International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Nair PS et al. Int J Reprod Contracept Obstet Gynecol. 2025 Oct;14(10):3275-3280
www.ijrcog.org
pISSN 2320-1770 | eISSN 2320-1789

DOI: https://dx.doi.org/10.18203/2320-1770.ijrcog20253070

Original Research Article

Maternal near miss events in a tertiary care teaching hospital: a prospective analysis of risk factors, clinical outcomes and healthcare system performance

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Received: 20 August 2025
Revised: 18 September 2025
Accepted: 19 September 2025

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ABSTRACT

Background: Maternal health is a critical indicator of a nation's overall health and development. Maternal near miss (MNM) cases, defined as women who nearly died but survived a life-threatening complication during pregnancy or childbirth, offer valuable insights into improving maternal healthcare systems.
Methods: A comprehensive analysis was conducted at a tertiary care teaching hospital to identify MNM cases using world health organization's (WHO) standardized criteria, which include clinical, laboratory, and management-based indicators. Data on the frequency, causes, and outcomes of MNM events were collected and analyzed to assess the quality of care provided. The study was a prospective design, conducted for 6 months from January 2024 to June 2024, involving 50 participants.
Results: The study found that hemorrhage, hypertensive disorders, and sepsis were the most common causes of MNM. Early identification and timely intervention were crucial in preventing progression to maternal death. The study also highlighted the impact of health system factors, such as accessibility to emergency obstetric care and the availability of skilled healthcare providers, on the incidence of MNM. Blood transfusion was the most common life-saving intervention (30%), and 64% of cases were pregnancy-related.
Conclusions: MNM cases occur more frequently than maternal deaths and provide a larger sample size for analysis, leading to improved maternal care and reduced maternal mortality. The findings underscore the importance of enhancing healthcare infrastructure, training healthcare providers, and implementing evidence-based interventions to improve maternal outcomes.

Keywords: Maternal health, Maternal near miss, Tertiary care hospital, Obstetrics, Gynaecology

INTRODUCTION

Maternal health is a critical indicator of a nation's overall health and development. Despite global efforts, maternal mortality remains a pressing concern, particularly in developing countries.[1,2] MNM cases, defined as "a woman who nearly died but survived a complication that occurred during pregnancy, childbirth, or within 42 days of termination of pregnancy," have gained prominence as a valuable tool for assessing and improving maternal healthcare.[3] These cases offer crucial insights into the

challenges and shortcomings of maternal healthcare systems, providing opportunities for targeted interventions and improvements.

The study of MNM cases is particularly important in tertiary care teaching hospitals, which often serve as referral centers for complex and high-risk pregnancies.[4,5] These institutions play a pivotal role in managing severe maternal complications and are ideally positioned to contribute to the body of knowledge on MNM events. By analyzing the patterns, causes, and outcomes of near miss cases, healthcare providers and policymakers can develop evidence-based strategies to enhance maternal care and reduce both morbidity and mortality.[6]

The WHO introduced standardized definitions and criteria for MNM in 2009 to facilitate consistent reporting and analysis.[7] These criteria categorize MNM cases into three groups: clinical, laboratory, and management-based. Understanding how factors within the healthcare system interact with MNM events can provide crucial insights for improving care, not only within the institution but also in the broader healthcare system.[8,9]

From a research perspective, studying MNM in a tertiary care setting contributes significantly to the global body of knowledge on maternal health.[10] These institutions are often equipped to conduct in-depth clinical and epidemiological investigations, potentially leading to new insights into the pathophysiology of severe maternal complications and innovative approaches to their management.

This study aims to identify the causes of maternal morbidity and mortality, specifically focusing on MNM events, when appropriately managed to reduce maternal mortality and adverse outcomes.[11]It seeks to uncover valuable information that can inform clinical practice, health policy, and medical education, ultimately contributing to the reduction of maternal morbidity and mortality and aligning with global efforts to ensure safe motherhood for all women.[12,13]

METHODS

Study setting

The present study was carried out among patients admitted to the obstetrics and gynecology department of government Vellore medical college and hospital.

Study design

The study utilized a prospective design.

Study duration

The study was conducted over a period of 6 months, from January 2024 to June 2024.

Sample size

A total of 50 participants were included in the study.

Selection criteria for patients

The criteria for identifying an MNM case followed the WHO standardized definition, requiring at least three criteria, with one from each category[7]:

Clinical findings: This includes severe complications such as severe pre-eclampsia, eclampsia, severe postpartum hemorrhage, severe sepsis or systemic infection, and uterine rupture.[14,15]

Laboratory-based criteria: Abnormal laboratory results indicating organ dysfunction or severe disease, such as severe anemia (hemoglobin <4 g/dL), jaundice in the presence of pre-eclampsia, or elevated creatinine levels indicating renal impairment.[16]

Management-based criteria: These focus on the type and intensity of medical interventions required to save the woman's life, including admission to an intensive care unit (ICU), massive blood transfusion (≥5 units of blood), hysterectomy due to complications, or the use of vasoactive drugs for shock management.[17]

Any single criterion that signified cardio respiratory collapse was considered an exclusion criterion.

Ethical consideration

Institutional ethical committee approval was obtained from the institutional ethical and scientific committee of govt. Vellore medical college, Vellore-11, with registration number ECR/1215/Inst/TN/2019. The approval was granted on January 23, 2024. Informed written consent was obtained from each participant, and they were fully informed about the nature, purpose, procedures, risks, and benefits of the research. Participants were assured of their voluntary participation and the right to withdraw from the study at any time without penalty. The study ensured confidentiality and adherence to ethical guidelines for human subjects research.[18]

Data collection

Data collection was carried out among patients admitted to the obstetrics and gynaecology department of Vellore medical college and hospital. A pre-tested questionnaire was used to collect data from the cases.

Analysis plan

The collected data was entered into Microsoft excel 19, and statistical analysis was performed using SPSS version 23. Continuous variables were presented as mean and standard deviation, while categorical variables were presented as frequency distribution and percentage.

Association among categorical variables was tested using the chi-square test and Fisher exact test. An independent t-test was used to determine the difference between means.

RESULTS

Participant demographics revealed a diverse age distribution, with the largest group, representing 26% (13 participants), falling between 18-25 years (Table 1). The 26-30 years and 36-40 years age groups each accounted for 20% (10 participants and 10 participants, respectively), while participants over 40 years comprised 24% (12 participants). The smallest age group was 31-35 years, making up 14% (7 participants) of the sample. In terms of parity, the study sample showed a relatively even distribution among most parity groups. The largest groups were those with parity of 2 and 4, each accounting for 22% (11 participants) of the total sample. Nulliparous women (those who had never given birth) constituted 16% (8 participants), while women with parity of 1 and 3 each represented 20% (10 participants).

Regarding educational status, the majority of participants, 62% (31 participants), had attained at least a secondary level of education. Specifically, 38% (19 participants) completed secondary education, and 24% (12 participants) had college-level education or above. A smaller proportion, 18% (9 participants), completed primary education, and 20% (10 participants) had no formal education. The study sample was almost evenly split between rural and urban residents, with 52% (26 participants) from urban areas and 48% (24 participants) from rural areas. The educational attainment of the participants' husbands showed that 36% (18 individuals) had primary education, making it the most prevalent group. Those with college education or higher comprised 34% (17 husbands), followed by secondary education at 20% (10 husbands), and 10% (5 husbands) with no formal education. Family income distribution was also evenly split, with 36% (18 families) reporting income less than 5000 units and an equal percentage (36%, 18 families) within the 5000-10000 income range. The remaining 28% (14 families) reported income exceeding 10000 units.

Regarding obstetric factors and complications, 52% (26 participants) reported previous obstetric complications, while 48% (24 participants) had no such history (Table 2). A significant proportion of participants, 54% (27 individuals), experienced a referral delay, highlighting a critical gap in the healthcare continuum. Participants' awareness of pregnancy complications was mixed, with 52% (26 participants) reporting awareness and 48% (24 participants) lacking awareness. Additionally, 52% (26 participants) reported attending regular antenatal care (ANC) visits, while 48% (24 participants) did not. The modes of delivery among the participants were varied: lower segment cesarean section (LSCS) was the most common mode at 38% (23 cases), followed by vaginal delivery at 32% (19 cases), and abortions accounting for 30% (8 cases).

The causes of near-miss events were diverse, with hemorrhage identified as the leading cause, accounting for 22% (11 cases). This was closely followed by anemia and hypertension, each responsible for 18% (9 cases). Sepsis was the fourth most common cause, at 16% (8 cases). Cardiac disease contributed to 10% (5 cases), respiratory issues for 6% (3 cases), and ectopic pregnancy and other unspecified causes each accounted for 4% (2 cases). Renal complications were the least common cause, with only 2% (1 case).

Life-saving interventions provided to participants varied, with blood transfusion being the most common, required in 30% (15 cases). Inotropic support was necessary in 20% (10 cases), while intubation and emergency laparotomy were each required in 10% (5 cases). Peripartum hysterectomy was performed in 4% (2 cases), and hemodialysis was the least common, required in 2% (1 case). Additionally, 14% (7 participants) required more than one of these interventions. The length of ICU stay varied among participants: 48% (24 individuals) stayed for 4-7 days, 28% (14 participants) for 1-3 days, and 24% (12 participants) required more than 7 days of ICU care.

Finally, the broad categorization of maternal near-miss cases revealed that the majority, 64% (32 out of 50 cases), were directly related to pregnancy. Pre-existing conditions accounted for 28% (14 cases), and incidental conditions constituted 8% (4 cases). These findings underscore the complex and multifaceted nature of maternal near-miss events.

Table 1: Baseline characteristics of the patients with MNM, (n=50).

Variables	N	Percentage (%)
Age (in years)		
18-25	13	26
26-30	5	10
31-35	7	14
36-40	13	26
>40	12	24
Parity		
Nulliparous	8	16
Gravida 1	10	20
Gravida 2	11	22
Gravida 3	10	20
Gravida 4	11	22
Family income (in INR)		
<5000	18	36
5000-10000	18	36
>10000	14	28
Referral delay		
Yes	27	54
No	23	46
Mode of delivery		
Abortion	8	16
Vaginal	19	38
LSCS	23	46

Table 2: Causes and outcomes in patients with MNM, (n=50).

Variables	N	Percentage (%)
Causes of MNM		
Hemorrhage	11	22
Anemia	9	18
Hypertension	9	18
Sepsis	8	16
Cardiac disease	5	10
Respiratory	3	6
Ectopic	2	4
Others	2	4
Renal	1	2
ICU stay		
1-3 days	14	28
4-7 days	24	48
>7 days	12	24
Live saving interventions		
Hemodialysis	1	2
Blood transfusion	15	30
Peripartum hysterectomy	2	4
Intubation	5	10
Inotropes support	10	20
Emergency laparotomy	5	10
More than 1 of the above interventions	7	14
Broad categorization of MNM		
Pregnancy related	32	64
Pre-existing conditions	14	28
Incidental conditions	4	8

DISCUSSION

Maternal near-miss events represent a critical area of study in obstetrics and gynecology, offering valuable insights into the factors that contribute to severe maternal morbidity and potential mortality.[19,20] This study, encompassing 50 cases of maternal near-miss, provides a nuanced perspective on the characteristics, risk factors, and outcomes associated with these events.

Demographics and socioeconomic factors

The age distribution of participants in this study reveals important patterns. A significant proportion of women over 35 (50% combined for 36-40 and >40 groups) underscores the increased risks associated with advanced maternal age, a trend consistently reported in global literature.[21]The parity distribution in our study presents an interesting contrast to some existing research, with 16% being nulliparous and the majority (84%) having had 1-4 previous pregnancies. This finding diverges from some studies where multiparous women are a significant risk factor for maternal near-miss.[22] The educational status analysis highlights a diverse range of educational backgrounds, with the majority (62%) having attained at least a secondary level of education, indicating a relatively well-educated sample overall. The near-even split between rural (48%) and urban (52%) residents is noteworthy, as many studies report higher rates of maternal complications in rural areas due to limited access to healthcare facilities.[23]This warrants further investigation into specific barriers to maternal healthcare in both settings. The family income data reveals that 72% of participants had a monthly income of Rs. 10,000 or less, indicating a significant portion of the study population comes from lower-income backgrounds. This aligns with the well-established link between poverty and adverse maternal outcomes, as documented by the WHO.[2]

Obstetric factors and complications

The high rate of previous obstetric complications (52%) among participants underscores the importance of comprehensive ANC and risk assessment.[14] Regular ANC visits revealed that only 52% of participants attended at least eight ANC visits, which falls short of the WHO recommendation.[15] This indicates a missed opportunity for early detection and management of pregnancy-related complications. The mode of delivery statistics provides valuable insights, with a high rate of cesarean sections (32%) among near-miss cases, consistent with global trends of increasing cesarean rates in high-risk pregnancies.[16] The significant proportion of abortion cases (30%) among the near-miss events is particularly alarming, highlighting unsafe abortion practices or underlying health conditions exacerbated by pregnancy termination.[17]

Causes of near-miss events

The distribution of causes for near-miss events in our study provides crucial information for targeting interventions. Hemorrhage emerged as the leading cause (22%), followed by hypertensive disorders and anemia (18% each), and sepsis (16%). These findings align with global data on the major causes of maternal mortality and morbidity, as reported by Say et al in a systematic review for the WHO.[24] The high incidence of hemorrhage-related near-miss events highlights the ongoing need for improved blood banking services, skills in active management of the third stage of labor, and timely recognition and management of postpartum hemorrhage.[25] The substantial proportion of sepsis cases (16%) is alarming and may indicate gaps in aseptic practices, delayed recognition of infections, or antibiotic resistance issues.[26] The presence of cardiac disease (10%) and respiratory complications (6%) among the causes of near-miss events highlights the importance of multidisciplinary care in managing high-risk pregnancies.[27]

Awareness and healthcare-seeking behavior

The data on awareness of pregnancy complications presents a mixed picture, with 52% of participants

reporting awareness and 48% lacking awareness. This near-even split suggests that while health education efforts have reached a significant portion of the population, there remains substantial room for improvement.[28] The high rate of referral delay (54%) is a critical finding that points to potential gaps in the healthcare system. Delays in referral can significantly impact maternal outcomes, as timely intervention is often crucial in preventing near-miss events from progressing to maternal deaths.[29]

Interventions and ICU care

The data on life-saving interventions provides insight into the critical care needs of near-miss cases. Blood transfusion was the most common intervention (30%), reflecting the high incidence of hemorrhage and anemia.[30] The substantial proportion of cases requiring inotropic support (20%) and emergency laparotomy (10%) highlights the severity of the near-miss events and the need for advanced critical care facilities in managing these cases. The length of ICU stay data, with 48% of cases requiring 4-7 days of ICU care and 24% needing more than the seven days, underscores the severe nature of these near-miss events and the resource-intensive care they require.[31]

Broad categorization and implications

The broad categorization of near-miss cases reveals that 64% were directly related to pregnancy, 28% were due to pre-existing conditions, and 8% were incidental. This distribution highlights the multifaceted nature of maternal near-miss events and the need for a comprehensive approach to maternal health.[32] The substantial percentage of cases attributed to pre-existing conditions (28%) highlights the growing importance of preconception care and medical optimization before pregnancy.[33]

CONCLUSION

This prospective study of maternal near-miss cases enriches current knowledge by delineating hemorrhage, hypertensive disorders, and sepsis as key preventable causes of severe morbidity. It advances understanding of how systemic factors such as referral delays and inadequate ANC critically shape maternal outcomes in resource-limited settings. By systematically applying WHO near-miss criteria, the study strengthens standardized reporting and enables meaningful international comparisons. Overall, this work identifies actionable intervention points across the continuum of care, supporting policy development and clinical practice improvements in maternal health.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee Ethical approval: Available (VMC /P / II / 0005 / 2024)

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Cite this article as: Nair PS, Kathiresan S, Periyasaame A, Mariantony EP, Jebanesan AP. Maternal near miss events in a tertiary care teaching hospital: a prospective analysis of risk factors, clinical outcomes and healthcare system performance. Int J Reprod Contracept Obstet Gynecol 2025;14:3275-80.