Maternal near miss hospitalizations in the Borana Zone, Ethiopia: A facility-based longitudinal cross-sectional study

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Maternal near miss refers to a situation in which a woman experiences a severe complication during pregnancy, childbirth, or postpartum but survives. While there has been considerable progress in reducing maternal mortality rates, maternal near miss cases can provide valuable insights into the quality of maternal healthcare and help identify areas for improvement. However, there is limited research on the factors contributing to maternal near miss cases, including health system failures, delays in care, and provider-related factors. Therefore, this study aimed to assess the incidence, causes, and factors associated with maternal near misses in public Hospitals.

Abstract

Background: Maternal near miss refers to a woman who nearly died but survived a complication that occurred during pregnancy, childbirth, or within 42 days of pregnancy termination. While there has been considerable progress in reducing maternal mortality rates, maternal near miss cases can provide valuable insights into the quality of maternal healthcare and help identify areas for improvement. However, there is limited evidence on the factors contributing to maternal near miss cases, including health system failures, delays in care, and provider-related factors. Therefore, this study aimed to assess the incidence, causes, and factors associated with maternal near misses in public Hospitals of Borena Zone.

Methods: A facility-based longitudinal cross-sectional study design was employed at four Public Hospitals in Borena Zone from August 15, 2022, to November 15, 2022, using the WHO criteria for maternal near miss event. In total, 117 participants were included in the study. Eligibility was determined using key clinical, organ dysfunction, laboratory, and management criteria, as per the WHO guidelines for near-miss events. Underlying and contributing causes of maternal near misses were documented from each participant's records.

Result: There were 1421 deliveries during the study period and 117 eligible women developed potentially life-threatening conditions. Only 61 women experienced severe maternal outcomes (55 near misses and six maternal deaths). The maternal near miss incidence ratio was 38.7 per 1000 live births, with a mortality index of 9.8%. Hypertensive disorders and obstetric hemorrhage are the leading underlying causes of maternal near misses.

Conclusion: The incidence of maternal near miss was remarkably high when compared to previous studies. Giving special emphasis to life-saving interventions, critical care, reducing delays and improving the referral system are critical to improve quality of care.

Keywords

Maternal near-miss, severe maternal outcome, WHO, Public Hospital, Borena

Introduction

Pregnancy-related morbidity and mortality continue to have a serious impact on the lives of women all over the world.[1,2] Sub-Saharan Africa and Southern Asia accounted for approximately 86% of the estimated global maternal deaths.[2,3] Most women who experience life-threatening complications may die, and a proportion may narrowly escape death due to a lifesaving obstetric intervention.[4] A maternal near-miss (MNM) is referred to as a woman who nearly died, but survived a complication that occurred

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during pregnancy, childbirth or within 42 days of termination of pregnancy.[4,5] Nowadays, MNM is considered a vital indicator used to monitor the quality of obstetric care services.[4] It serves as a crucial tool for determining the most common pregnancy problems, underlying risk factors, and the availability of life-saving obstetric treatments.[6,7]

According to a recent systematic review and meta-analysis study, the global prevalence of MNM was 1.4%.[8] Among the studies that have been conducted in Africa, the weighted pooled prevalence of MNM was 31.9 with significant heterogeneity between studies.[6] Near miss events are common and are estimated to be around 12 times more frequent than maternal deaths.[8–11] Studies have shown that predictors of maternal near misses are postpartum hemorrhage, pregnancy induced hypertension, sepsis, ruptured uterus, and abortion.[1,4,12]

Improving maternal health remains an important topic of sustainable development goals (SDG), which is to reduce the global Maternal Mortality Ratio (MMR) to less than 70 per 100,000 live births by 2030 and Ethiopia also intends to achieve this target by 2030.[2,13] The 2016 Ethiopian Demographic and Health Survey (EDHS) reported 412 maternal deaths per 100,000 live births.[7] Although a promising reduction had been made in past few decades, maternal near-miss, pregnancy related complications, and deaths were still exceptionally high, particularly in communities that are hard-to-reach and resources-limited areas.[4,9] Thus, it is important to have up-to-date information on the magnitude and causes of MNMs to identify areas of intervention aimed at improving maternal and perinatal health.

Material and methods

Setting

Borena Zone is one of the 21 zonal administrative divisions in the Southern Oromia region in Ethiopia. According to the 2007 Census, the zone had a female population of 475,465 representing the 49.8% of the total population of 962,489 inhabitants. It is served by five public hospitals and 44 health centers. All public hospitals in Borena Zones have been providing comprehensive emergency obstetrics care services. The study was conducted as part of a project aimed at complimenting the efforts of performance-based financing (PBF) for health project in Borena zone.

Study design

This was a facility-based longitudinal cross-sectional study at four[4] public hospitals in Borena Zone from August 15 to November 15, 2022. Participants' medical records and charts were reviewed until participants were discharged from the hospital.

Participants

This study included all women who were pregnant, in labor, or who delivered or aborted in the past 42 days arriving at the facility with complications or who developed those complications during their stay at the health facilities were included in the study. Women who developed complications after 42 days of termination of pregnancy were excluded from the study.

Variables

The main outcomes variables were MNM ratio, MNM mortality ratio and Mortality index. Additional studied variables were patients' demographics, severe complications with related underlying/contributing causes, organ dysfunction and intervention types.

Data sources/measurement

Data was collected using the WHO near-miss criteria.[4] Collected patients' demographic and prehospitalization characteristics were Age (15–24, 25–34, and $\geq$35), Residence (Urban, Rural), Marital status (Married, Single/separated/divorced), Educational status (No formal education, with formal education), Age at first marriage (<18 years, $\geq$18 years), Antenatal care (ANC: Yes, Not), Referral status (from other facility, Not referred).

Severe complications were Severe postpartum hemorrhage, Severe preeclampsia, Eclampsia, Sepsis or severe systemic infection, Ruptured uterus. Critical (intensive care unit) interventions were Use of blood products, Interventional radiology, Laparotomy, Admission to Intensive Care Unit. Organ dysfunction/life-threatening conditions were Cardiovascular dysfunction, Respiratory dysfunction, Renal dysfunction, hematologic dysfunction, Hepatic dysfunction, Neurologic dysfunction, Uterine dysfunction.

Underlying Causes of Death/Near Miss were Pregnancy with abortive outcome, Obstetric hemorrhage, Hypertensive disorders, Pregnancy-related infection. Contributing causes were Anemia, Previous cesarean section, Prolonged / obstructed labor. Treatments were Oxytocin, Ergometrine, Magnesium sulfate, Parenteral therapeutic antibiotics.

Additional outcome variables were Proportion of severe maternal outcomes occurring within 12 h of admission (SMO12) cases among all severe maternal outcomes (SMO) cases, SMO12 mortality index, Intrahospital SMO rate (per 1000 live births), Intrahospital mortality index, ICU admission rate, ICU admission rate among women with SMO, Proportion of maternal deaths occurring without ICU admission. Hospital access related variables were Delay in deciding to seek health facility (Delay one), Time to reach the hospital (Delay two), Delay at treating hospital (Delay three). All relevant dates were collected along with the referral process followed.

Data processing and Analysis

According to formulas reported in,[4] the number of women giving birth within the study period served as the denominator for the SMO ratio and the maternal near-miss ratio (MNMR). As the numerator, each of the two outcomes had the corresponding number of events. The MNM mortality

Table 1. Socio-demographic and socioeconomic characteristics of mothers with severe maternal outcome at public Hospitals in Borena Zone, Ethiopia, 2022 (*n* = 117).

Characteristics	Categories	Frequency	Percent (%)
Age	15–24	46	39.3
	25–34	57	48.8
	≥35	14	11.9
Residence	Urban	80	68.4
	Rural	37	31.6
Marital status	Married	114	97.4
	Single/separated/divorced	3	2.6
Educational status	No formal education	55	47.1
	Has formal education	62	52.9
Age at first marriage	Below 18 years	42	35.9
	18 years and above	75	64.1
ANC	Yes	89	76.1
	No	28	23.9
Referral status	Referred from other facility	75	64.1
	Not referred	42	35.9

ratio was calculated as the ratio between MNM cases and maternal deaths. The SMO12 proportion was calculated as the proportion of SMO12 cases among all SMO cases. Hospital access indicators were calculated. Intra-hospital care indicators were also calculated.

Ethical consideration

Prior to data collection ethical clearance was obtained from Oromia Health Bureau, Health Research Ethical Review Committee. The anonymity of the participants was respected via the use of medical record number (MRN) rather than the name of the participant. The names of the participants were not reported in the findings of the study to ensure confidentiality.

Results

Socio-demographic characteristics

A total of 1421 live births were recorded from all participating hospitals during the study period. A total 117 of women developed potentially life-threatening conditions. The average age of women who developed potentially life-threatening diseases was around 25.5 years old, with a standard deviation of 5.5 and most participant's age fall under the age category of 25–34. More than half (55.7%) of the cases were illiterate (had no formal education). About 23.9% of cases did not attend ANC (Antenatal Care) service. The majority (64.1%) of the cases were referred from lower health facilities (Table 1).

Morbidity condition among women with potentially life-threatening conditions

Among women presented potentially life-threatening conditions, severe pre-eclampsia (48.7%) and severe

Table 2. Morbidity conditions in the audited sample of women with potentially life-threatening conditions at public health facilities in Borena Zone, Ethiopia, 2022. (*n* = 117).

Severe complications	Frequency	Percentage (%)
Severe postpartum hemorrhage	26	22.2
Severe pre-eclampsia	57	48.7
Eclampsia	21	17.9
Sepsis or severe systemic infection	14	12.0
Ruptured uterus	2	1.7
Critical interventions		
Use of blood products	35	29.9
Interventional radiology	2	1.7
Laparotomy	10	8.5
Admission to intensive care unit	32	27.4
Organ dysfunction		
Cardiovascular dysfunction	39	33.3
Respiratory dysfunction	51	53.6
Renal dysfunction	9	7.7
Coagulation/hematologic dysfunction	6	5.1
Hepatic dysfunction	8	6.8
Neurologic dysfunction	8	6.8
Multiple organ dysfunction	43	36.7

postpartum hemorrhage (22.2%) were the leading severe maternal complications for hospitalization. A substantial number of women underwent critical interventions of which the use of blood products (29.5%) and admission to the intensive care unit (ICU) (27.4%) were the common interventions. The number of major organ dysfunctions seen in most cases were respiratory dysfunction and cardiovascular dysfunction at 53.6% and 33.3% respectively (Table 2).

Incidence of maternal near miss

From 117 women who developed potentially life-threatening conditions, 55 women experienced near misses and 6 maternal deaths. The MRM and SMO incidence ratios were 38.7 and 42.9 per 1000 live births, respectively. The MNM mortality ratio was 9.17–1 with a mortality index of 9.8% (Table 3).

Underlying and contributory causes

In this study, the leading causes of MNM were Hypertensive disorders (severe pre-eclampsia and eclampsia) 61.8% (CI; 48%−74%) and obstetric hemorrhage at 29.1% (CI; 18%− 42%). Sepsis or pregnancy related infection (66.7%) was the leading cause of maternal death. The majors contributing cause of maternal near miss (43.6%) (CI; 30%−57%) reported was anemia (Table 4).

Process or facility related indicators

Out of the total 61 SMO cases, 23 (37.7%) of women presented the life-threatening conditions on arrival or within the first 12 h of hospital admission. The mortality index (MI) of women with SMO on arrival or within the first 12 h of hospital admission was 21.7%. The intrahospital SMO12 rate was 26.7 per 1000 live births and the SMO12 mortality index was 2.6%. The ICU admission rate was 2.3%, while the ICU admission rate among women with SMO was 24.6%. Half of the maternal deaths occurred without ICU admission. All of the women with severe post-partum hemorrhage (PPH) received uterotonics where oxytocin was the most common uterotonics used. Of the 21 cases with eclampsia 20 (95.2%) received anticonvulsants in which most of the anticonvulsants given was magnesium sulfate (Table 5).

Access to health facility

A considerable number of cases encountered some form of delay in the continuum of care. This is categorized as delay one, delay two, and delay three. A total of 49 (41.88%) women out of the 117 women experiencing potentially life threatening conditions experienced delay one. The dominant reason for the first delay was lack of support from family followed by underestimating the severity of the conditions, use of herbal medication (traditional medications), and terrible experience with health systems. Regarding delay two, 63 (53%) of the cases took more than 2 h to reach the nearest health facility. Sixty (51.3%) cases encountered delay three at the referring or first health facility visited. Delay two and delay three highlight the influence of access and the referral system on women with SMO in low-resourced settings in which maternal mortality remains unacceptably high (Table 6).

Table 3. Near miss incidence and outcome indicators at public Hospitals in Borena Zone, Ethiopia, 2022 (*n* = 117).

Outcomes	Near-miss indicators
All live births in the population under surveillance	1421
Women with potentially life-threatening conditions	117
Severe maternal outcomes (SMO) cases (number)	61
Maternal deaths (*n*)	6
Maternal near-miss cases (*n*)	55
Overall near-miss indicators	
Severe maternal outcome ratio (per 1000 live births)	42.93
Maternal near-miss ratio (per 1000 live births)	38.71
Maternal near-miss mortality ratio	9.17: 1
Mortality index	9.8%

Table 4. Underlying and contributory causes of maternal near miss at public Hospitals in Borena Zone, Ethiopia, 2022 (*n* = 55).

Underlying causes and associated conditions	Maternal near-miss cases		Mortality Ratio	Mortality Index
	Number	Percent (%)	Ratio	Percent (%)
Underlying causes				
Abortion	9	16.4	9.0: 1	10.0
Obstetric hemorrhage	16	29.1	16.0: 1	5.9
Hypertensive disorders	34	61.8	11.3: 1	8.1
Pregnancy-related infection	16	29.1	4.0: 1	20.0
Contributory causes				
Anemia	24	43.6	24.0: 1	4.0
Previous cesarean section	2	3.6	-	0.0
Prolonged/obstructed labor	2	3.6	-	0.0

Table 5. Process or facility related indicators in public Hospitals of Borena Zone, Ethiopia.

Use of intervention and treatment	Percentage (%)
Treatment of severe postpartum hemorrhage	
Oxytocin	100.0
Ergometrine	11.5
Anticonvulsants for eclampsia	
Magnesium sulfate	95.2
Treatment for sepsis	
Parenteral therapeutic antibiotics	85.7
Hospital access indicators	
Proportion of SMO12 cases among all SMO cases	37.7
SMO12 mortality index	21.7
Intrahospital care	
Intrahospital SMO rate (per 1000 live births)	26.74
Intrahospital mortality index	2.6
Intensive care use	
ICU admission rate	2.3
ICU admission rate among women with SMO	24.6
Proportion of maternal deaths assisted without ICU admission	50

Table 6. Delays on access to reproductive health services among the study participants.

Access to reproductive health services	Categories	Frequency (%)
Delay in deciding to seek health facility (delay one)	Yes	49 (41.9)
	No	68 (58.1)
Time to reach the hospital (delay two)	<2 h	55 (47.0)
	>2 h	62 (53.0)
Delay at treating hospital (delay three)	<15 min	60 (51.3)
	>15 min	57 (48.7)

Factors associated with to severe maternal outcome

The findings revealed several significant associations. Firstly, mothers from higher-income households demonstrated a lower likelihood of developing severe maternal outcomes. Additionally, those who entered their first marriage before the age of 18 were found to be at a higher risk for SMO. Anemia was identified as a risk factor for SMO. Time to reach nearby health facility markedly associated with SMO as mother who took more than 2 h to reach facility had more chance to develop SMO. Moreover, prolonged waiting time at the hospital (waiting over 15 min after arrival) was identified as a risk factor for SMO. Admission to the intensive care unit was strongly linked to SMO cases, and a notable correlation was observed between the number of antenatal care (ANC) visits and severe maternal outcomes (Table 7).

Discussion

The magnitude of MNM among hospital deliveries was 38.7 per 1000 live births within the surveyed hospitals. The incidence of SMO was 42.9 per 1000 live births. Most women with MNM developed organ dysfunction before or within the first 12 h of hospital arrival. Moreover, ICU admission of women with SMO was 13%. According to a recent WHO report, an MNM or SMO ratio higher than 10 per 1000 live births indicates that a substantial percentage of women will need lifesaving interventions to survive their complications.[4]

The MNMR found in this study is higher than in previous studies conducted in various parts of Ethiopia: 8.01 in Addis Ababa,[14] 16.1 in Hawassa,[15] 24.3 in South Region,[9] and 28.5 in Tigray Ethiopia.[3] It also higher than in the studies conducted in Tanzania,[16] Sudan,[17] Uganda.[18] The observed discrepancy might be due to differences in case definition and types of health facility included. Another explanation for the higher magnitude of MNM presented in this study could be attributed to the presence of severe drought in the studied area. Conversely, the magnitude of MNM is this study is lower than prior studies conducted in east Ethiopia (80 per 1000 live births),[19] and south-west Ethiopia (50.4 per 1000 live births).[20] The prior studies used disease-based criteria, which were less stringent than the WHO criteria for identifying maternal near-miss cases.

The current study showed that the leading causes of MNM were pregnancy induced hypertension and severe postpartum hemorrhage, which are comparable to the findings of studies conducted elsewhere in Ethiopia[8,14,15,20–22] and other African countries.[16,17] Pregnancy related infection (sepsis) was associated with the highest case fatality; like the findings of earlier studies done in other parts of the country[22,23] and other developing countries.[16,17] Near-miss cases that develop during hospitalization can help to measure the quality of obstetric care provided within the health facilities.[4,22] In line with previous findings, this study showed that most women experienced SMO on admission or within 12 h of arrival at hospitals.[10,14,22] This suggests the existence of substandard obstetrics care and a weak referral system at lower facilities. According to the WHO, the presence of substantial proportion of women arrive at health facilities with SMO suggests a delay in seeking either care (first delay) or delay in reaching a health facility (second delay).[4]

This study noted that ICU admission rate among women with SMO is low and about half of maternal deaths occurred without ICU admission. This low percentage of women with SMO admitted to the ICU and the high percentage of maternal deaths that occurred without ICU admission suggest a shortage of ICU beds.[1,4,22] Therefore, it is necessary to set up ICUs dedicated solely to the obstetric population. Appropriate use of effective interventions results in improved health outcomes.[1,2,4]

Table 7. Factors associated with severe maternal outcome in public hospitals of Borena Zone. Ethiopia.

Sociodemographic characteristics		SMO N (%)	Non-SMO N (%)	p-Value
Attended formal education	Yes	27 (44.3)	35 (62.5)	0.048
	No	34 (55.7)	21 (37.5)	
Admitted to ICU	Yes	15 (24.6)	17 (30.4)	0.485
	No	46 (75.4)	39 (69.6)	
Delivery or abortion occurred before reaching HF	Yes	11 (18.0)	5 (8.9)	0.152
	No	50 (82.0)	51 (91.1)	
Age at first marriage	Below 18 years	55 (90.2)	20 (35.7)	<0.001
	18 years and above	6 (9.8)	36 (64.3)	
Women delayed in seeking help (delay 1)	Yes	24 (39.3)	25 (44.6)	0.562
	No	37 (60.7)	31 (55.4)	
Time to reach HF (delay 2)	More than 2 h	23 (37.7)	1 (1.8)	<0.001
	Less than 2 h	38 (62.3)	55 (98.2)	
Waiting time (delay 3)	More than 15 min	44 (72.1)	13 (23.2)	<0.001
	Less than 15 min	17 (27.9)	43 (76.8)	
Household income	Below median	42 (68.9)	6 (10.7)	<0.001
	Above median	19 (31.1)	50 (89.3)	
Anemic	Yes	25 (41.0)	8 (14.3)	0.001
	No	36 (59.0)	48 (85.7)	
Cesarean section	Previous history	2 (3.3)	5 (8.9)	0.198
	No previous history	59 (96.7)	51 (91.1)	
Age category	15–24	26 (42.62)	20 (35.71)	0.135
	25–34	25 (40.98)	32 (57.14)	
	35 and above	10 (16.39)	4 (7.14)	
Number of ANC visit	None	20 (32.79)	8 (14.29)	0.001
	One visit	12 (19.67)	5 (8.93)	
	Two visits	23 (37.70)	19 (33.93)	
	Three visits	5 (8.20)	18 (38.14)	
	Four visits	1 (1.64)	6 (10.71)	
Parity	Nully	18 (29.5)	18 (32.1)	0.805
	Primi	10 (16.4)	11 (19.6)	
	Multi	33 (54.1)	27 (48.2)	
Duration of hospital stay	≤7 days	51 (83.6)	47 (83.9)	0.962
	≥8 days	10 (16.4)	9 (16.1)	

This study has added to the literature by assessing interventions provided for women with maternal near miss and hospital access indicators, which are essential components of quality of care. The use of prospective data to identify women with SMO and the quality of care provided to women with life-threatening conditions using a validated WHO tool add valuable information that can used to design programs and interventions aimed at improving maternal health in resource limited and remote settings.

However, because of logistic and feasibility concerns, our follow-up time was limited to only the length of the hospital stay instead of up to 42 days of postpartum as recommended by WHO. The short and long-term maternal consequences of near-miss events were also not addressed in the current study. The focus on women experiencing SMOs limited the data available to perform advanced statistical analysis. A sample size of 117 is considered too small to produce robust and reliable results in a logistic regression model, with 500 being the recommended minimum sample size.[24]

Conclusion

During the study period, the incidence of maternal near miss was 38.87 per 1000 live births in all participating hospitals, which is higher than the previous studies. The common underlying causes of most maternal near miss cases were hypertensive disorders and obstetric hemorrhage. Anemia was the major contributing cause reported for maternal near miss. Giving special emphasis to life-saving interventions, critical care and implementation of prenatal risk identification and prompt referral to the nearby hospitals are essential for reducing delays in provision of appropriate care.

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