death from COVID-19. Bivariate analysis was performed using Pearson's chi-square test, with 5% significance. For the multivariate analysis, binary logistic regression was used, yielding Odds Ratios and 95% confidence intervals. Results: Nationally, 566 SARS cases due to COVID-19 were reported in pregnant and postpartum adolescents during the period, of which 108 resulted in death. This corresponds to a Maternal Mortality Ratio (MMR) of 10.2 deaths per 100,000 live births. The North, Northeast, and Southeast regions showed a significant association between maternal death and COVID-19 infection. The risk factors significantly associated with death included dyspnea, respiratory distress, O_2 saturation <95%, ICU admission, and use of ventilatory support. Conclusions: During the pandemic, maternal mortality among adolescents was significantly associated with severe respiratory failure symptoms in different regions of Brazil.

Keywords: *Maternal Mortality; COVID-19; Adolescent; Cross-sectional Studies.*

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I. Introduction

Maternal mortality is a serious public health issue and a violation of reproductive and sexual rights, remaining high despite global efforts to prevent and control mortality indicators. According to data from the World Health Organization (WHO), an estimated 287,000 women died during pregnancy, childbirth, or the postpartum period in 2020, corresponding to a global Maternal Mortality Ratio (MMR) of 223 deaths per 100,000 live births.[1] Research indicates that most of these deaths—over 92%—are preventable and could be averted through investments ensuring equitable access to quality maternal and child healthcare services.[1,2]

In Brazil, between 2019 and 2020, the MMR increased from 55.3 per 100,000 live births to 72 per 100,000 live births.[1,3] In 2021, official estimates indicated an MMR of 113.2 deaths per 100,000 births,[3] reflecting a 20-year setback in maternal health indicators and an alarming upward trend compared to the pre-COVID-19 period.[4,5] These indicators remain far above the target set by the United Nations under the Sustainable Development Goals (SDGs), which aim to reduce maternal mortality, by 2030, to fewer than 30 deaths per 100,000 live births.[5]

The COVID-19 pandemic, caused by SARS-CoV-2, posed numerous challenges to global public health, disproportionately affecting the most vulnerable populations. Among these groups are pregnant and postpartum adolescents, who are at higher risk due to biological factors inherent to early pregnancy and psychosocial immaturity, which can translate into behaviors and habits during pregnancy that increase the risk of maternal and fetal complications.[6,7,8]

In Brazil, maternal mortality associated with COVID-19 has been a growing concern, especially in pregnant and postpartum adolescents who often face difficulties accessing healthcare, particularly in conditions

of socioeconomic hardship.[6] Research suggests that mortality from pregnancy- or childbirth-related complications is associated with ethnic inequalities, housing conditions, and education levels. According to studies, MMR is higher among Indigenous and Black women, those with lower education, lower socioeconomic status, and those living in rural areas.[6],[7],[8] These disparities worsened during the COVID-19 pandemic due to multiple factors such as overburdened health systems responding to COVID-19 cases; social distancing measures aimed at reducing transmission; and reduced availability of general healthcare services, making prenatal care and childbirth follow-up more challenging.[4],[8],[9]

Research findings show that pregnant and postpartum women infected with SARS-CoV-2 face a higher risk of severe complications, such as preeclampsia, preterm birth, and the need for mechanical ventilation, which can progress to maternal death. When pregnancy occurs during adolescence, the risks of complications are significantly higher.[8],[9] The increase in maternal deaths underscores the need for investigations to elucidate the main factors contributing to mortality in this age group and to guide investments in public policies and healthcare programs specifically tailored for vulnerable populations.

Globally, the critical health situation experienced during the COVID-19 pandemic has prompted researchers from different countries to delve deeper into understanding the pandemic's multiple impacts, with a view to expanding investments and interventions to reduce morbidity and mortality. Against this backdrop, the present study aims to analyze factors associated with maternal mortality due to COVID-19 among pregnant and postpartum adolescents, during the pandemic period, in all regions of Brazil, from 2020 to 2022.

II. Methods

This is a cross-sectional study including all deaths of pregnant and postpartum adolescents diagnosed with Severe Acute Respiratory Syndrome (SARS) due to COVID-19, from 2020 to 2022. Data were obtained from the Influenza Epidemiological Surveillance System (SIVEP-Flu), maintained by the Ministry of Health, via the openDataSUS portal, in the second half of 2023 (https://opendatasus.saude.gov.br/dataset?tags=SRAG).

Adolescents were defined as those between the ages of 10 and 19, according to the criteria established by the World Health Organization (WHO).[16] According to 2022 census data, Brazil's total population was 203,062,512 inhabitants, with a population density of 23.86 inhabitants per square kilometer. It is estimated that, in the same year, there were 15,529,014 female adolescents in the country.[10]

In this study, the dependent variable (outcome) was maternal death from COVID-19 among pregnant and/or postpartum adolescents. Maternal death was defined as a death occurring during pregnancy, childbirth, or the postpartum period as a result of complications from COVID-19 infection.[11]

Independent (predictor) variables were stratified by age range and included the following: macro-regions of residence (North, Northeast, South, Southeast, and Center-West); place of residence (rural or urban); race/skin color (White or non-White); adequacy of education for age (inadequate or adequate); vaccination against influenza (yes or no); signs and symptoms such as fever (yes or no), cough (yes or no), dyspnea (yes or no), respiratory distress (yes or no), O_2 saturation <95% (yes or no), diarrhea (yes or no); pre-existing conditions (cardiopathy [yes or no], chronic pneumopathy [yes or no]); ICU admission (yes or no); use of ventilatory support (yes or no); and the interval between hospitalization and death (>7 days or ≤7 days). For the variable "adequacy of education for age," the calculation was based on the expected years of schooling for each adolescent's age.

For data analysis, an initial univariate analysis was conducted to estimate the absolute and relative frequencies of the predictor variables. This was followed by a bivariate analysis using Pearson's chi-square test, at a 5% significance level, to identify possible associations between maternal mortality from COVID-19 (dependent variable) and the aforementioned independent variables.

Multivariate analysis was then performed via binary logistic regression (Wald test), based on results of the bivariate analysis ($p < 0.20$). The results are presented in Odds Ratios (OR) with 95% confidence intervals to assess associations between the independent variables and the outcome (maternal death from COVID-19 by age range). These analyses were performed using the Statistical Package for the Social Sciences (SPSS) software, version 25.0, licensed to the State University of Feira de Santana (UEFS).

Because this study used secondary, publicly available data from Ministry of Health information systems, submission to a Research Ethics Committee (REC) was not required.

III. Results

Across all Brazilian regions, according to SIVEP-Flu data from 2020 to 2022, there were 566 recorded cases of SARS due to COVID-19 among pregnant and postpartum adolescents (ages 10-19). Of these cases, 108 progressed to maternal death (19.1%), corresponding to a crude MMR of 10.2 deaths per 100,000 live births (Tables 1 and 2). The Northeast and Southeast regions recorded the highest percentages of maternal deaths (38.9% and 30.6%, respectively). Regarding sociodemographic characteristics, 84.8% of the women lived in urban areas, the majority (82.0%) were of non-White race/skin color, and 69.8% had schooling considered inadequate for their age (Table 1).

In terms of vaccination and the presence of signs and symptoms, most of the adolescents who died were not vaccinated against influenza (77.8%) and presented with fever (58.1%), cough (64.9%), dyspnea (64.8%), respiratory distress (58.2%), and O_2 saturation <95% (58.8%). About 54.0% of these adolescents were admitted to the ICU, more than 60.0% required ventilatory support, and in over 65.0% of cases, the time between hospital admission and maternal death exceeded seven days (Table 1).

According to the logistic regression analysis, the North (OR=3.8; 95%CI=1.2-11.4), Northeast (OR=5.7; 95%CI=2.0-16.7), and Southeast (OR=5.4; 95%CI=1.8-15.8) regions showed a significant association with maternal death from COVID-19. Dyspnea (OR=3.7; 95%CI=2.2-6.0), respiratory distress (OR=2.7; 95%CI=1.6-4.4), and O_2 saturation <95% (OR=5.0; 95%CI=3.0-8.4) were also significantly associated with the outcome. ICU admission (OR=3.8; 95%CI=2.3-6.0) and use of ventilatory support (OR=4.6; 95%CI=2.8-7.5) contributed significantly to maternal death, as did hospitalization for more than seven days, which was the primary exposure factor, increasing the chance of death by sixfold (OR=6.1; 95%CI=3.3-11.3) (Table 1).

IV. Discussion

The findings of this study indicate that maternal mortality from COVID-19 among Brazilian pregnant and postpartum adolescents (2020–2022) was associated with clinical factors (signs and symptoms of severe respiratory failure, the use of mechanical ventilation, and O_2 saturation) across different regions of the country. Maternal mortality was significantly higher in the Northeast, Southeast, and North regions, among non-White women with education levels inadequate for their age, as well as those who required ICU admission and ventilatory support.

This investigation recorded 108 maternal deaths from COVID-19 among adolescents—higher than the figures reported by other Latin American countries. An observational study conducted between 2020 and 2021 on maternal deaths linked to COVID-19 in eight Latin American nations (Honduras, Paraguay, Colombia, Ecuador, Peru, Dominican Republic, Bolivia, and Costa Rica) documented 447 deaths in all age groups, of which only 5.6% occurred in those under 20 years of age.[12]

In Brazil, Szwarcwald et al. (2022)[13] reported an MMR of 35.7 per 100,000 live births from COVID-19 deaths across all age brackets in 2020–2021. Focusing exclusively on adolescents (10–19 years), the present study found an MMR of 10.2 maternal deaths from COVID-19 per 100,000 live births, accounting for 20.9% of all-cause maternal deaths.

Pregnant adolescents have biological characteristics that make them more susceptible to severe complications from viral infections like COVID-19. In addition to the heightened vulnerability to respiratory infections inherent to pregnancy, this group often shows lower adherence to prenatal care, partially due to later initiation of services, which can delay diagnosis and reduce opportunities for early prevention and intervention regarding COVID-19 infection.[6]

Worldwide, numerous studies observed a rise in maternal mortality during the COVID-19 pandemic—particularly in 2021.[9][14] In Brazil, SARS-CoV-2 infection led to immediate peaks in the MMR and, consequently, elevated maternal mortality over the two-year pandemic period (2020–2021).[15][16] However, a 34.1% drop in MMR was noted after the start of Brazil's SARS-CoV-2 vaccination campaign targeting pregnant women, beginning in mid- 2021.[17]

In the present research, the geographic distribution of maternal mortality showed significant disparities among the country's different regions. The Northeast, North, and Southeast regions were significantly associated with maternal death from COVID-19 in the adolescent age group, which may be linked to several factors. These regions faced challenges such as limited capacity for early, targeted healthcare at the regional level and difficulties in accessing healthcare resources. Studies highlight that, historically, the Northeast and North regions have contended with infrastructural and resource constraints, including human resources, equipment, and adequate services. Meanwhile, in the more developed Southeast region, the health system's overload during the pandemic peaks largely contributed to increased COVID-19 mortality.[4][8]

Higher maternal mortality among non-White women (self-identified as Brown or Black) may be linked to racial inequalities affecting healthcare in Brazil. Previous research emphasizes that Black and Brown women encounter greater barriers to prenatal care and often suffer racial discrimination in healthcare settings, leading to suboptimal care and delays in timely diagnosis and treatment. During the pandemic, these compounded factors likely contributed to worse maternal outcomes for adolescent pregnant and postpartum individuals.[7][16][18]

The association between low education levels and higher maternal mortality found in this study underscores significant social vulnerability. Research shows that inadequate schooling for one's age not only reflects limited educational access but often correlates with precarious living conditions, lower income, and restricted access to healthcare. These circumstances can lead to delayed medical attention and an increased likelihood of exposure to risk factors, including COVID-19 infection.[16][18]

The study also identified ICU admission and the use of ventilatory support as variables significantly tied to elevated maternal mortality—consistent with literature highlighting the need for intensive care and mechanical

ventilation as indicators of severe COVID-19. High mortality in such cases may reflect the infection's severity, delayed healthcare-seeking behavior, inadequate service provision, and pre-existing comorbidities that exacerbate the clinical course of the disease.[9,15]

The COVID-19 pandemic profoundly affected maternal health, driving up mortality rates through health-system overload, social-distancing measures, and staff shortages in prenatal and delivery services. During pandemic surges, many services were stretched beyond capacity, resulting in limited technical resources and difficulties in providing specific care for pregnant and postpartum women exhibiting COVID-19 symptoms.[4,8]

This study demonstrates that, between 2020 and 2022—during the height of the COVID-19 pandemic—maternal mortality among adolescents in different Brazilian regions was high and strongly associated with clinical factors (symptoms and their severity, ventilatory support, O_2 saturation, and ICU admission).

Despite the limitations inherent in secondary data usage, this research advances understanding of epidemiological indicators, potentially guiding and strengthening effective, equitable health policies and practices aimed at improving care for pregnant and postpartum adolescents—a population deemed particularly vulnerable, especially in Brazil's most under-resourced regions.

V. Conclusion

The findings of this study highlight that COVID-19 imposed a substantial burden on maternal health among pregnant and postpartum adolescents in Brazil between 2020 and 2022. A notably high Maternal Mortality Ratio was observed, with deaths strongly linked to severe respiratory conditions—such as dyspnea, respiratory distress, and O_2 saturation below 95%—and the need for advanced medical interventions, including ICU admission and mechanical ventilation. These clinical indicators underscore the necessity of early detection and prompt, specialized care to reduce risks and prevent lethal outcomes.

Moreover, the results showed meaningful geographic disparities, with the Northeast, Southeast, and North regions experiencing higher maternal mortality rates among adolescents than other parts of the country. Socioeconomic and racial factors further compounded this issue, as non-White adolescents and those with inadequate schooling for their age were disproportionately affected. These findings suggest that social determinants of health— ranging from persistent racial inequalities to gaps in educational access—play a decisive role in exacerbating vulnerability and limiting timely, high-quality healthcare.

From a public health standpoint, these outcomes call for a multipronged approach. First, targeted interventions are essential to ensure early and robust prenatal care, particularly in historically underserved regions. Strengthening primary healthcare networks and improving referral pathways to advanced care can offer pregnant adolescents more comprehensive services, including rapid identification of respiratory complications. Second, concerted efforts to diminish racial disparities—by addressing discrimination and reinforcing culturally competent healthcare—are vital to achieving equitable outcomes. Third, social support programs, coupled with educational policies aimed at keeping adolescents engaged in school, can help mitigate risks by fostering greater health literacy and timely engagement with prenatal services.

The pandemic context revealed systemic weaknesses in healthcare delivery, emphasizing the urgency to bolster infrastructure and workforce capacity, so that future crises do not compound existing health disparities. Although the secondary database used in this study has inherent limitations—such as potential underreporting, missing data, and variability in data quality—our findings present valuable insights for researchers and policymakers. Future investigations that employ mixed methods, including qualitative assessments, may provide further depth on how socio-cultural and economic factors intersect with clinical management to shape maternal health outcomes.

Ultimately, this study underscores the profound impact of COVID-19 on adolescent maternal mortality in Brazil and highlights areas where public policy, healthcare provision, and social interventions can converge to protect a group that remains especially vulnerable. By acknowledging and actively addressing both the clinical and social determinants at play, it becomes possible to reduce preventable deaths, enhance overall maternal and newborn health, and promote a more equitable healthcare landscape in the wake of this global health crisis.

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Table 1 – Characterization of cases of Severe Acute Respiratory Syndrome (SARS) due to Covid-19 and factors associated with maternal mortality from Covid-19 among pregnant and postpartum adolescents (10–19 years old) in the Regions of Brazil, during the period 2020–2022.

Variable	N	%	Maternal death		*p**	OR	CI 95%		*p**
			n	%					
Region					0,002				
North	123	21,7	22	20,4		3,8	1,2	11,4	0,019
Northeast	168	29,7	42	38,9		5,7	2,0	16,7	0,001
Central-West	63	11,1	7	6,5		2,2	0,6	7,7	0,239
Southeast	139	24,6	33	30,6		5,4	1,8	15,8	0,002
South	73	12,9	4	3,7		1	-	-	
Origin					0,575				
Rural	71	13,4	15	15,2		1,2	0,6	2,2	0,576
Urban	458	86,6	84	84,8		1	-	-	
Race/skin color					0,101				
Non-white	386	75,7	82	82,0		1,6	0,9	2,8	0,103
White	124	24,3	18	18,0		1	-	-	
Education					0,307				
Inadequate	181	63,7	37	69,8		1,4	0,7	2,7	0,309
Adequate	103	36,3	16	30,2		1	-	-	
Vaccination					0,058				
Yes	92	34,5	10	22,2		0,5	0,2	1,0	0,062
No	175	65,5	35	77,8		1	-	-	
Fever					0,082				

Yes	230	49,7	50	58,1		1,5	0,9	2,4	0,083
No	233	50,3	36	41,9		1	-	-	
Cough					0,22				
Yes	283	59,3	61	64,9		1,3	0,8	2,1	0,221
No	194	40,7	33	35,1		1	-	-	
Dyspnea					0,000				
Yes	176	39,6	57	64,8		3,7	2,2	6,0	0,000
No	268	60,4	31	35,2		1	-	-	
Respiratory distress					0,000				
Yes	168	38,5	46	58,2		2,7	1,6	4,4	0,000
No	268	61,5	33	41,8		1	-	-	
O2 **saturation** <95%					0,000				
Yes	123	28,9	47	58,8		5,0	3,0	8,4	0,000
No	302	71,1	33	41,3		1	-	-	
Diarrhea					0,060				
Yes	21	5,3	7	9,9		2,4	0,9	6,2	0,067
No	374	94,7	64	90,1		1	-	-	
Heart disease					0,032				
Yes	9	2,6	4	6,6		3,9	1,0	15,1	0,046
No	338	97,4	57	93,4		1	-	-	
Chronic lung disease					0,073				
s	3	0,9	2	3,5		10,4	0,9	116,3	0,058
No	340	99,1	55	96,5		1	-	-	
Variable	**N**	**%**	**Maternal death**		***p****	**OR**	**CI 95%**		***p****
			n	**%**					
ICU admission					0,000				
Yes	146	29,1	48	53,9		3,8	2,3	6,0	0,000
No	355	70,9	41	46,1		1	-	-	
Ventilatory support					0,000				
Yes	165	33,1	54	62,8		4,6	2,8	7,5	0,000
No	333	66,9	32	37,2		1	-	-	
Hospitalization length					0,000				
>7 days	131	28,2	34	65,4		6,1	3,3	11,3	0,000
7 days	333	71,8	18	34,6		1	-	-	

Source: MS - SIVEP-Gripe OR = Odds Ratio
95%CI = 95% Confidence Interval
* Statistical significance for $p \leq 0.05$

Table 2 – Maternal Mortality Ratio (MMR) due to Covid-19 among adolescents (10–19 years old), in the Regions of Brazil, during the period 2020–2022.

Region	**Maternal deaths**		**Live births**	**MMR Total***	**MMR due to Covid-19***
	All causes	**Due to Covid-19**			
North	115	22	187.193	61,4	11,8
Northeast	180	42	362.681	49,6	11,6
Southeast	144	33	313.995	45,9	10,5
South	37	04	109.108	33,9	3,7
Central-West	40	07	89.016	44,9	7,9
Brazil	**516**	**108**	**1.061.993**	**48,6**	**10,2**

Source: MS - SIM/SINASC/SIVEP-Gripe
*MMR per 100,000 live births.