A cohort study of maternal near-miss events and its adverse perinatal outcomes: an obstetrical finding in Northwest Ethiopia

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BACKGROUND: Globally, various studies have reported that most adverse perinatal outcomes were associated with maternal near-misses. In Ethiopia, studies on adverse perinatal outcomes from maternal near-miss are scarce.

OBJECTIVE: This study aimed to assess the incidence, determinants, and maternal near-miss effects on perinatal outcomes among women at public hospitals in the South Gondar zone in 2021.

STUDY DESIGN: A facility-based prospective cohort study was conducted from January 10, 2021, to May 10, 2021. The chi-square test, multivariable logistic regression methods, and SPSS software were used. The strength of associations and significance level were examined using *P* values and odds ratios with 95% confidence intervals, respectively. In addition, multicollinearity and model fitness were checked.

RESULTS: A total of 304 respondents (76 exposed and 228 unexposed) were included in the study with a response rate of 100.0%. The incidence rates of adverse perinatal outcomes among exposed and unexposed groups were 71.1% (95% confidence interval, 60.0–73.8) and 21.1% (95% confidence interval, 15.8–28.8), respectively. Multivariable logistic regression showed that short interbirth interval (adjusted odds ratio, 8.39; 95% confidence interval, 5.36–16.08), lower household income (adjusted odds ratio, 3.61; 95% confidence interval, 1.12–6.54), rural residence (adjusted odds ratio, 2.54; 95% confidence interval, 1.21–4.07), previous stillbirth (adjusted odds ratio, 4.24; 95% confidence interval, 1.04–17.31), absence of antenatal care (adjusted odds ratio, 9.84; 95% confidence interval, 4.89–17.51), and anemia (adjusted odds ratio, 4.19; 95% confidence interval, 1.01–17.46) were significantly associated with increased odds of adverse perinatal outcomes

CONCLUSION: This study revealed that the incidence of adverse perinatal outcomes was significantly higher among exposed groups than unexposed groups. The result signified the need for improving the health of mothers by all stakeholders to improve perinatal outcomes.

Key words: adverse perinatal outcomes, Ethiopia, near-miss, prospective cohort

Introduction

Maternal near-miss (MNM) refers to a woman who nearly died but survived a complication that occurred during pregnancy or childbirth or within 42 days of termination of pregnancy.[1] Previously, MNM was measured using the World Health Organization (WHO) near-miss criteria worldwide, including sub-Saharan countries.[1,2] Currently, newly adapted sub-Saharan criteria are being used by developing countries, including Ethiopia.[2–4]

The adapted sub-Saharan near-miss criteria are expected to eliminate the challenge of underestimation by the original WHO near-miss criteria of developing countries. We have used these near-miss classification criteria to avoid measurement heterogeneity. This means that using the sub-Saharan near-miss measurement tool could minimize the heterogeneity of selecting the exposed and unexposed groups among readers and different researchers. The adapted sub-Saharan near-miss criteria include the WHO criteria with modification with respect to the local context, admission to the intensive care unit (ICU), eclampsia, sepsis or severe systemic infection, and uterine rupture.[3,4]

Available literature shows that MNM is strongly associated with adverse perinatal outcomes, namely, perinatal asphyxia, delivery of a low birthweight (LBW) neonate, admission to the neonatal ICU (NICU), stillbirth (SB),

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All data included in this manuscript can be accessed from the corresponding author on request through the e-mail address.

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The ethical clearance was obtained from the institutional review board of Debre Tabor University. A letter of permission was obtained from the clinical coordinator of each study hospital. Clear explanation about the purpose of the study was given along with the letter of support for all concerned body. Finally, a written informed consent from the respondents was obtained after thoroughly explaining the aim of the study to each respondent. All methods were performed following the relevant guidelines and regulations.

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Why was this study conducted?

This study was conducted to explore the ultimate effect of maternal near-miss (MNM) toward adverse perinatal outcomes (APOs) with a prospective study design. Despite the world's struggle to reduce APOs, perinatal morbidity and mortality are still higher globally, especially in developing countries, such as Ethiopia.

Key findings

The incidence rates of APOs among exposed and unexposed women were 71.1% (95% confidence interval [CI], 60.0−73.8) and 21.1% (95% CI, 15.8−28.8), respectively. MNM is an independent determinant of APOs. In addition, poor socioeconomic status, lack of antenatal care services, previous bad obstetrical histories, and short interdelivery intervals are found to be predictors of APOs.

What does this add to what is known?

The prospective nature of this study avoids the cause-and-effect dilemma or egg-and-chicken dilemma raised in the case of cross-sectional studies. Our study shows the burden of MNM and APOs among rural residents in Ethiopia. In addition, this study includes early neonatal death as an APO and uses the sub-Saharan near-miss criteria that reduce underestimation for African countries.

preterm birth (PTB), decreased Apgar score, and early neonatal mortality.[5,6]

According to the WHO's global survey on maternal and perinatal health, MNM was significantly associated with SB (odds ratio [OR], 3.95; 95% confidence interval [CI], 3.17−4.94), LBW, admission to the NICU (OR, 2.11; 95% CI, 1.95−2.28), and early neonatal death (OR, 4.77; 95% CI, 3.74−6.07).[7] Another hospital-based study in 2011 showed that 65.5% and 40.0% of MNM were associated with LBW and admission to the NICU, respectively.[8] Another study in Iraq in 2013 also reported that 36.5% and 20% of MNM resulted in PTB and SB, respectively.[9]

In a cohort study conducted in Nigeria in 2013, 28.4%, 41.3%, 44.4%, and 33.3% of MNM were associated with the development of SB, PTB, LBW, and asphyxia, respectively.[6] Another study in Gambia reported that 44.3% of MNM events were associated with adverse perinatal outcomes (APOs).[10] In Ethiopia, studies on the effect of MNM on perinatal outcomes are scarce. Of note, 1 prospective cohort study in 2018 at Addis Ababa reported that the incidence of APOs was 72.9% among MNM. According to this study, MNM was associated with SB, PTB, LBW, asphyxia, and admission to the NICU.[11]

In addition, different previous studies reported that confounding variables, such as sociodemographic status, reproductive health (RH), and obstetrical complications, affected APOs.[12−14] For example, studies from Nepal, Pakistan, Afghanistan, Tanzania, Ghana, and Nigeria reported that no formal education, decreased household income, rural residencies, advanced maternal age, ethnicity, lack of antenatal care (ANC) service, previous SB, short interdelivery interval, and presence of medical disorders were associated with at least 1 APO.[6,13−16] In Ethiopia, according to the Ethiopian Demographic and Health Survey 2019 report and a study conducted at public hospitals of Addis Ababa, lower level of education, rural residence age extremes, bad obstetrical histories, medical disorders, and short birth interval were all associated with APOs.[11,17]

Studies conducted on the effect of MNM on APOs in sub-Saharan countries, including Ethiopia, used the original WHO near-miss criteria. However, it is felt that this tool underestimates the burden in developing country settings.[3,18] In addition, studies conducted on APOs among MNM were scarce in Ethiopia. Moreover, available studies did not answer the question of causality because of the nature of the design. There was only a single prospective study conducted in the urban part of Ethiopia.[11]

This study was designed to fill these gaps, representing the rural areas of Ethiopia. Furthermore, it will contribute to policymakers and programmers. It will also contribute to the medical literature to show the emphasis on preventive-oriented medicine for the reduction of perinatal morbidity and mortality as maternal and perinatal conditions are the 2 sides of the same coin.

Methods

Study design and settings

A facility-based prospective cohort study was conducted to assess the effect of MNM on adverse outcomes and the determinants of APOs at public hospitals in the South Gondar zone, Amhara region, Ethiopia, from January 10, 2023, to May 10, 2023. As near-miss cases are referred to facilities known to have better access to appropriate care, the selection among hospitals was based on the availability of the maternity ward, ICU, facilities for cesarean delivery, blood transfusion service, and senior obstetricians. Hence, the study was conducted at Debre Tabor specialized hospital, Nefas Mewcha primary hospital, Mekane Yesus primary hospital, and Addis Zemen primary hospital.

Sample size and sampling procedure

The sample size was calculated using EpiInfo software (version 7; Centers for Disease Control and Prevention, Atlanta, GA) by considering sample size determination for cohort studies. The parameters that were used in sample size calculation included 95% CI, power of 80%, near-miss to the non−near-miss ratio of 1:3, prevalence of the outcome in the nonexposed group of 8.4%, prevalence of the outcome in the exposed group of 29.5%,[11] and adding 10.0% of loss to follow-up rate. The final minimum sample size was 42 exposed women and 126 unexposed women, with a total of 168 samples. However, this study required a large sample size to increase the power of the study, and as it was logistically feasible, all available

near-misses were taken during the study period.

The final sample size was 304. We have done this sample size modification to increase the number of participants beyond the figure obtained from the statistical software calculation according to previous findings and the method used for cohort studies for not obviating the statistical method and power increment. In addition, all available exposed women were taken, and the unexposed groups were sampled using a simple random sampling technique on the same day of the near-miss event. All patients with APOs were followed up until discharge or until 7 days after delivery.

Cohort selection and eligibility criteria

Women who developed MNM events were included in the exposed group, and women who delivered without any complication were included in the nonexposed group. For a woman to be considered as exposed, having at least 1 of the adapted sub-Saharan near-miss criteria was enough. The unexposed group was selected on the basis of the date of delivery. All pregnant mothers who had fulfilled at least 1 of the adapted sub-Saharan criteria of MNM were considered as exposed, and those who delivered on the same day of the MNM event with no complication were considered as unexposed. The study excluded women who were admitted for abortion or ectopic pregnancy and women who were delivered at another health facility.

All possible obstetrical and RH characteristics of both the exposed and unexposed women were included in the bivariable analysis, and selected variables were included in the final analysis. The details about the cohort selection and variable inclusion are obtained from the supplementary material. Finally, regarding the selection of study variables to be followed prospectively, we have exhaustively searched for the possible confounders and found that undocumented day-to-day clinical experiences, expert clinician and obstetrician recommendations, and researchers' consultations were considered for variable selection.

Outcome measurements

The main outcome of interest of this study was APOs. SB, LBW, PTB, admission to the NICU, early neonatal death, and birth asphyxia were defined as APOs. Birth asphyxia was defined as failure to initiate and sustain breathing at birth, characterized by an Apgar score of <7 at 1 and/or 5 minutes. PTB was defined as delivery of a live neonate at >28 to <37 completed weeks of gestation. Here, gestational age was determined using the last normal menstrual period or early milestone or fetal weight sequentially. Our study did not include those near-miss women before 28 weeks of gestation and beyond 7 days after delivery. Adverse neonatal outcomes after discharge when discharged before 7 postnatal days were not studied.

Data collection procedures

Before data collection was started, the adapted sub-Saharan near-miss criteria were explained to the data collectors. These near-miss criteria were printed, training was given to the data collectors, and the criteria were posted to the maternal and child health clinics of the study hospitals. Consent and data from the patients who experienced a near-miss event were taken after the patients recovered from their near-miss event. The desired information about APOs was collected from the medical records of both the exposed and unexposed groups. When the preterm neonate is sent to the NICU, the medical records of the neonate are extracted for checking preterm neonatal death until the seventh postnatal day. In addition, data on MNM were obtained from the woman's medical record by having the adapted sub-Saharan criteria at hand. The adapted sub-Saharan criteria include the WHO criteria with modification to the local context, admission to the ICU, eclampsia, sepsis or severe systemic infection, and uterine rupture. To check for possible confounders, both the exposed and unexposed women were interviewed after they became healthy, near their discharge time.

Data processing and analysis

After manually checking its completeness and consistency, the data were entered using EpiData software (version 4.6; EpiData Association, Denmark) and analyzed using SPSS software (version 23; SPSS Inc, Chicago, IL). The chi-square test was used to check the presence of statistically significant differences in determinant factors between the exposed and the nonexposed groups. To know the crude association between MNM and other confounders with APOs, the OR was calculated with a 95% CI. Variables with an OR of ≤0.2 were considered for multivariate analysis. Variables with an adjusted OR (aOR) of ≤0.05 were considered to determine significant association. The Hosmer-Lemeshow goodness-of-fit test was used to check the model fitness. Poor fit was considered as a value of <0.05. It was considered to have multicollinearity when the variance inflation factor (VIF) was >10, and there was no multicollinearity when the VIF was <10.

Result

Sociodemographic characteristics

A total of 304 respondents, 76 women with near-miss (exposed women) and 228 women with uncomplicated birth (unexposed women), were included in the analysis. Most participants were in the age group of between 25 and 34 years (59.5%), living in rural areas (57.6%), orthodox Christian (54.9%), and married (92.8%). The mean ages of the study participants among exposed and unexposed mothers were 29.63 (SD, ±5.85) years and 27.93 (SD, ±5.17) years, respectively (Table 1).

Reproductive and clinical characteristics

Near-miss women were more likely to have previous SB (P<.001) and a birth interval of <2 years (P<.001), were less likely to have attended ANC (P<.001), and were most likely anemic and hypertensive (both P<.001) than nonexposed women. The mean times of interbirth interval among the exposed and unexposed groups were 1.92 (SD, ±0.54) years and 2.26 (SD, ±0.67) years, respectively (Table 2).

TABLE 1
Distribution of sociodemographic characteristics among exposed and unexposed women in public hospitals, South Gondar zone, Ethiopia, 2023

Characteristics	Exposed group (n=76) n (%)	Unexposed group (n=228) n (%)	Total (N=304) n (%)	*P* value[a]
Age group				
18–24 y	16 (21.0)	54 (23.7)	70 (23.0)	.469
25–34 y	34 (44.7)	147 (64.5)	181 (59.5)[b]	
≥35 y	26 (34.3)	27 (11.8)	53 (17.4)[b]	<.001[b]
Educational status				
Unable to read and write	28 (36.8)	45 (19.7)	73 (24.0)	.360
Able to read and write	20 (26.4)	57 (25.0)	77 (25.3)	.790
Primary	13 (17.1)	63 (27.6)	76 (25.0)	.201
Secondary	7 (9.2)	43 (18.9)	50 (16.4)	.124
Higher	8 (10.5)	20 (8.8)	28 (9.2)	
Place of residence				
Urban	24 (31.6)	105 (46.1)	129 (42.4)	
Rural	52 (68.4)	123 (53.9)	175 (57.6)	.02[b]
Monthly income (ETB)				
≤1000	31 (40.8)	46 (20.2)	77 (25.3)	.026[b]
1001–2000	19 (25.0)	55 (24.1)	74 (24.3)	.049[b]
2001–3000	16 (21.0)	80 (35.1)	96 (31.6)	.259
3001–4000	5 (6.6)	40 (17.5)	45 (14.8)	.926
≥4001	5 (6.6)	7 (3.1)	12 (3.9)	
Marital status				
Married	67 (88.2)	215 (94.3)	282 (92.8)	
Never married	9 (11.8)	13 (5.7)	22 (7.2)	.08
Religion				
Orthodox	38 (50.0)	129 (56.6)	167 (54.9)	.758
Muslim	33 (43.4)	79 (34.6)	112 (36.8)	.343
Protestant	5 (6.6)	20 (8.8)	25 (8.2)	
Age at marriage (y)				
<18	18 (23.7)	14 (6.1)	32 (10.5)	.001[b]
≥18	58 (76.3)	214 (93.9)	272 (89.5)	

Never married indicates no formal husband at all before this time.

ETB, Ethiopian birr.

[a] *P* value obtained using the chi-square test; [b] p-value of less than 0.05.

Erega. Incidence, determinants, and maternal near-miss effects of adverse perinatal outcomes in Ethiopia. Am J Obstet Gynecol Glob Rep 2024.

Incidence of adverse perinatal outcomes

The incidence rates of APOs among mothers exposed to near-miss and unexposed mothers were 71.1% (95% CI, 60.0−73.8) and 21.1% (95% CI, 15.8 −28.8), respectively, with a *P* value of <.001. Neonates born from mothers who had near-miss were more likely to be SB (*P*<.001), have LBW (*P*<.001), be born before term (*P*<.001), die within 7 days (*P*<.001), be asphyxiated (*P*<.001), and be admitted to the NICU (*P*<.001) (Table 3).

Predictors of adverse perinatal outcomes

Under possible adjustment for other confounding variables, such as inter-birth interval, previous history of SB, ANC service use, educational status, income, residence, and medical diseases,

TABLE 2
Distribution of reproductive and clinical characteristics among exposed and unexposed women in public hospitals, South Gondar zone, Ethiopia, 2023

Characteristics	Exposed group (n=76) n (%)	Unexposed group (n=228) n (%)	Total (N=304) n (%)	*P* value[a]
Received ANC				
Yes	36 (47.4)	199 (87.3)	235 (77.3)	
No	40 (52.6)	29 (12.7)	69 (22.7)	<.001[b]
Parity				
≤1	19 (25.0)	59 (25.9)	78 (25.7)	.014[b]
2–4	27 (35.5)	124 (54.4)	151 (49.7)	
≥5	30 (39.5)	45 (19.7)	75 (24.7)	<.001[b]
Previous still birth				
Yes	25 (32.9)	29 (12.7)	54 (17.8)	<.001[b]
No	51 (67.1)	199 (87.3)	250 (82.2)	
Previous CD				
Yes	10 (13.2)	15 (6.6)	25 (8.2)	.076
No	66 (86.8)	213 (93.4)	279 (91.8)	
Interbirth interval				
<2 y	41 (53.9)	56 (24.6)	97 (31.9)	.001[b]
2 y	21 (27.7)	87 (38.2)	108 (35.5)	.311
>2 y	14 (18.4)	85 (37.2)	99 (13.5)	
Previous anemia				
Yes	20 (26.3)	21 (9.2)	41(13.5)	.001[b]
No	56 (73.7)	207 (90.8)	263 (86.5)	
Previous hypertension				
Yes	29 (38.2)	22 (9.6)	51(16.8)	.001[b]
No	47 (61.8)	206 (90.4)	253 (83.2)	
Previous DM				
Yes	4 (5.3)	3 (1.3)	7 (2.3)	.066
No	72 (94.7)	225 (98.7)	297 (97.7)	

ANC, antenatal care; *CD*, cesarean delivery; *DM*, diabetes mellitus.

[a] *P* value obtained using the chi-square test; [b] indicated for p value of less than 0.05.

Erega. Incidence, determinants, and maternal near-miss effects of adverse perinatal outcomes in Ethiopia. Am J Obstet Gynecol Glob Rep 2024.

the effect of MNM on APOs was highly significant. The odds of developing APOs were more than 3 times higher among women with near-miss (aOR, 3.26; 95% CI, 1.17–9.01) than unexposed women. Here, a short interbirth interval (<2 years) increased the odds of developing APOs by around 8 times (aOR, 8.39; 95% CI, 5.36–16.08) compared with a birth interval of >2 years.

In addition, the study showed that previous SB, rural residence, lack of ANC service use, anemia, and a monthly income of <1000 Ethiopian birr (ETB) increase the odds of developing APOs by more than 4, 2, 9, 4, and 3 times, respectively (Table 4).

Discussion

The primary finding of this study is that MNM is a risk factor for APOs independent of other confounding factors. The incidence rates of APOs among women with and without MNM were 71.1% (95% CI, 60.0–73.8) and 21.1% (95% CI, 15.8–28.8), respectively. The findings are similar to the study conducted in Addis Ababa, which were 72.9% among exposed women and 24.5% among unexposed women.[11] This could be explained by the similarity in study design, hospital selection, and technique of selection of the exposed and unexposed groups.[11] However, this study found a higher incidence than studies conducted in Butajira (18.2%) and Dessie (32.5%).[19,20] This could be explained by the difference in the study design and

TABLE 3
Incidence of adverse perinatal outcomes among women with near-miss and women with uncomplicated deliveries in public hospitals, South Gondar zone, 2023 (N=304)

Outcome variable	Near-miss group (n=76) n (%)	Uncomplicated delivery group (n=228) n (%)	cOR (95% CI)	*P* value[a]
APOs	54 (71.1)	48 (21.1)	9.20 (5.10−16.59)	<.001[b]
Stillbirths	18 (23.7)	19 (8.3)	3.44 (1.68−6.92)	.001[b]
Low birthweight	35 (46.1)	18 (7.9)	9.95 (5.15−19.26)	<.001[b]
Preterm births	33 (43.4)	17 (7.5)	9.52 (4.87−18.63)	<.001[b]
Asphyxia	39 (51.3)	24 (10.5)	8.95 (4.83−16.61)	<.001[b]
Admitted to NICU	38 (50.0)	17 (7.5)	12.41 (6.36−24.20)	<.001[b]
Early neonatal death	13 (17.1)	6 (2.6)	7.63 (2.79−20.89)	<.001[b]

APO, adverse perinatal outcomes; *CI*, corresponding author; *cOR*, crude odds ratio; *NICU*, neonatal intensive care unit.

[a] *P* value obtained using the chi-square test; [b] p-value less than 0.05.

Erega. Incidence, determinants, and maternal near-miss effects of adverse perinatal outcomes in Ethiopia. Am J Obstet Gynecol Glob Rep 2024.

the effect of MNM in our study. This huge association of MNM and APOs could be explained by worse obstetrical complications exposed to APOs through preterm termination for therapeutic purpose and placental insufficiency from that obstetrical insult which directly or indirectly APOs. This finding is similar to studies conducted in Brazil and Nigeria that revealed an increased risk of APOs, such as SB, LBW, PTB, asphyxia, early neonatal death, and admission to the NICU.[6,11,21]

Here, the lack of ANC service use by women increased the odds of APOs by more than 9 times (aOR, 9.84; 95% CI, 4.89−17.51) compared with those who had ANC follow-up. Our finding is supported by studies that documented a reduction in APOs through the proper provision of ANC services to timely diagnose prenatal complications.[13,14,22] Our study finding is also in line with a prospective cohort study conducted at public hospitals in Addis Ababa that showed that the absence of ANC use increases the odds of APOs by more than 5 times compared with the use of ANC services.[11] This means that proper ANC use is the mainstay for early prevention, diagnosis, and treatment of complications before adverse outcomes occur. In addition, this study reported that a short interdelivery interval (<2 years) increases the odds of APOs by more than 8 times compared with an interbirth interval of >2 years (aOR, 8.39; 95% CI, 5.36−16.08). This means that women with a short interbirth interval are at an increased risk of developing morbidity and APOs compared with those who do not have a short interbirth interval. This is due to decreased physiological preparation, anatomic hostility, and limited time for fetal nourishment and intrapartum tolerance.[6,14,22]

Another independent determinant of APOs was the presence of medical diseases (anemia). Being anemic (hemoglobin concentration of <11 g/dL), irrespective of near-miss status, increased the odds of APOs by more than 4 times compared with not being anemic (aOR, 4.19; 95% CI, 1.01−17.46). Moreover, this finding is consistent with studies conducted in Ethiopia, Nigeria, Ghana, and Tanzania.[6,11,15,16] This could be explained by the risk of decreased intrauterine nutrient and oxygen transfer and insult to the perinatal period of the fetus and early neonate. Women with a household monthly income of ≤1000 ETB (aOR, 3.61; 95% CI, 1.12−6.54) were associated with APOs compared with women who had greater income. This might be due to women with low economic status being less likely to afford to minimize delays.[23−25] Here, women who had previous SB in preceding births had increased odds of having APOs by around 4 times compared with women without a history of SB (aOR, 4.24; 95% CI, 1.04−17.31). This finding is supported by available evidence that suggested that women with SB in their previous pregnancy were at higher risk of APOs in subsequent pregnancies.[9,22] This means that the causes of most obstetrical complications are recurrent unless treated and controlled timely via preconception care and proper prenatal monitoring.[15,16,22]

In addition, this study signified that rural residency was associated with APOs. Compared with urban residency, rural residency increased the odds of developing APOs by around 2.5 times (aOR, 2.54; 95% CI, 1.21−4.07). This means that women living in rural areas are relatively disadvantaged in terms of their socioeconomic status, which could increase their risk of APOs.[10,19] This, in turn, affects the health-seeking behavior of women, including ANC service use plus early diagnosis and treatment of medical complications during pregnancy, such as anemia.[15,19]

Strengths and limitations

This study has many strengths and some inherent limitations. This study aimed to determine the effect of MNM on APOs in the rural parts of Ethiopia

TABLE 4
Multivariable logistic regression of MNM and adverse perinatal outcomes concerning other confounding variables in public hospitals, South Gondar zone, Ethiopia, 2023 (N=304)

Variable	Adverse perinatal outcomes		cOR (95% CI)	aOR (95% CI)
	Yes (n=102) n (%)	No (n=202) n (%)		
MNM				
Yes	54 (52.9)	22 (10.9)	9.20 (4.30–13.59)	3.26 (1.17–9.09)[a]
No	48 (47.1)	180 (89.1)	1	1
Age group				
18–24 y	34 (33.3)	36 (17.8)	4.95 (0.11–5.37)	1.45(0.45-4.66)
25–34 y	29 (28.4)	152 (75.3)	1	1
≥35 y	39 (38.3)	14 (6.9)	14.60 (5.45–16.75)	5.43 (0.61–3.02)
Residence				
Urban	22 (21.6)	107 (53.0)	1	1
Rural	80 (78.4)	95 (47.0)	4.10 (2.56–7.87)	2.54 (1.21–4.07)[b]
Monthly income (ETB)				
≤1000	53 (51.9)	24 (11.9)	2.21 (1.13–6.01)	3.61 (1.12–6.54)[b]
1001–2000	24 (23.5)	50 (24.7)	0.48 (0.21–7.14)	0.86 (0.13–4.57)
2001–3000	16 (15.8)	80 (39.6)	0.20 (0.01-4.45)	0.65 (0.11–6.38)
3001–4000	3 (2.9)	42 (20.8)	0.07 (0.01–9.32)	0.53 (0.10–7.38)
≥4000	6 (5.9)	6 (3.0)	1	1
Received ANC				
Yes	49 (48.0)	186 (92.1)	1	1
No	53 (52.0)	16 (7.9)	12.57 (4.49–14.57)	9.84 (4.89–17.51)[c]
Previous SB				
Yes	38 (37.2)	16 (7.9)	6.90 (3.83–14.12)	4.24 (1.04–17.31)[b]
No	64 (62.8)	186 (92.1)	1	1
Parity				
≤1	34 (33.3)	44 (21.8)	3.71 (2.08–7.26)	1.82 (0.56-6.22)
2–4	26 (25.5)	125 (61.9)	1	1
≥4	42 (41.2)	33 (16.3)	6.12 (3.58–12.66)	1.37 (0.31–6.03)
Interbirth interval				
<2 y	69 (67.6)	28 (13.9)	13.19 (7.82–21.06)	8.39 (5.36–16.08)[c]
2 y	17 (16.7)	91 (45.0)	2.45 (1.01–7.19)	2.00 (0.50–7.99)
>2 y	16 (15.7)	83 (41.1)	1	1
Anemia				
Yes	33 (32.3)	8 (4.0)	11.59 (5.41–27.98)	4.19 (1.01–17.46)[b]
No	69 (67.7)	194 (96.0)	1	1
Hypertension				
Yes	39 (38.2)	12 (5.9)	9.80 (4.60–13.43)	2.09 (0.61–7.17)
No	63 (61.8)	190 (94.1)	1	1

ANC, antenatal care; *aOR*, adjusted odds ratio; *cOR*, crude odds ratio; *ETB*, Ethiopian birr; *MNM*, maternal near-miss; *SB*, stillbirth.

[a] $P \leq 0.01$.; [b] $P \leq 0.05$.; [c] $P \leq 0.001$.

Erega. Incidence, determinants, and maternal near-miss effects of adverse perinatal outcomes in Ethiopia. Am J Obstet Gynecol Glob Rep 2024.

prospectively and used the sub-Saharan near-miss criteria. This study included early neonatal death as an APO and had not lost to follow-up. Although this study has many strengths, the study did not assess the effect of quality healthcare service and the role of delays of near-miss women for APOs. The effect of MNM 7 to 42 days after delivery was not followed up because of feasibility issues.

Conclusion

The study revealed that women exposed to MNM during pregnancy and time of delivery were at increased risk of APOs than uncomplicated delivery groups. In addition, variables like poor socioeconomic status, lack of ANC services, previous bad obstetrical histories, and short interdelivery intervals were the common predictors.

Glossary

ANC, antenatal care
aOR, adjusted odds ratio
APO, adverse perinatal outcome
CI, confidence interval
cOR, crude odds ratio
ETB, Ethiopian birr
ICU, intensive care unit
LBW, low birthweight
MNM, maternal near-miss
PTB, preterm birth
RH, reproductive health
SB, stillbirth
VIF, variance inflation factor
WHO, World Health Organization

CRediT authorship contribution statement

Besfat Berihun Erega: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Wassie Yazie Ferede:** Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Formal analysis, Data curation, Conceptualization.

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