Original Article

# Incidence, Causes, and Perinatal Outcomes of "Near-Miss" Obstetric Emergencies during the COVID-19 Pandemic: Experience from a Tertiary Referral Center of Western Rajasthan, India

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## Abstract

**Background:** Pregnant women and neonates are often considered as being a vulnerable group during the coronavirus disease 2019 (COVID-19) pandemic. Several studies have compared the impact of COVID-19 on pregnant and nonpregnant women. This study aimed to examine the reasons for severe acute maternal morbidity (SAMM) and "near-miss cases" and their effects on perinatal outcomes before and during the COVID-19 pandemic. **Materials and Methods:** All women admitted to our facility with pregnancy-related complications for birth or in the puerperium who required critical care unit (CCU) or high dependency unit (HDU) admission were included in the study. A modified version of the World Health Organization (WHO)'s Maternal Near-Miss Screening Tool was used to identify maternal near-miss cases and other obstetric emergencies requiring CCU admission. **Results:** The incidence of "near-miss" obstetric emergencies was -30.7 per 1000 live births. Over the 3 years of data obtained, 152 near-miss cases were found. Thirty-five cases were seen in the pre-COVID-19 period, whereas 117 near-miss cases were noted during the COVID-19 pandemic. The most common cause of near-miss cases in both groups was severe preeclampsia (65.8%). The rate of ICU admissions was 80.3% (94/117) during COVID-19, while only three cases required ICU before the COVID-19 pandemic. There were a total of 11 maternal deaths, and all were reported during the COVID-19 pandemic. **Conclusion:** There was a significant increase in ICU admission rates and "near-miss" obstetric emergencies during the COVID-19 pandemic. The COVID-19 infection indirectly led to higher maternal morbidity secondary to lockdown effects on antenatal care and delayed referrals. This study will contribute to the existing literature on the impact of the COVID-19 pandemic on maternal and child health. The results will help inform policy decisions and guide the development of interventions to improve the quality of care for pregnant women during the pandemic.

**Keywords:** Antenatal care, critical care unit (CCU), maternal near miss, severe acute maternal morbidity (SAMM), severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)

## Introduction

The coronavirus disease 2019 (COVID-19) was classified by the World Health Organization (WHO) as a global pandemic on March 11, 2020, and since then, it has affected all domains of health care worldwide.[1] Antenatal care is one of the most affected healthcare facilities both directly and indirectly. Pregnant women may not be at increased risk of contracting this virus, but the chances of a landing into critical complications are high. Newer studies from across the globe have shown that women with COVID-19 are at higher risk of hospitalization, intensive care unit (ICU) admission, mechanical ventilation, and preterm birth.[2–4] Indirectly, the COVID-19 pandemic brought with it several social restrictions and isolations, thus jeopardizing routine antenatal visits, and hence, women with high-risk factors were likely missed,

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resulting in higher near-miss cases, especially in low- and middle-income countries (LMICs).

According to a report by the Washington-based think tank, Center for Global Development, India, experienced a catastrophic course of COVID-19 during the second wave of the pandemic. This has been called the country's worst tragedy after the 1947 partition, as nearly all emergency healthcare services were overwhelmed with critically ill patients.[5] Adding to this misery, there has been a sudden surge in obstetric emergencies requiring mechanical ventilation, with most of these being high-risk critical pregnancies. It is noteworthy that there is a clear correlation between the number of maternal deaths and the availability of ICU care, as countries with the highest maternal mortality rates also have the lowest per capita number of ICU beds.

The aim of this study was to identify all women admitted to the hospital during pregnancy, delivery, and in the postpartum period, with severe acute maternal morbidity (SAAM) or near-miss events and to find out the causes and correlates of hospitalization in the ICU, critical care unit (CCU), or high dependency unit (HDU) during the COVID-19 pandemic. These data would be instrumental in auditing the quality of critical care given during a pandemic, pitfalls in the referral system, and the affected antenatal care in general. Documenting this impact of a pandemic is mandatory in future planning of critical care resources, modifying antenatal care measures, and strengthening the referral system to achieve the most sought-after goal of reducing maternal morbidity even during unaccepted natural calamities.

## Materials and Methods

This was a facility-based cross-sectional study conducted at a tertiary care referral center in Western Rajasthan, India, over 3 years from January 2019 to December 2021. The study protocol was approved by the Institutional Ethics Committee (AIIMS/IEC/2021/3560). The study has been performed in accordance with the ethical standards described in the 1975 Declaration of Helsinki, as revised in 2000. A modified version of the WHO's Maternal Near-Miss Screening Tool[6] was used to identify patients presenting with SAMM and maternal near-miss cases requiring CCU admission. SAMM can be explained as a severe life-threatening obstetric complication necessitating an urgent medical intervention to prevent the likely death of the mother[7] and includes women with a "near-miss" event. The WHO defines "near-miss" as a woman who, being close to death, survives a complication that occurred during pregnancy, delivery, or up to 42 days after the end of her pregnancy.[8]

All women fulfilling the WHO near-miss criteria requiring admission in a CCU with or without the need for mechanical ventilation irrespective of their COVID-19 status were included in the study after ensuring informed consent to participate in the study. All women with obstetric emergencies not requiring CCU care or pregnant women with non-obstetric conditions requiring CCU care were excluded from the study.

The admission and delivery records for all pregnant women delivering at our institute or who have been referred for antenatal or postnatal complications up to 42 days after the termination of the pregnancy and admitted to the ICU during their course of treatment were reviewed by the hospital information system during the said period. This period includes the pre-pandemic phase, the onset of the pandemic when a strict lockdown was in place in India, and the period of the second wave that saw an enormous surge in patients requiring mechanical ventilation.

All records were screened for eligibility using the modified version of the WHO's Maternal Near-Miss Screening Tool.[6] Participants were assessed for the presence of specific symptom-based criteria (such as severe hemorrhage, severe preeclampsia, eclampsia, sepsis, or systemic infection or ruptured uterus), intervention-based criteria (such as the use of blood products, laparotomy, or admission to the ICU), or organ dysfunction-based criteria (such as cardiovascular, respiratory, renal, hematological, hepatic, neurological, or uterine dysfunction).

The maternal near-miss incidence ratio (MNMIR), maternal near-miss mortality ratio, causes of CCU admissions, adverse perinatal outcomes, and mortality index (MI) were calculated and compared with those of national statistics pre-pandemic.

*MNMIR* refers to the number of near-miss cases per 1000 live births.

*MI* = Maternal deaths/Maternal near miss + Maternal deaths [MD/MNM + MD] *100.

Frequencies and basic descriptive statistics were calculated for all variables, including proportions, means, and standard deviations, using a Statistical Package for Social Sciences, version 23 (SPSS 23). An independent-samples *t*-test was used to compare means, while the Chi-square test was applied to calculate the probability for parametric data. A probability of $<0.05$ was considered significant.

## Results

In the study duration, a total of 152 women presented with SAMM requiring ICU care and 11 of them also had COVID-19 infection at the time of admission. The total number of deliveries during the period was 4,972 with 4,936 live births. The mean age of the sample population was $27.08 \pm 5.1$ years. Around 77% of cases of SAMM (117/152) were admitted during the COVID-19 pandemic, making the overall near-miss incidence ratio 30.7 per 1000 live births [Figure 1].

Table 1 shows the comparative analysis of near-miss indicators in the pre-COVID-19 and COVID-19 periods.

During the pandemic, nearly half of these women (60/117) had no antenatal visits or any kind of medical supervision during their pregnancies. In contrast, among the remaining half, most of the women sought antenatal care at a tertiary care hospital, indicating that the antenatal departments of primary and secondary care hospitals during the pandemic remained

almost nonfunctional. Around 66% of women with SAMM were referred antenatally at our institute and delivered with us, while the remaining 34% were referred postnatally.

Among the causes of near miss, 65.7% (100/152) women had hypertensive disorders ranging from preeclampsia with severe features, chronic hypertension with superimposed preeclampsia, and impending eclampsia and 15.7% (24/152) had eclamptic episodes. A few women with hypertensive disorders also had other medical and obstetric complications. Table 2 represents the number of women with SAMM and their underlying morbidities in isolation or combination, along with the incidence of maternal deaths in each category in the pre-COVID-19 and COVID-19 periods.

As far as fetal outcomes are concerned, 33 intrauterine deaths were reported (28.2%) during the pandemic period as compared to three (8.5%) in the pre-COVID-19 period. This difference was statistically significant ($P = 0.04$), while four (11.4%) early neonatal deaths occurred within 7 days of birth in the pre-COVID-19 period, and this number was 36 (30.7%) during the pandemic ($P = 0.06$). 31.6% (48/152)

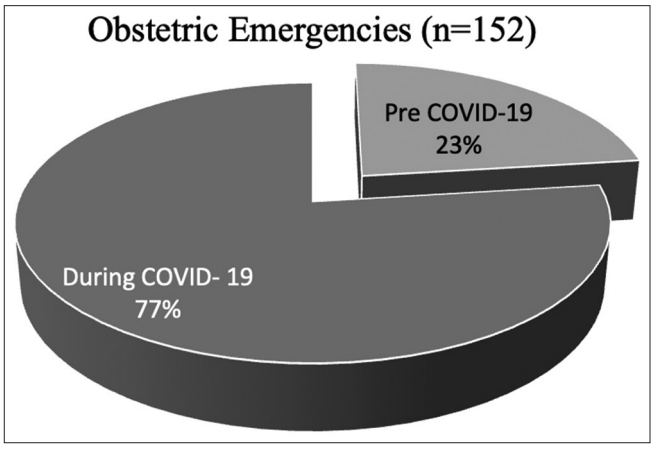


**Figure 1:** Distribution of obstetric emergencies in the pre-COVID-19 and COVID-19 era

**Table 1: Comparative indicators of maternal near miss during the pre-COVID-19 and COVID-19 periods**

| | 2019 (pre-COVID-19) | Jan 2020–Dec 2021 (COVID-19) | Total | *P* |
|---|---|---|---|---|
| Mean age (years)±2SD | 26.14±4.7 | 27.39±5.1 | 27.08±5.1 | 0.207 |
| Events | | | | |
| Total deliveries (*n*) | 2298 | 2692 | 4972 | |
| Stillbirths (%) | 8 | 28 | 36 | |
| Live birth (*n*) | 2290 | 2664 | 4936 | |
| Maternal near-miss cases | 35 | 117 | 152 | 0.00 |
| Maternal near-miss incidence ratio (MNMIR) per 1000 LB | 15.2 | 43.9 | 30.7 | |
| Maternal deaths (MD) | 0 | 11 | 11 | |
| Maternal near miss: MD | - | 10.6 | 13.8 | |
| Mortality index MD/(MNM+MD) *100 | 0 | 8.5 | 6.7 | |

SD—standard deviation, LB—live birth

**Table 2: Causes of maternal near-miss and maternal mortality**

| Severe complications/potentially life-threatening conditions leading to critical interventions or intensive care unit admission (*n* (%)) | Number of women affected with one or more complications | | | *P* | Maternal deaths (all during COVID-19) |
|---|---|---|---|---|---|
| | Pre-COVID-19 (2019) (*n*=35) | During COVID-19 (Jan 2020–Dec 2021) (*n*=117) | Total (*n*=152) | | *n*=11 |
| Antepartum hemorrhage | 4 (11.4) | 9(7.7) | 13 | 0.498 | |
| Postpartum hemorrhage | 6 (17.1) | 28 (23.9) | 34 | 0.49 | 2 |
| Ruptured uterus | 0 | 2 (1.7) | 2 | 0.409 | |
| Postpartum sepsis | 4 (11.4) | 27 (23.1) | 31 | 0.157 | 2 |
| Preeclampsia/eclampsia | 30 (85.7) | 70 (59.8) | 100 | 0.004* | 1 |
| Eclampsia | 2 (5.7) | 22 (18.8) | 24 | - | |
| Abortion complications | 0 | 3 (2.56) | 3 | - | |
| Ectopic pregnancy | 0 | 3 (2.56) | 3 | - | |
| DIC | 3 (8.5) | 27 (23.1) | 30 | 0.08 | |
| COVID-19 infection | 0 | 11 (9.40) | 11 | | 1 |
| Multiple organ dysfunction syndrome (MODS) | 2 (5.7) | 35 (29.9) | 37 | 0.003* | 4 |
| Acute respiratory distress syndrome (ARDS) | 2 (5.7) | 42 (35.8) | 44 | 0.00* | |
| Heart disease | 0 | 14 (11.9) | 14 | 0.04* | 1 |
| Peripartum hysterectomy | 1 (2.8) | 12 (10.2) | 13 | | |
| Cesarean | 21 (60) | 69 (58.9) | | | |

*statistically significant. DIC—disseminated intravascular coagulation, COVID-19—coronavirus disease 19

of women delivered preterm babies, and all these mothers received either a single dose or a full course of antenatal steroids to accelerate lung maturity.

The cesarean section rate in this population was almost similar to 60% (21/35) in group A as compared to 58.9% (69/117) in group B. Overall, two women underwent laparotomy for ruptured uterus, three women underwent laparotomy for ruptured ectopic as they presented with hypovolemic shock, and three women underwent uterine evacuation for postabortal complications. All these women were admitted to the ICU and required more than five units of blood transfusion. Around 10.2% (12/117) of women had to undergo peripartum hysterectomy for obstetric hemorrhage, again requiring massive blood transfusion.

There were 11 maternal deaths reported in these 3 years and all the deaths occurred in 2021, during the COVID-19 pandemic. 65% of these women died within 12 hours of stay at our institute, and only one woman was COVID-19 positive. The most common cause of maternal mortality was multiple organ dysfunction syndrome (MODS) with the most involved organs being the liver, kidney, and lungs. Of the four women dying due to MODS, all had puerperal sepsis as their primary underlying cause. Around 22.8% (8/35) of women with SAMM required a total of 20 units of blood and blood product transfusion during their hospital stay during the pre-COVID-19 period as compared to 36.7% (43/117) women requiring a total of 332 units during the COVID-19 period. There was a significant difference in the number of units of blood products required.

Delay in referral to the tertiary care setup was noted in 77.7% of cases, and the most common reason cited was not seeking medical care due to lockdown and fear of contracting the infection. 82.4% of women were from rural backgrounds, 65% of women were primiparas, and 48.4% of women belonged to a low socioeconomic status.

## Discussion

The incidence of near-miss obstetric emergencies in the pre-COVID-19 era was 15.3 per 1000 live births that increased to 30.7 per 1000 live births during the COVID-19 pandemic. Sample Registration System the maternal mortality ratio (MMR) of India stands at 113 per 100,000 live births as per the SRS 2016–2018, and for Rajasthan, it is 164 per 100,000 live births.[7] In the present study, the MMR was 222.8 per 100,000 live births, which is almost double the national statistics reported before the pandemic. Several factors may be attributed to the observed severe maternal outcomes, including a decrease in outpatient visits, missing the golden hour of referral for critical mothers, a decrease in institutional deliveries, and limited CCUs. The most common cause of near miss was hypertensive disorders of pregnancy and its complications, while the most common cause of maternal mortality was puerperal sepsis, leading to MODS. The ICU admission rate was 28.7 times higher in the COVID-19 pandemic as compared to the pre-COVID-19 era in our institute. Intrauterine and early neonatal deaths in women with SAMM were 28.2% and 30.7%, respectively, during the pandemic. The most important correlates of increased incidence of SAMM and ICU admission were lack of appropriate antenatal care, decrease in institutional deliveries, and timely referral.

As a developing nation, India has its own challenges in improving the MMR. With the spread of COVID-19, healthcare infrastructure has collapsed all over the world, thereby imposing an additional burden on maternal and child health care. In this study, our primary objective was to document the near-miss cases rather than maternal mortalities as the number of SAMM is more as compared to mortality data and one can directly interview the surviving mother and find out the pitfalls in medical care with greater reliability. In a recent study from India on "near-miss" obstetric events performed before the pandemic, the near-miss ratio was 8.4/1000 and the major cause defined was postpartum hemorrhage.[9] In our study, the number of near-miss cases was quite high (30.7 per 1000 LB) and the most common cause was hypertensive disorders of pregnancy and their complications.

We used the modified WHO near-miss approach to identify our study population as it maintains uniformity in its application, leading to the reproducibility of data. It also makes it available for all settings and helps investigate and improve the quality of obstetric care.[10] The indicators of organ dysfunction are clearly defined by the WHO in their near-miss assessment, hence avoiding misdiagnosis of the same. We clearly identified a negative impact of the COVID-19 pandemic on our maternal and child health services, which may reflect the state of maternity care in most LMICs.

A multicentric, cross-sectional study with an embedded case-control study was conducted by Oppong *et al*.,[11] in 2018, where they studied the incidence and factors associated with maternal near miss. They concluded that for every maternal death, there were nearly five maternal near misses. It also proves the applicability and quantification of WHO near-miss criteria. In our study, this maternal near-miss: maternal death ratio was 13.8, suggesting an increase in near-miss cases due to the pandemic but improved critical care, leading to a decrease in mortality of these women. However, such high numbers of near-miss morbidities have been described in the rural population of Ethiopia by Mekonnen *et al*.,[12] who reported it to be 28.7%.

A 2021 study by Elsaddig and Khalil[13] studying the effects of the COVID-19 pandemic on pregnancy outcomes has shown that rates of venous thromboembolism and myocardial infarction were higher in pregnant women with COVID-19 than in pregnant women without COVID-19. Cesarean section, miscarriage, preterm births, and stillbirth rates were also seen to be on the rise. However, this may be due to a lower threshold for ICU admission in unwell pregnant women with COVID-19. In our study also, women presenting with intrauterine death

and preterm labor were more (28.2% and 31.6%, respectively) as compared to the pre-COVID-19 period.[14]

There are limited data available on the impact of the COVID-19 pandemic on maternity services. In one recent study from Ireland, the authors found no negative impact on perinatal outcomes during the pandemic and reported no difference in perinatal deaths or preterm births during the pandemic as compared to the pre-COVID-19 era; however, the authors did not report on near-miss cases or the number of ICU admissions.[15] Our study demonstrated a negative impact of the pandemic on the overall care of antenatal mothers and the contradicting findings may be explained by the difference in the healthcare infrastructure between a high-income country and a LMIC like ours. This can be taken care of by decentralizing maternity services by strengthening the primary and secondary care hospitals, along with the target of door-to-door basic antenatal care available to the most vulnerable population. Furthermore, appropriate utilization of the government healthcare schemes such as Ayushman Bharat and Health and Wellness Centres should also be performed.[16,17]

The limitation of our study is that it is a single-center study.

## Conclusion

The present study documents the increase in the incidence of women presenting with SAMM, including an increase in the near-miss incidence ratio and MMR during the pandemic. For every maternal death, there were nearly ten maternal near misses.

This study will contribute to the existing literature on the impact of the COVID-19 pandemic on maternal and child health. The results will help inform policy decisions and guide the development of interventions to improve the quality of care for pregnant women during the pandemic.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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