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Original Research Article

A prospective study on maternal near-miss and maternal mortality in a tertiary care hospital

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ABSTRACT

Background: Maternal near-miss (MNM) has become a key indicator of healthcare quality, offering valuable insights into severe maternal morbidity. In developing countries, maternal morbidity remains a pressing issue, and understanding MNM cases is crucial for improving maternal health outcomes. The present study was carried out to evaluate the causes, interventions, and delays in managing maternal near-miss cases in a tertiary care hospital.
Methods: This observational study was conducted at Al-Ameen Medical College and Hospital, from September 2022 to September 2023. A total of 863 deliveries were analyzed, and 67 MNM cases were identified. The study included pregnant women who experienced severe maternal complications, and data on demographic, clinical, and intervention characteristics were collected. The incidence ratio, mortality index, and delay factors were also calculated.
Results: The MNM incidence ratio was 78.7 per 1000 live births. The most common risk factors were preeclampsia (29.9%), antepartum hemorrhage (APH) (16.4%), eclampsia, and surgical site infections (13.4%). A majority of MNM cases required high dependency unit (HDU) admission (55.2%), and 13.4% underwent hysterectomy. Delays were most prominent at the patient level (46.3%), followed by referral side delays (38.8%). The study also found that women with severe anemia had lower gestational ages and a higher incidence of transfusion interventions.
Conclusions: This study highlights the significant burden of MNM, particularly due to hypertensive disorders and hemorrhage. Delays in care, especially from the patient and referral sides, contribute to poor maternal outcomes. Early detection, effective interventions, and improved healthcare systems at all levels are crucial to reduce maternal morbidity.

Keywords: Antepartum hemorrhage, Eclampsia, Hysterectomy, Maternal mortality, Near miss

INTRODUCTION

Maternal health has been a central focus of global health initiatives, yet maternal mortality remains a pressing concern in developing countries. While maternal mortality provides a significant indicator of healthcare quality, it is insufficient to fully understand the spectrum of challenges faced by pregnant women.[1] Maternal near-miss (MNM) has emerged as a valuable complement to maternal mortality data, offering deeper insights into severe maternal morbidity and identifying critical gaps in the healthcare system. Maternal mortality continues to pose a substantial challenge in developing countries, while maternal near-miss (MNM), defined as instances where a woman nearly dies but survives a severe complication during pregnancy, childbirth, or within 42 days postpartum/post-termination, acts as a vital indicator of the quality of maternal healthcare.[2] The global prevalence of maternal near miss is estimated to be 18.67/1000.[3] The prime causes of maternal near miss are obstetric difficulties, including severe hemorrhage, hypertensive diseases such as pre-eclampsia and eclampsia, sepsis, obstructed labor, and pre-existing medical illnesses such as cardiovascular disease, diabetes, and anemia.[4]

India accounts for a significant proportion of the global maternal mortality burden, with an estimated maternal mortality ratio (MMR) of 103 per 100,000 live births.[5] Despite ongoing efforts through programs like Janani Suraksha Yojana and Pradhan Mantri Surakshit Matritva Abhiyan, disparities persist due to socio-economic, cultural, and systemic challenges. MNM cases are estimated to be 5-15 times more frequent than maternal deaths and offer a valuable proxy to assess the quality of care.[6] In India, the incidence of MNM cases was observed to be 2.56% and the MNM ratio was observed to be 25.66 per 1000 live births.[7] Understanding the characteristics, risk factors, and outcomes of MNM can lead to actionable insights into the preventable causes of maternal morbidity and mortality.

Tertiary care hospitals play a pivotal role in the management of high-risk pregnancies and obstetric emergencies. As referral centers, these hospitals are equipped to manage complex cases, making them ideal settings for studying ONM and maternal mortality. Conducting a prospective study in such a setting allows for the collection of real-time data, minimizing recall bias and providing comprehensive insights into patient management and outcomes. In this backdrop, the present study was carried out to evaluate the causes of maternal near miss and maternal mortality. In addition, intervention for improving health care was evaluated, and the factor which led to the delay in the management of cases was studied at the patient, referral and tertiary health centre level were also assessed.

METHODS

This was an observational study conducted in the Department of Obstetrics and Gynecology, Al-Ameen Medical College and Hospital, Vijayapura, Karnataka, for a period of one year from September 2022- September 2023. The study included 863 deliveries, out of which 852 were live births. Approval from the institutional ethics committee was taken before starting of study and informed consent were obtained from all the patients.

Inclusion criteria

All pregnant women admitted to the hospital, irrespective of gestational age, who experienced severe maternal complications or obstetric emergencies (e.g., severe hemorrhage, hypertension, sepsis). Women with postpartum complications within 42 days of delivery. Women referred from peripheral health facilities with life-threatening pregnancy-related complications.

Exclusion criteria

Women not willing to participate or unable to provide informed consent (where applicable). Women admitted for gynecological conditions unrelated to pregnancy (e.g., ovarian cysts, uterine fibroids). Women who presented for routine antenatal check-ups without any complications.

Operational definitions

Maternal mortality

Death of a woman during pregnancy or within 42 days of termination of pregnancy (regardless of the duration and site of the pregnancy) from any cause related to or aggravated by pregnancy or its management, but not from accidental or incidental causes (WHO definition).[8]

Maternal near-miss (MNM)

A woman who nearly died but survived a complication during pregnancy, childbirth, or within 42 days of termination of pregnancy (WHO definition).[9]

The WHO recommends identifying near-miss events based on three categories of criteria, which include clinical findings, laboratory test results, and management-based interventions that point to organ dysfunction or life-threatening conditions.

The specific criteria include:

Cardiovascular dysfunction

Shock (systolic BP<90 mmHg for ≥60 minutes despite fluid resuscitation), cardiac arrest, use of continuous vasoactive drugs, cardiopulmonary resuscitation.

Respiratory dysfunction

Acute cyanosis, gasping, respiratory rate >40 breaths/minutes or <6 breaths/minutes for ≥60 minutes, O_2 saturation <90% for ≥60 minutes despite oxygen administration, intubation and ventilation (unrelated to anesthesia).

Renal dysfunction

Oliguria (<30 ml/hour for ≥4 hours or <400 ml/24 hours), creatinine ≥300 µmol/l (≥3.5 mg/dl), dialysis for acute renal failure.

Coagulation/DIC dysfunction

Failure to form clots, requirement of ≥4 units of blood transfusion to maintain hemodynamic stability, severe acute thrombocytopenia

Hepatic dysfunction

Jaundice in the presence of pre-eclampsia, severe acute hyperbilirubinemia (bilirubin >6.0 mg/dl or >100 µmol/l).

Neurological dysfunction

Prolonged unconsciousness (≥12 hours), stroke, uncontrolled fits/status epilepticus, total paralysis.

Uterine dysfunction

Hysterectomy due to infection or hemorrhage (attributable to the current pregnancy), pregnant women meeting any of the above organ dysfunction criteria, or other life-threatening conditions leading to critical management interventions, were classified as near-miss cases.

In addition, the following near miss indices were also calculated,

MNM incidence ratio (denotes the number of maternal near miss (MNM) cases per 1,000 live births [LB]) MNM IR = MNM/LB

Maternal near miss and mortality ratio: (proportion between maternal near miss cases and maternal deaths). Better care is indicated by higher ratio (MNM: MD)

Mortality index (MI): (number of maternal deaths divided by the number of women with life threatening conditions, expressed as a percentage). [MI = MD/(MNM + MD)].

Statistical analysis

The collected data were statistically assessed using SPSS version 25. Quantitative data was represented by the mean, whereas qualitative data was represented as a percentage.

RESULTS

In the study period of 1 year, the total number of deliveries was 863, out of which 852 were live birth. Among women, there were a total of 67 cases who met the WHO MNM identification criteria, one of whom had mortality and 66 experienced near-miss cases. In the present study the MNM incidence ratio was 78.7 per 1000 live births and the mortality index was 1.4%.

Table 1: Demographics and clinical characteristics of MNM pregnant women (n=67).

Parameters	Maternal near miss (n=67)
Age (years) (mean±SD)	26.49±5.08
Age group (N, %)	
18-25 years	32 (47.8)
26-30 years	18 (26.9)
>30 years	17 (25.4)
Parity (N, %)	
Primipara	32 (47.8)
Multipara	35 (52.2)
Booking status (N, %)	
Booked	18 (26.9)
Booked out	20 (29.9)
Unbooked	29 (43.3)
Period of gestation (POG) (weeks)	35.90±3.95
POG (N, %)	
<28 weeks	3 (4.5)
28-31+6 weeks	4 (6.0)
32-33+6 weeks	2 (3.0)
34-36+6 weeks	20 (29.9)
≥37 weeks	38 (56.7)

The demographics and clinical characteristics of the MNM cases were shown in Table 1. In this near-miss cohort (n=67), the mean age was 26.49±5.08 years, with nearly half (47.8%) between 18-25 years. Parity was almost balanced between primiparous (47.8%) and multiparous (52.2%), indicating susceptibility across both groups. Regarding antenatal care, 43.3% were unbooked, underscoring the need for consistent follow-up. Meanwhile, only 26.9% had formal booking at the study institution, and 29.9% had booked out. The mean period of gestation was 35.90±3.95 weeks and majority of patients had term pregnancy (56.7%).

The risk factors for the maternal near miss among the pregnant women were shown in Table 2. In the present study, the major risk factor for MNM was preeclampsia in 29.9%, followed by APH in 16.4%, eclampsia and surgical site infection (SSI) in 13.4% of cases respectively.

The various interventions for the maternal near miss pregnant women were shown in table 3. In this study out of 67 MNM cases, 55.2% had high dependency unit (HDU) admission and 14.9% had ward admission. Hysterectomy and transfusion were done in 13.4% of the patients and HDU admission + transfusion (>5 units) was done in 3% of the patients.

Table 2: Risk factors for maternal near miss among the pregnant women.

Risk factors	Frequency	Percentage
Preeclampsia	20	29.9
Antepartum	11	16.4
Eclampsia	9	13.4
SSI	9	13.4
Severe anemia	7	10.4
Heart disease	5	7.5
PPH	4	6.0
HIV	1	1.5
Thrombocytopen	1	1.5

Table 3: Pattern of interventions in maternal near miss pregnant women.

Intervention	Frequency	Percentage
HDU admission	37	55.2
Ward admission	10	14.9
Hysterectomy	9	13.4
Transfusion	9	13.4
HDU admission + transfusion (>5 units)	2	3.0

Table 4: Factors related to the level of delay among the maternal near miss pregnant women.

Level of delay	Frequency	Percentage
From patient side	31	46.3
From referral side	26	38.8
From hospital side	10	14.9

The level of delay was shown in Table 4. Among the MNM pregnant women, 46.3% of the participants had the level of delay from the patient side, 38.8% of the participants had the level of delay from referral side and 14.9% of the participants had the level of delay from the hospital side.

The association between the risk factors for MNM and demographics and clinical variables was shown in Table 5. In this study, among the MNM cases the period of gestation was lower in 32.71±6.52 in women with severe anemia when compared to other risk factors such as preeclampsia, SSI, APH and it was significant (p=0.04). The incidence of HDU admission was higher for preeclampsia (100%), heart disease (100%) and ward admission was higher for severe anemia (100%), meanwhile the incidence of hysterectomy was higher in APH (81.8%) and transfusion was higher in severe anemia (100%) when compared to other risk factors and it was significant (p<0.001). The patient side level of delay was higher for heart disease (80%), preeclampsia (65%), HIV (100%) thrombocytopenia (100%) and the referral side delay was higher for severe anemia (85.7%) and the hospital side delay was higher for PPH (50%) and the overall association was found to be significant (p=0.006).

In the present study, the near miss incidence ratio was higher for preeclampsia and eclampsia cases (34.03%) followed by haemorrhage (17.60%). This study shows that, our hospital has high occurrence of cases of near-miss where the highest involves preeclampsia and eclampsia patients followed by those diagnosed with haemorrhage. The results were shown in Table 6.

Table 5: Association between maternal near miss risk factors and demographics and clinical variables.

Parameters	Risk factors (%)									P value
	Preeclampsia (n=20)	APH (n=11)	Eclampsia (n=9)	SSI (n=9)	Severe anemia (n=7)	Heart disease (n=5)	PPH (n=4)	HIV (n=1)	Thrombocytopenia (n=1)	
Age (years)	26.35±5.09	25.55±4.39	26.89±5.13	25.67±5.94	28.86±5.21	27.20±4.60	29.00±5.89	21.00±0	19.00±0	0.46[1NS]
Age group (years)										
18-25	10 (50.0)	6 (54.5)	3 (33.3)	5 (55.6)	2 (28.6)	2 (40.0)	2 (50.0)	1 (100.0)	1 (100.0)	0.98[2NS]
26-30	5 (25.0)	3 (27.3)	3 (33.3)	2 (22.2)	3 (42.9)	2 (40.0)	0 (0.0)	0 (0.0)	0 (0.0)	
>30	5 (25.0)	2 (18.2)	3 (33.3)	2 (22.2)	2 (28.6)	1 (20.0)	2 (50.0)	0 (0.0)	0 (0.0)	
Parity										
Primipara	11 (55.0)	5 (45.5)	4 (44.4)	4 (44.4)	3 (42.9)	2 (40.0)	2 (50.0)	1 (100.0)	0 (0.0)	0.99[2NS]
Multipara	9 (45.0)	6 (54.5)	5 (55.6)	5 (55.6)	4 (57.1)	3 (60.0)	2 (50.0)	0 (0.0)	1 (100.0)	
Booking status										
Booked	5 (25.0)	4 (36.4)	4 (44.4)	2 (22.2)	2 (28.6)	1 (20.0)	0 (0.0)	0 (0.0)	0 (0.0)	0.33[2NS]
Booked out	7 (35.0)	2 (18.2)	3 (33.3)	1 (11.1)	1 (14.3)	4 (80.0)	1 (25.0)	0 (0.0)	1 (100.0)	
Unbooked	8 (40.0)	5 (45.5)	2 (22.2)	6 (66.7)	4 (57.1)	0 (0.0)	3 (75.0)	1 (100.0)	0 (0.0)	
POG (weeks)	36.95±2.31	33.36±5.57	36.22±1.86	38.33±1.41	32.71±6.52	35.00±3.67	36.50±2.65	38.00±0	40.00±0	0.04[1]*
POG (weeks)										
<28	0 (0.0)	2 (18.2)	0 (0.0)	0 (0.0)	1 (14.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0.76[3NS]
28-31+6	1 (5.0)	1 (9.1)	0 (0.0)	0 (0.0)	1 (14.3)	1 (20.0)	0 (0.0)	0 (0.0)	0 (0.0)	
32-33+6	0 (0.0)	0 (0.0)	1 (11.1)	0 (0.0)	1 (14.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
34-36+6	7 (35.0)	3 (27.3)	4 (44.4)	1 (11.1)	2 (28.6)	1 (20.0)	2 (50.0)	0 (0.0)	0 (0.0)	
≥37	12 (60.0)	5 (45.5)	4 (44.4)	8 (88.9)	2 (28.6)	3 (60.0)	2 (50.0)	1 (100.0)	1 (100.0)	
Intervention										<0.001[3]*

Continued.

Parameters	Risk factors (%)									P value
	Preeclampsia (n=20)	APH (n=11)	Eclampsia (n=9)	SSI (n=9)	Severe anemia (n=7)	Heart disease (n=5)	PPH (n=4)	HIV (n=1)	Thrombocytopenia (n=1)	
HDU admission	20 (100.0)	1 (9.1)	9 (100.0)	0 (0.0)	0 (0.0)	5 (100.0)	2 (50.0)	0 (0.0)	0 (0.0)	
Ward admission	0 (0.0)	0 (0.0)	0 (0.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	
Hysterectomy	0 (0.0)	9 (81.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Transfusion	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	7 (100.0)	0 (0.0)	1 (25.0)	0 (0.0)	1 (100.0)	
HDU admission + transfusion	0 (0.0)	1 (9.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (25.0)	0 (0.0)	0 (0.0)	
Level of delay										
From patient side	13 (65.0)	3 (27.3)	3 (33.3)	3 (33.3)	1 (14.3)	4 (80.0)	2 (50.0)	1 (100.0)	1 (100.0)	0.006[3]*
From referral side	6 (30.0)	8 (72.7)	3 (33.3)	2 (22.2)	6 (85.7)	1 (20.0)	0 (0.0)	0 (0.0)	0 (0.0)	
From hospital side	1 (5.0)	0 (0.0)	3 (33.3)	4 (44.4)	0 (0.0)	0 (0.0)	2 (50.0)	0 (0.0)	0 (0.0)	

*Significant at p<0.05, [1]Kruskal Wallis Test, [2]Fisher's Exact Test, [3]Chi-Square Test, NS: non significant

Table 6: MNM incidence ratio (per 1000 live births).

Risk factors	Total near miss cases	Near miss cases 1000 live births
Preeclampsia/ eclampsia	29	34.03
Hemorrhage	15	17.6
SSI	9	10.56
Anemia	7	8.21
Heart Disease	5	5.86
Others, HIV and thrombocytopenia	2	2.34

DISCUSSION

Maternal near-miss (MNM) events serve as critical indicators of healthcare quality, offering insights into the gaps in maternal care systems. In this study, conducted at Al-Ameen Medical College and Hospital in Vijayapura, Karnataka, a total of 67 MNM cases were identified over a one-year period from 852 live deliveries, which equates to an MNM incidence ratio of 78.7 per 1000 live births. In the present study the MNM incidence ratio was higher when compared to the other Indian studies. In a study conducted by Sunanda et al in Karnataka the MNM incidence ratio was 18.76/1000 live birth.[10] In another study conducted by Kulkarni et al at two tertiary healthcare centers in Mumbai the MNM incidence ratio was 60.4/1000 live birth.[11] However, in low resource countries like Ethiopia the pooled prevalence of MNM was 140/1000.[12]

In the present study, the mean age of the MNM cases 26.49±5.08 years, with a large proportion (47.8%) being between 18-25 years, and almost equal distribution between primiparous and multiparous women. This suggests that maternal near-miss is a significant concern across different age groups and parity levels, with an ongoing need for early intervention and risk monitoring. In the present study, majority of MNM cases, 56.7% had period of gestation more than 37 weeks. Likewise, in a study done by Kulkarni et al the mean age of the pregnant women with MNM was 26±4.2 years and majority of the MNM cases, 43% were in the age range of 25-30 years.[13] In a study done by Ramalingappa et al majority of the MNM cases, 40.8% were in term gestation.[7] The study highlights that preeclampsia was the leading risk factor for maternal near miss (MNM), affecting 29.9% of cases, which aligns with global findings emphasizing hypertensive disorders as major contributors to maternal morbidity. Antepartum hemorrhage (APH) followed at 16.4%, further underscoring the critical role of bleeding complications in maternal near-miss events. Eclampsia and surgical site infections (SSI) were each present in 13.4% of cases, reflecting the significant burden of both hypertensive disorders and infection-related complications in high-risk pregnancies. These results underscore the importance of early detection, timely intervention, and better management of these complications to prevent severe maternal morbidity. Enhanced antenatal monitoring, especially for women at risk of preeclampsia and APH, could potentially reduce MNM outcomes. Additionally, improving infection control practices during and after delivery can mitigate the occurrence of SSIs. Likewise, in a study conducted in Ghana at three centers, preeclampsia is the major cause for maternal near miss encompassing 39.2%, followed by hemorrhage in 12.1% of the cases.[4] Likewise, in a study done by Bhaskar et al the major risk factor for MNM is preeclampsia in 26.15% of the cases, followed by severe anemia in 12.39% and Atonic PPH in 9.63% of the cases.[14]

The interventions in this study reveal the severity of maternal near-miss (MNM) cases, with the majority (55.2%) requiring admission to the high dependency unit (HDU), indicating the need for intensive monitoring and care. A smaller proportion (14.9%) needed ward admission, suggesting that not all MNM cases were critical

enough to require HDU-level care. The fact that 13.4% of women underwent hysterectomy and the same percentage required blood transfusions highlights the significant surgical and hemodynamic interventions necessary in such cases. Additionally, 3% of the patients required both HDU admission and transfusion of more than 5 units of blood, indicating life-threatening conditions necessitating complex care. These findings stress the importance of prompt, specialized care and sufficient medical resources to manage severe maternal complications. In a study done by Bhadra et al.15 39.47% of MNM cases requires HDU admission and in another study done by Chhabra et al reported that the hysterectomy is the most prevalent procedure in 54% of the MNM cases.[16]

The present study findings highlight significant delays in the management of maternal near-miss (MNM) cases, with the highest proportion of delays (46.3%) occurring at the patient level. This suggests that factors such as lack of awareness, reluctance to seek care, or socio-economic barriers may contribute to late presentation. Delays from the referral side (38.8%) emphasize issues in transferring patients from peripheral health facilities to tertiary centers, potentially due to inadequate transport or communication. A smaller proportion (14.9%) experienced delays from the hospital side, indicating areas for improvement in hospital preparedness and response. Addressing delays at all levels is crucial to reducing maternal morbidity and improving outcomes for women experiencing severe complications during pregnancy. Likewise, in a study done by Chainani and Nandanwar, majority of the delay is from patient's side in 48.6% of the maternal near miss cases.[17]

The study found that women with severe anemia had a significantly lower period of gestation (32.71±6.52 weeks) compared to other risk factors like preeclampsia, APH, and SSI, indicating that anemia may lead to earlier complications in pregnancy. The need for HDU admission was highest in cases of preeclampsia and heart disease (100%), highlighting the severe nature of these conditions, while severe anemia led to a higher rate of ward admission (100%) and blood transfusions (100%). The incidence of hysterectomy was significantly higher in APH cases (81.8%), suggesting the need for surgical intervention in severe hemorrhage situations. Delays in care were most pronounced from the patient side in heart disease, preeclampsia, and HIV, and from the referral side in severe anemia, indicating key areas where timely action could prevent adverse outcomes. Overall, the significant associations between these variables emphasize the importance of early detection and efficient management at all levels of care. Previous reports indicate that the maternal anemia is associated with the increased risk (OR: 3.43) of preterm birth.[18] In a study done by Zhang et al 55.4% of the MNM cases underwent hysterectomy and it is usually done during massive hemorrhagic shock.[19] Studies also indicate that APH is one of the prominent risk factors for near miss.[20]

The study reveals that preeclampsia and eclampsia accounted for the highest near-miss incidence ratio (34.03%), indicating a significant prevalence of hypertensive disorders as major contributors to maternal morbidity in the hospital. Hemorrhage followed with a near-miss incidence of 17.60%, highlighting the serious risks posed by bleeding complications. In a study done by Gupta et al the MNM incidence /1000 live birth for preeclampsia and hemorrhage were 3.97 and 6.61 respectively.[21]

Limitations of study include ICU facilities were available few potentially life-threatening conditions before going on to near might have been selected. Our institute mostly receive hypertension in pregnancy, hemorrhagic and sepsis patients, so other causes of maternal near miss which might have been contribute an important part have missed.

CONCLUSION

The reasons for maternal near-miss cases in this study were primarily attributed to factors such as ignorance, lack of awareness about maternal health, inadequate human resources, and the absence of essential medical equipment in the ICU and blood bank at peripheral hospitals. One significant non-medical factor contributing to these near-misses is the delays in care at various levels. Addressing these delays is crucial in reducing maternal morbidity and mortality. Based on the results, it is clear that hypertension and hemorrhage were the leading causes of near-miss events, followed by sepsis and anemia. This highlights the importance of early detection and timely management of these complications. Maternal near-miss analysis serves as a valuable tool for assessing the quality of healthcare and identifying areas for improvement. It emphasizes the need for every healthcare institution to conduct regular audits to enhance maternal health outcomes.

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