ORIGINAL ARTICLE

Determinants of Maternal Near Miss in Western Ethiopia

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ABSTRACT

BACKGROUND: *Analysis of maternal near miss events and identification of factors resulting in maternal death are vital to improve the quality of obstetric care in any given setting. This study is aimed to determine the magnitude of maternal miss and identify its determinants.*

METHODS: *A hospital-based unmatched case-control study design was used. Sixty one maternal near misses (as cases) and 122 mothers who had a normal obstetric outcome (as controls) at obstetrics and gynecology ward of Nekemte Referral Hospital were included from May 1st , 2018 to July 31st, 2018. The criteria set by the World Health Organization were used to identify maternal near miss cases. The data were collected via face-to-face interviews using pretested structured questionnaires and analyzed using SPSS version 22. For every case, two controls were recruited. Descriptive statistics and logistic regressions were used. A 95% CI and p-value of <0.05 were considered to be statistically significant.*

RESULT: *The magnitude of maternal near miss was 4.97%. Factors including multigravidity (AOR= 3.84, 95% CI: 1.23-11.91), lack of antenatal care (AOR=6.02, 95% CI: 1.55-23.28), delays in accessing health facility (AOR=12, 95% CI: 2.55-56.57) and induction of labor (AOR =9.4, 95% CI: 2.97-29.71) were strongly associated with maternal near miss. Hypertension during pregnancy (40.9%) and obstetric hemorrhage (39.3%) were identified as the major causes of maternal near miss.*

CONCLUSION: *The magnitude of maternal near miss was high but lower compared to magnitude in other parts of Ethiopia, and numerous preventable determinant factors were identified.*

KEYWORDS: maternal near miss, determinant factors, Nekemte

INTRODUCTION

Maternal mortality is a global health problem. Over 99% of maternal deaths occur in low- and middle-income countries due to extreme poverty resulting in lack of access to quality healthcare and education of women (1). Because of considerable efforts to combat maternal mortality during the era of the Millennium Development Goals (MDGs), the maternal mortality ratio has decreased by 44% (2).

The standard indicator of maternal mortality is the maternal mortality ratio (MMR). In view of the declining maternal mortality, the concept of maternal near miss (MNM)

was introduced. According to the criteria set by the World Health Organization (WHO), MNM is defined as a woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of delivery or termination of pregnancy (2,5).

Analysis of MNM cases, compared to MMR, helps to identify what goes wrong in pregnancy related care when an MNM occurs in a given setting (3,4,5,6). It highlights the quality of obstetrics care at a health facility and gives valuable information in identifying the factors that lead to maternal death (7,8,9,10).

The magnitude of MNM varies between and within countries; however, the highest rates are found in low- and middle-income countries (7,11,12,13). Different studies across the world have identified numerous factors that are strongly associated with MNM. Delays at home, on the way to health facilities and at the health facility itself play significant roles in increasing the magnitude of MNM (13,14). In Ethiopia, few studies have been conducted in specific areas on MNM (15,16,17,18,20,21). However, to date, no published data exist in Western Ethiopia. Thus, the current study acts as benchmark for further studies on maternal near miss.

METHOD AND MATERIALS

Study area and period: This study was conducted at Nekemte Referral Hospital from May 1st, 2018 to July 31st, 2018. The hospital is found in Nekemte Town, 331 kilometers west of Addis Ababa. The hospital was established in 1923 and provides health care for more than 2 million people in the surrounding area. It also serves as a clinical attachment site for undergraduate health science students and postgraduate students in Integrated Emergency Obstetrics, Gynecology and General Surgery (IEOS). Currently, the hospital has 178 beds providing medical, surgical, gynecology, obstetrics, pediatrics, radiology, laboratory, pharmacy, psychiatry, and physiotherapy services for patients. The gynecology and obstetrics department is led by a team of health professionals comprising 2 gynecologists, 2 IEOS and 20 midwives.

Study design: A facility based unmatched case-control study was conducted.

Study population: All women who were managed for pregnancy related complications during pregnancy, labor and delivery and/or within 42 days of delivery or termination of pregnancy at Nekemte Referral Hospital from May 1st, 2018 to July 31st, 2018 were considered as the study population. Cases were identified based on WHO near miss criteria. Controls were mothers who had no complications.

Sample size determination and sampling technique: The sample size for this study was determined using Epi-Info version 7 by considering double population comparisons of proportions based on the following assumptions. Antenatal care (ANC) was one of the determinant variables for MNM (15,17). A level of confidence of 95% and power of 90% were used. After adding 10% for non-responses, the final sample size was 61 for cases (MNM) and 122 for controls, giving a total of 183 mothers. A ratio of 1:2 was used for the case to control group i.e. for each MNM case, two participants from the control groups were recruited. Simple random sampling technique was used to select study participants.

Study variables: Age, level of education, occupation, religion, ethnicity, marital status, educational status, income, place of residence and estimated distance of place of residence from Nekemte Referral Hospital were study variables. Obstetrics factors and factors related to obstetrics Interventions were also studied.

Data analysis and processing: Data entry was done using Epi-Info version 3.5.3 after checking for completeness. It was then cleaned and exported to SPSS Version 20 for analysis. Frequencies and other descriptive statistics were done. Bivariate analysis was used to examine the association between dependent and independent variables; Odds Ratios (ORs) and their 95% Confidence Intervals (CIs) were calculated. All variables that had a p-value of < 0.25 in the bivariate analysis were included in the multivariate logistic regression analysis model to determine the factors associated with dependent variables. Statistical significance was set at p-value of < 0.05.

Data collection procedures: A pre-tested structured questionnaire was developed from the

WHO near miss approach (5). All cases who fulfilled at least one of the conditions stated in the WHO criteria (5) were identified at the end of each day by trained midwives. These cases were reviewed and approved for inclusion by the principal investigator and/or ward obstetricians. Five midwives and two nurses were recruited and trained to collect socioeconomic variables, obstetrics factors and levels of delays. All questionnaires were checked for completeness by the principal investigator.

Ethical consideration: Ethical clearance was obtained from the Ethics Review Committee of Jimma University, Ethiopia. After explaining the procedure and purposes of the study to the hospital manager and the medical director, permission to recruit study participants and access obstetric records and logbooks was obtained from Nekemte Referral Hospital. All the information collected from the patients and registry were handled confidentially by omitting patients' identifiable information. The data collected were used for the purposes of this study only.

RESULTS

Socio-demographic characteristics of study participants at Nekemte Referral Hospital: One hundred and eight three (183) women were enrolled in the study. Sixty-one (61) were cases of MNM while 122 were controls. The response rate was 100%. There were 1,227 pregnancy and pregnancy related admissions during the study period, giving an MNM rate of 4.97%. Mothers recruited in the study were aged between 15- 49 years, with the majority falling in the age group 20-34 years. Seventy three point seventy seven percent (73.77%) of cases and 90.16% of controls were aged 20-34 years. Most study participants, both in the cases and control groups, were married, protestant Christians and from the Oromo ethnic group. Most participants from MNM group could not read and write (52.46% vs. 18.03%), were from poor families (40.98% vs. 19.67%), resided in a rural areas (72% vs. 50.82%) and lived far from the hospital (>10km) (75.41% vs. 50.0%) when compared to those in the control group (Table 1).

Table 1: Socio-demographic characteristics of study participants at Nekemte Referral Hospital from May 1st, 2018 to July 31st, 2018

Study variables	Category	Case	Control	Total
		N (%)	N (%)	N=183(%)
Residence area	Rural	44(72.13)	62(50.82)	106(57.9)
	Urban	17(27.87)	60(49.18)	77(42.1)
Age	15-19 years	4(6.56)	8(6.56)	12(6.6)
	20-34 years	45(73.77)	110(90.16)	155(84.7)
	35-49 years	12(19.67)	4(3.57)	16(8.7)
Ethnicity	Amhara	12(19.67)	2(1.64)	14(7.7)
	Oromo	49(80.33)	120(98.36)	169(92.3)
Religion	Protestant	43(70.49)	94(77.05)	137(74.9)
	Orthodox	8(13.11)	20(16.39)	28(15.3)
	Muslim	10(16.39)	8(6.56)	18(9.8)
Marital status	Single	3(4.92)	1(0.82)	4(2.2)
	Married	58(95.08)	121(99.18)	179(97.8)
Age at marriage	<18 years	35(57.38)	53(43.44)	88(48.1)
	19-24 years	23(37.70)	59(48.36)	82(44.8)
	≥25 years	3(4.92)	10(8.20)	13(7.1)
Educational status	Can't read and write	18(29.51)	17(13.93)	35(19.1)
	Read & write but no formal education	2(3.28)	4(3.28)	6(3.3)
	Primary education (grade 1-8)	19(3.11)	32(26.23)	51(27.9)
	Secondary education (grade 9-10)	9(14.75)	43(35.25)	52(28.4)
	Above secondary	13(2.13)	26(21.31)	39(21.3)

Table 1. Continued….

Occupational status	Farmer	32(52.46)	22(18.03)	54(29.5)
	Housewife	14(22.95)	60(49.18)	74(40.4)
	Self employed	5(8.20)	17(13.93)	22(12.0)
	Government employee	10(46.39)	23(18.85)	33(18.0)
Monthly income in USD	≤36.40	0(0.0)	3(2.46)	3(1.6)
	36.41-72.70	25(40.98)	24(19.67)	49(26.8)
	72.71-109.10	17(27.87)	43(35.25)	60(32.8)
	≥109.11	19(31.14)	52(42.62)	71(38.8)
Distance from hospital	≤10km	15(24.59)	61(50)	76(41.5)
	>10km	46(75.41)	61(50)	107(58.5)
	Total	61(100)	122(100)	183(100)

USD=United States' Dollar, km=kilometer

Table 2 shows that the mean age of the participants was 27.20 ± 6.06 years and 24.8 ± 4.45 years for cases and controls respectively. The mean distance travelled to reach the hospital was 35.38km ±37.73 versus 19.47 km ± 29.05 respectively in cases when compared to control group. Hospital stays were 5.79 ±3.98 days in cases and 1.39±2.94 days in the control group. However, age at marriage and 1st pregnancy were similar in both groups.

Table 2: Mean and Standard deviation (SD) of variables of study participants at Nekemte Referral Hospital from May 1st, 2018 to July 31st, 2018

Variables	Case			Controls			Total		
	N	Mean	SD.	N	Mean	SD	N	Mean	SD
Distance travelled (km)	61	35.38	37.73	122	19.47	21.88	183	24.77	29.05
Monthly income in USD	61	120.4	82.5	122	123.4	53.2	183	122.4	64.2
Age (in years)	61	27.20	6.06	122	24.8	4.45	183	25.60	5.17
Age at marriage (in years)	61	18.62	3.19	122	19.51	2.79	183	19.21	2.95
Age at 1st pregnancy (in years)	61	20.25	3.39	122	20.93	3.03	183	20.70	3.16
Hospital stay (in days)	61	5.79	3.98	122	1.39	2.94	183	2.86	3.91

USD=United States' Dollar, km=kilometer

Obstetric factors related maternal near miss at Nekemte Referral Hospital: The majority of the study participants (44.26% in cases and 53.28% in controls) were gravida 2-4. Twenty six point twenty three percent (26.23%) of MNM cases had received no antenatal care (ANC) while 98.36% of controls had received ANC. Labor was induced in 32.79% of MNM the cases compared to only 4.29% of the controls. There were 4.92% home deliveries in MNM cases; the entire control group delivered in hospital. Most of MNM cases stayed more than or equal to 3 days in the hospital, but 98.36% of patients in the control group were discharged within 3 days of admission. There were more stillbirths (54.1% vs. 0.82%) amongst MNM cases compared to the control group (Table 3).

Three delays model and maternal near miss at Nekemte Referral Hospital: Most study participants, cases and controls (81.97% vs. 91.82%), received care in less than 30 minutes up on arrival at the hospital. However, it took more than 60 minutes to reach the hospital in 77.05% of the cases and 40.16% of the controls. A higher proportion of MNM cases (77.41%) were referred from another health facility compared to the control group (50.82%). In both groups, the primary means (58.5%) of transport to the hospital was ambulance (Table 4).

Table 3: Obstetric factors related to maternal near miss at Nekemte Hospital from May 1st, 2018 to July 31st, 2018. (N = 183).

variables	Category	Case	Control	Total
		N (%)	N (%)	N (%)
Gravidity	Primigravida	19(31.15)	48(39.34)	67(36.6)
	Gravida 2-4	27(44.26)	65(53.28)	92(50.3)
	Gravida ≥5	15(24.59)	9(7.38)	24(13.1)
Age at first pregnancy	≤18 years	25(40.98)	27(22.13)	52(28.41)
	19-24 years	26(42.62)	79(64.75)	105(57.4)
	≥25 years	10(16.39)	16(13.11)	26(14.2)
Gestational age	<28 weeks	12(19.67)	3(2.46)	15(8.2)
	28-36 weeks	16(26.23)	12(9.84)	28(15.3)
	37-42 weeks	33(54.10)	107(87.70)	140(76.5)
Onset of labor	Spontaneous	41(67.21)	116(95.08)	157(85.8)
	Induction of labor	20(32.79)	6(4.92)	26(14.2)
Duration of labor	≤12 hours	42(68.9)	49(40.16)	91(49.73)
	>12 hours	19(31.1)	73(49.84)	92(50.27)
Birth outcome	Alive	28(45.90)	121(99.18)	149(81.4)
	Dead	33(54.10)	1(0.82)	34(18.6)
Duration of hospital stay	≤3 days	13(21.31)	120(98.36)	133(72.7)
	3-7 days	38(62.30)	0(0)	38(20.8)
	>7 days	10(16.40)	2(1.64)	12(6.6)
Place of Delivery	Home	3(4.92)	0(0)	3(1.64)
	Health Center	4(6.56)	0(0)	4(2.2)
	Hospital	54(88.52)	122(100)	183(96.16)
Antenatal care	No	16(26.23)	2(1.64)	18(9.83)
	Yes	45(73.78)	120(98.36)	165(90.16)

Table 4: The three delay model to maternal near miss at Nekemte Referral Hospital from May 1st, 2018 to July 31st, 2018. (N = 183).

Variable	Category	Case	Control	Total
		N (%)	N (%)	N (%)
Delay at home	≤6 hours	32(52.46)	91(74.59)	123(67.2)
	>6 hours	29(47.54)	31(25.41)	60(32.8)
Delay on the way to hospital	≤30 minutes	12(19.67)	41(33.61)	53(29.0)
	31-60 minutes	2(3.28)	32(26.23)	34(18.6)
	>60 minutes	47(77.05)	49(40.16)	96(52.5)
Delay at treating hospital	≤30 minutes	50(81.97)	112(91.82	162(88.5)
	>30 minutes	11(18.03)	10(8.18)	21(11.5)
Source of referral	Self	15(24.59)	60(49.18)	75(41.0)
	Health center	33(54.10	55(45.08)	88(48.1)
	District hospital	13(23.31	7(5.74)	20(10.9)
Means of transportation	Traditional ambulance	1(1.64	0(0)	1(0.5)
	Rent car	16(26.23	59(48.36)	75(41.0)
	Ambulance	44(72.13	63(51.64)	107(58.5)
	Total	61(100)	122(100)	183(100)

Causes of maternal near miss at Nekemte Referral Hospital: Thirty-four-point four percent (34.4%) of MNM cases had more than one obstetric cause. The major causes of MNM were hypertensive disorders during pregnancy (40.9%), obstetric hemorrhage (39.3%), obstructed labor (19.7%), uterine rupture (16.4%), ruptured ectopic pregnancy (6.6%), complications following abortions (4.9%), pregnancy related severe sepsis

(4.9%) and gestational trophoblastic disease (1.6%)   (Table 5).

Table 5: Causes of maternal near miss cases at Nekemte Referral Hospital from May 1st, 2018 to July 31st, 2018 (N=61)

Variables	Number	Percentage
Pregnancy induced hypertension	25	40.9
Obstetrics hemorrhage	24	39.3
Obstructed labor	12	19.7
Uterine rupture	10	16.4
Ectopic pregnancy	4	6.6
Sepsis	3	4.9
Gestational trophoblastic disease	1	1.6
Abortion	3	4.9
More than one of the above causes	21	34.4

Determinants of maternal near miss at Nekemte Referral Hospital: Variables related to basic sociodemographics and obstetrics were considered as risk factors associated with a MNM in the analysis of this study. After adjusting in the multivariate logistic regression model, multigravidity, lack of ANC, induction of labor and delays in reaching hospital were positively associated with a MNM. For instance, those mothers who were pregnant for the 2nd – 4th times (AOR: 4.94 [95% CI: 1.46-16.8]) and more or equal to 5 times (AOR: 3.84 [95% CI: 1.23-11.91]) were nearly fivefold and fourfold more likely to experience MNM events respectively. Likewise, mothers with no ANC (AOR: 6.02[95%CI: 1.55-23.28]) were six times more likely to have MNM events compared to mothers who received ANC. Mothers who were induced with oxytocin (AOR: 9.40[95% CI: 2.97-29.71]) were nine times more likely to have MNM events (Table 6).

Table 6: Factors associated with maternal near miss at Nekemte Referral Hospital from May 1st , 2018 to July 31st , 2018. (N =   183)

Variables	Category	Case N	Control N	COR(95%C)	AOR (95% CI)	P-value
Second delay	≤30 min	12	41	1*	1*	
	31-60 min	2	32	0.21(0.98,22.44)	2.30(0.98,5.40)	0.057
	>60 min	47	49	3.28 (0.14, 0.65.)	12.0(2.55,56.57)	0.002*
Gravidity	Primigravida	19	48	1*	1*	
	Gravida 2-4	27	65	1.05(1.57,11.25)	4.94(1.46,16.80)	0.010*
	Gravida ≥5	15	9	14.21(1.57,10.28)	3.82(1.23,11.91)	0.021*
ANC follow up	No	16	20	10.49(3.33, 33.07)	6.02(1.55,23.28)	0.009*
	Yes	45	163	1*	1*	
Onset of labour	Spontaneous	41	116	1*	1*	
	Induced	20	6	9.43 (0.04,0.28)	9.40(2.97,29.71)	0.000*

N=number; *=statistically significant variables (P-value <0.05); 1*= reference category; OR= Crude Odd Ratio; AOR= Adjusted Odd Ratio

DISCUSSION

In order to tackle maternal deaths, clear understanding of the magnitude and associated factors of MNM in a given setting is crucial. This study showed that the rate of MNM (4.97%) was lower than the rates documented in similar studies conducted at other hospitals in Ethiopia: three Amhara Regional State hospitals (23.3%), Debre Markos Referral Hospital (29.7%) and Jimma University Teaching Hospital (7.38%) (15,18,21). This could be explained by the fact that different stakeholders were working on prevention of contributing factors of maternal death, and differences in the sociodemographic characteristics among study participants. The MNM was also lower than studies done in two

African countries; namely, Morocco (12%) and Nigeria (14%) (6,13), but it was higher than a similar study conducted in India (3.74%) (12).

This study identified numerous associated factors with MNM including multigravidity, lack of ANC, delays in reaching hospital and induction of labor. Mothers with no ANC were six times more likely to have a MNM event compared to mothers who received ANC. Similar studies conducted in Ethiopia also found a significant association between ANC and MNM (14,15). This is further supported by studies done in Morocco and the United Kingdom which also identified lack of ANC as a determinant factor (13,18).

In this study, as in a study done in Tigray Regional State, mothers who were induced with oxytocin and those who traveled more than 60 minutes to reach hospital were more likely to experience MNM event (21). Thus, appropriate follow-up during induction of labor and arranging ambulance services when referral to hospital is made are crucial to decrease or prevent MNM events.

A study in the Philippines found that multigravida mothers were at increased risk of MNM compared to primigravida mothers corroborating our findings (22). Therefore, broadening access to, and education of family planning methods should be encouraged.

With regard to the three delays model, delays on the way to the hospital were the most significant. In most cases, care was provided within 30 minutes of arrival at the hospital. This is comparable to a study done at Tigray Regional State hospitals (19) but contrary to a study in Morocco where most delays occurred at home and at health facilities (13). Therefore, to mitigate this delay, those responsible sectors in this part of the country should focus on ambulance services and/or road construction.

Worldwide, almost all causes of maternal deaths and MNM are preventable (1). The major causes of MNM identified in this study were hypertensive disorders during pregnancy (40.9%), obstetric hemorrhage (39.3%), obstructed labor (19.7%), uterine rupture (16.4%), ruptured ectopic pregnancy (6.6%),

complicated abortions (4.9%), pregnancy related severe sepsis (4.9%) and gestational trophoblastic disease(1.6%). These findings are comparable with a study done at Jimma University Specialized Hospital and EDHS 2016 (18,23).

Our findings are contrary to the studies in Tigray, India and EDHS 2016 report where obstetrics hemorrhage was the leading cause of MNM (12,19,23), hypertensive disorders during pregnancy was the leading cause of MNM in this study. Additionally, a study in Debre Markos Referral Hospital, Ethiopia, found obstructed labor to be the leading cause of MNM (17). However, studies conducted in Morocco, Brazil, Egypt, and Addis Ababa found hypertensive disorders during pregnancy and obstetric hemorrhage as the leading and 2nd leading causes of a MNM event, in line with our findings (7,13,16,23,24). Furthermore, severe sepsis was the least common cause of MNM in this study, similar to studies from India, Egypt, Debra Markos Hospital, Ethiopia, (7,17,24). Different stakeholders should give priority attention to these causes if MNM rates are to decline.

In conclusion, the magnitude of maternal near miss was high at the study area but lower *c*ompared to magnitude in other parts of Ethiopia**.** Numerous preventable determinant factors were identified. Thus, both governmental and nongovernmental stakeholders should focus on these factors to prevent maternal morbidities and mortalities. The major limitation of this study is the small sample size that might can lead to statistical imprecision.

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