EVALUATION OF MATERNAL NEAR MISS EVENTS AT TIBEBE GHION SPECIALIZED HOSPITAL IN BAHIR DAR, ETHIOPIA

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ABSTRACT

BACKGROUND: Maternal mortality and morbidity are significant challenges in Ethiopia. The maternal mortality ratio remains high with recent estimates of 412 maternal deaths per 100,000 live births as of 2016 in the nation. Maternal Near Miss events (MNM) are severe morbidities in which a woman narrowly escapes death. In order to develop ways to improve maternal mortality and morbidity, this study sought to estimate: 1) the prevalence of maternal mortality and MNM; and 2) the associated risk factors for these events, at a tertiary referral hospital in Bahir Dar, Ethiopia.

METHODS: This was a cross-sectional study of 658 consecutive delivering pregnant patients and their neonates at Tibebe Ghion Specialized Hospital (TGSH) in Bahir Dar, Ethiopia, from February 26-June 10, 2020. Demographic and outcome data were collected as part of a quality improvement initiative using the REDCap mobile app. Univariate and multivariate logistic regression were used to investigate the relationship between the key demographic and clinical variables with MNM. The creation of the database was approved by the TGSH clinical care committee in February 2020 and the University of Iowa Institutional Review Board approved the de-identified data analyses.

RESULTS: There were no maternal deaths and 70 MNM during the study period. The median patient age was 26 years (IQR 23-30); 49% of women were nulliparous, and 56% delivered vaginally. Patients had higher odds of experiencing MNM if living in a rural area (OR=3.71, $p<0.01$) or with a hypertensive disorder of pregnancy (OR=2.27, $p=0.03$). The postpartum hemorrhage rate was 1.7%.

CONCLUSION: The MNM and mortality rates at TGSH were less than elsewhere in the region. Living in a rural area and having hypertensive disorders of pregnancy were major predictors of MNM events. Future quality improvement projects should be developed to increase antenatal care attendance, help rural women receive antenatal care, and improve treatment for hypertensive disorders in pregnancy.

KEYWORDS: Maternal health, maternal mortality, global health, hypertensive disorders of pregnancy, Ethiopia

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INTRODUCTION

The maternal mortality rate frequently serves as a metric for the quality of obstetric care in a country. High maternal morbidity and mortality remain a challenge in low- and middle-income countries, despite advances in the number of trained obstetricians and availability of hospitals. While Ethiopia was one of many countries that failed to meet the Millennium Development Goal to reduce the maternal mortality ratio (MMR) by 2015, the country made strides in reducing its MMR from 676 maternal deaths per 100,000 live births in 2011 to 412 per 100,000 in 2016.[1, 2] Currently, in the higher income countries, maternal mortality ranges widely from 2 out of 100,000 in Norway to 19 out of 100,000 in the United States.[3] The Sustainable Development Goals now provide a target to reduce the global MMR to fewer than 70 deaths per 100,000 live births and to limit the MMR in any single country to less than 140 maternal deaths per 100,000 live births.[4] Severe maternal morbidity, usually referred to in Ethiopia as Maternal Near Miss (MNM), is often an important marker of cases where a mortality was narrowly avoided, and MNMs are frequently areas where care improvement can be targeted to improve the overall MMR.[5]

At Tibebe Ghion Specialized Hospital (TGSH) in Ethiopia, initial efforts to design quality improvement projects aimed at improving the MMR or avoiding MNM events were limited by a lack of baseline data regarding the causes of morbidity and/or mortality. This study, the Ethiopian Maternal Near Miss (EMNM) Project, was part of an international collaboration formed as an offshoot of the 2015-2018 collaboration between the American College of Obstetrics and Gynecology and the Ethiopian Society of Obstetrics and Gynecology.[6] We aimed to track baseline maternal data for use in future quality improvement initiatives and ultimately help to reduce the MMR. The primary objective of this study was to estimate the prevalence of and contributing factors to maternal mortality and MNM at TGSH in Bahir Dar, Ethiopia.

METHOD AND MATERIALS

A single-institution cross-sectional study was conducted as part of a clinical quality improvement initiative. We developed a Research Electric Data Capture (REDCap) database that tracked demographic and clinical outcome data on all pregnant patients delivering at TGSH. The project was reviewed and approved by the TGSH hospital clinical care committee in February 2020. The Institutional Review Boards at the University of Iowa and TGSH do not require approval for quality improvement projects. The de-identified data review done by University of Iowa researchers was considered exempt by the University of Iowa Institutional Review Board (IRB #201912070).

The WHO Maternal Near Miss criteria modified for Sub-Saharan Africa were used to define MNM. These criteria utilize only clinical, lab, and management elements that are readily available in low-resource settings. Previously, the criteria effectively identified all MNM cases when used in eastern Ethiopia, compared to underreporting that occurred with use of original WHO criteria.[7,8] Our REDCap database was set up for use with the REDCap mobile app, which allows for offline data entry when internet is unavailable.

Bahir Dar, located in northern Ethiopia, is the capital city of the Amhara region. The population of Bahir Dar is approximately 751,000, as of 2016. Patients from Bahir Dar and surrounding communities come to TGSH, a referral institution, for obstetric and delivery care. The hospital is a teaching institution affiliated with Bahir Dar University and hosts medical students and obstetrics and gynecology residents. Twenty-eight weeks gestation is considered the age of infant viability in this setting.

Data were collected between February 26 and June 10, 2020. All patients who delivered at TGSH during the time period were included and there were no exclusion criteria. All data were obtained from hospital paper charts. Data collection was stopped on June 10, 2020 secondary to the COVID-19 pandemic.

Demographic and clinical outcome variables were summarized. The relationship between demographic and clinical variables with MNM events as a primary outcome were analyzed. Secondary outcomes analyzed included hypertensive disorders of pregnancy (HDP) and neonatal Apgar scores. Continuous measures are displayed as counts and percentages. Chi-square tests of independence were performed to examine the relation between two categorical variables. Multivariate logistic regression was used for the relationship between one or multiple predictors with dichotomous outcome variables including MNM events, HDP, or dichotomous Apgar scores. Comparisons with p-values <0.05 were considered statistically significant and those variables found to meet this significance threshold were chosen for multivariable analysis. All analyses were performed using SAS 9.4 (Cary, NC).

RESULTS

There were 658 consecutive deliveries from February 26 to June 10, 2020. Complete data were available for 637. Twenty-one women who delivered during the study period had incomplete clinical charts and they were not included in the data analysis. The total number of deliveries during the study period was verified by comparison to tallies submitted to the Ethiopian Ministry of Health. Subsequent review of the 21 incomplete charts suggested that these were largely precipitous deliveries in which the patient discharged quickly before documentation could be completed.

Patient demographic information is presented in Table 1. The median age of patients was 26 years old (range 15-43, interquartile range (IQR) 23-30); 74.6% were from an urban area. Almost all women (97.5%) reported being married. Approximately 30% of patients reported being unable to read or write, while 19% had attended college or beyond.

Patient antenatal and delivery information is presented in Table 2. Approximately half of patients were nulliparous (48.9%). More than 80% of patients had three or fewer prior pregnancies. Gestational age was most commonly determined by last menstrual period or time of quickening, which led to a wide range of estimated gestational ages. More than two-thirds of patients had four or more antenatal care (ANC) visits.

Table 1. Demographics of patients delivering at Tibebe Ghion Specialized Hospital, Bahir Dar, Ethiopia, 2020 (n=637)

Variable	Statistics
Age in years – Median (IQR)	26 (23-30)
Monthly Income in Ethiopian Birr – Median (IQR)	3000 (1500-5000)
Household Location – n (%)	
- Urban	475 (74.6)
- Rural	162 (25.4)
Distance lived from hospital – n (%)	
- <50km	556 (87.3)
- 50-100km	55 (8.6)
- >100km	26 (4.0)
Marital Status – n (%)	
- Single	11 (1.7)
- Married	621 (97.5
- Divorced	4 (0.6)
- Widowed	1 (0.2)
Education Status – n (%)	
- Unable to read or write	194 (30.5)
- Can read and write	4 (0.6)
- Primary school	183 (28.7)
- High school	135 (21.2)
- College and above	121 (19.0)
Patient Occupation – n (%)	
- Housewife	260 (40.8)
- Farmer	154 (24.2)
- Employee	91 (14.3)
- Merchant	87 (13.7)
- Other	45 (7.1)

Table 2. Antenatal and delivery Information for February 26—June 10, 2020, Tibebe Ghion Specialized Hospital, Bahir Dar, Ethiopia (n=637)

Variable	Category	n (%)
Gravidity (including current pregnancy)	1	279(43.8)
	>1	358(56.2)
Parity (excluding current delivery)	Nulliparous (0)	312 (49.0)
	Multiparous (1-4)	292 (45.8)
Gestational Age of Current Pregnancy (weeks)	Grand Multiparous (>5)	33(5.2)
	28 – 36 weeks	92 (14.4)
	37-42 weeks	373 (58.6)
	> than 42 weeks	51 (8.0)
	Unknown	(19.0)
Plurality of current gestation	Singleton	617 (96.9)
	Twin	20 (3.1)
Did patient receive antenatal care?	Yes	621 (97.5)
	No	16 (2.5)
Number of antenatal visits	1	14 (2.25)[a]
	2	55 (8.86)
	3	126 (20.29)
	4	198 (31.88)
	5	125 (20.13)
	6	64 (10.31)
	7	17 (2.74)
	8	14 (2.25)
	More than 8	7 (1.13)
Location of antenatal care visits	Local Health Center	376 (59.0)
	Other government hospital	48 (7.5)
	Private institution	71 (11.2)
	Tibebe Ghion Specialized Hospital	228(35.8)
Antepartum Complications or Risk Factors	Antepartum hemorrhage	11 (1.7)
	Hypertensive disease [b]	48 (7.5)
	Cardiac disease	3 (0.5)
	Pre-existing or gestational	10 (1.6)
	diabetes	9 (1.4)
	HIV	2 (0.3)
	Malaria	15 (2.4)
	Hepatitis B	34 (5.3)
	Anemia	20 (3.1)
	Syphilis	2 (0.3)
	Maternal age <16 y	58(9.1)
Mode of delivery	Vaginal Delivery	381 (59.8)
	Forceps-assisted vaginal delivery	8 (1.3)
	Cesarean Delivery	248 (38.9)

[a]Antenatal care number of visits calculated for the 621 women that did receive antenatal care
[b]Antepartum hypertension included chronic hypertension, gestational hypertension, and pre-eclampsia diagnosed prior to admission. By time of discharge, it was noted that 100 women had a diagnosis of hypertensive disorder of pregnancy

Antepartum complications included HDP (7.5%), anemia (5.3%), syphilis (3.1%), Hepatitis B (2.4%), gestational or pre-existing diabetes (1.5%), HIV (1.4%), and malaria (0.3%). Several cases of HDP were diagnosed during the delivery admission; by discharge, 100 total cases of HDP had been diagnosed in our study population (15.72%).

There were no maternal deaths at TGSH during the study period. There were 70 patients with MNM, for a prevalence of 11.0%. There were 27 cases (4.2%) of sepsis and 11 cases (1.7%) of postpartum hemorrhage noted. Figure 1 shows the frequency of each type of MNM, based on the WHO MNM criteria modified for Sub-Saharan Africa. Many of the women who met criteria for an MNM had more than one severe event occur.

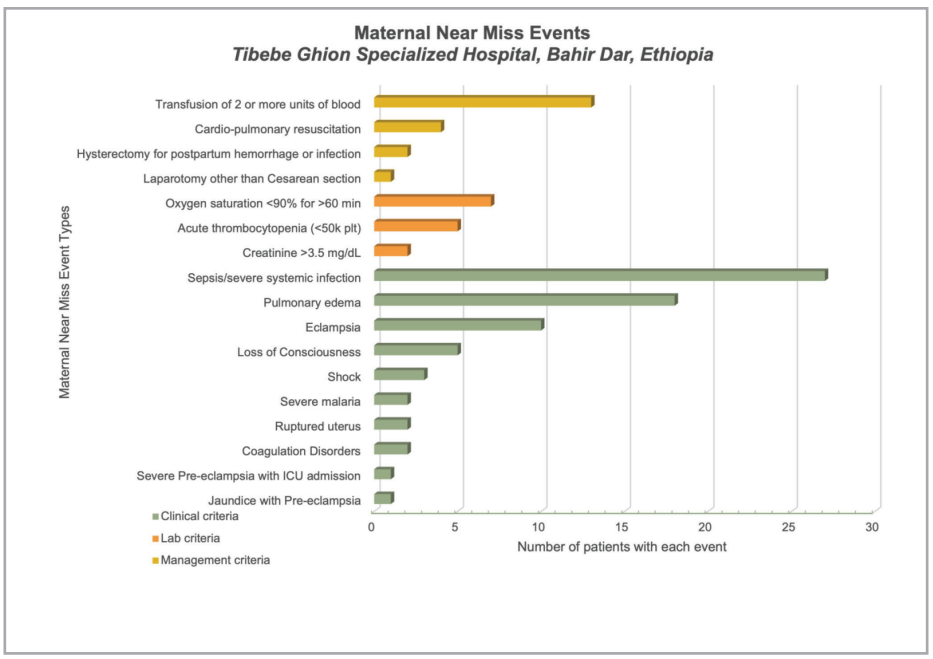

Figure 1 – Number of patients with specific Maternal Near Miss (MNM) events. Frequency of qualifying MNM events using the WHO Maternal Near Miss events tool adapted for Sub-Saharan Africa. There were 70 patients with MNM events, but 105 events total given that some patients met criteria with more than one qualifying event.

Table 3. Association of key demographic and clinical variables with experiencing a Maternal Near Miss (MNM) 2020, (n=70 patients with MNM events; n=100 patients with Hypetensive Disorders of Pregnancy)

Variable	MNM		AOR (95%CI)	p-value
	N	%		
Hypertensive disorders of pregnancy				
-Yes	61	61.00%	10.41 (6.06-17.91)	<0.01
-No	39	39.00%		
Location:				
-Rural	36	22.22%	3.71 (2.23-6.17)	<0.01
-Urban	34	7.16%		
Distance lived:				
-50-100km	14	25.45%	4.07 (2.06-8.07)	<0.01
->100km	13	50%	11.93 (5.20-27.39)	<0.01
-<50km	43	7.73%		
Occupation:				
-Employee	5	5.49%	.26 (.10-.71)	<0.01
-Merchant	5	5.75%	.27 (.10- .74)	0.01
-Other	7	15.56%	.83 (.34-2.05)	0.68
-Housewife	25	9.62%	.48 (.27-.86)	0.01
-Farmer	28	18.18%		

Table 3 shows the association of key demographic and clinical variables with MNM. In the bivariate analysis, the odds of experiencing MNM was 3.71 times higher for women living in a rural area than women living in an urban area (95% CI: 2.23-6.17; p <0.01). Patients' occupation was a significant predictor for MNM events (p<0.01). When controlling for number of ANC visits, patient age, education status, number of prior deliveries, and current gestational age, women who identified as farmers were more likely to experience MNM (AOR 3.51, 95% CI: 1.72-7.17; p<0.01). The patients' age, income, and education level were not found to be statistically significant risk factors for having an MNM.

Analysis of our secondary objectives revealed that distance from the hospital was correlated with having HDP (p<0.01). Specifically, the crude odds ratios of having HDP were 3.72 (95% CI: 2.02-6.85; p<0.01) and 6.04 (95% CI: 2.68-13.61; p<0.01) for patients living 50-100 km and more than 100 km, respectively, compared to those living less than 50 km away. The relationship between HDP and dichotomous location (rural vs urban) was not significant. Earlier gestational age of delivery was also significantly related to experiencing HDP (p<0.01). Further analyses in a multivariable logistic model showed that patients delivering at a gestational age of 28-37 weeks had higher odds of having HDP than full-term patients (AOR=2.39, 95% CI: 1.23-4.65, p=0.01).

Bivariate logistic regression was also fit to test the relationship between HDP and MNM or Apgar scores. In women with HDP, the crude odds of having an MNM were 10.41 times higher (95% CI: 6.06-17.91; p<0.01) and the crude odds of having a newborn with an Apgar score <7 at 5 minutes was 2.27 times higher (95% CI: 1.05-4.90; p=0.04). However, there was no significant difference for the 1 min APGAR score (COR=1.84, 95% CI: 0.92-3.67, p= 0.08).

DISCUSSION

In this study of all deliveries over a 3.5- month period at a tertiary referral hospital in Bahir Dar, Ethiopia, maternal morbidity and mortality were lower than in surrounding regions. HDP were the most common obstetric complications, and a major contributor to maternal morbidity.

The MNM rate at TGSH was 11% during our study period, which is less than half that (23%) found in a study of the surrounding Amhara region in 2015.[9] That study included 806 women from 5 regional hospitals, and many demographic characteristics were similar to the current study. However, some differences included that half of the mothers in the Amhara regional study reported being illiterate whereas only 30% of the mothers in the TGSH study were. The median monthly income was higher in the TGSH study at 3000 Birr (about $80) as opposed to 2000 Birr (about $50) in the Amhara regional cohort. The education and income level differences may be explained by the urban to rural ratio in each study; the ratio was 75:25 in the TGSH study and 38:62 in the Amhara regional hospital cohort. These differences in the two populations may explain some of the differences between the findings in the studies.

The amount of prenatal care received in our study was higher than both that seen in the previous study of Amhara and elsewhere in Ethiopia. In the past, the WHO recommended a minimum of 4 ANC visits, but updated this recommendation to 8 visits in 2016.[10] According to the most recent Ethiopian Demographic and Health Survey, 43% of pregnant women received at least 4 ANC visits,[2] as did 66.7% of patients in our study. However, only 3.38% of women at TGSH had 8 or more ANC visits. We identified increasing ANC attendance as a future focus for quality improvement projects. A recent systematic review found that despite proven benefits of excellent ANC, research on interventions to improve ANC adherence in sub-Saharan Africa is extremely limited.[11] Interventions focused on incentives to attend

care or improved planning of visits were effective[11] and serve as a suggestion for potential future projects at TGSH.

The women in this study who lived in a rural area were found to have higher odds of experiencing MNM (OR=3.71) and the further patients lived from the hospital, the more likely they were to have HDP. This is similar to findings from a matched case-control study in the Tigray region of Ethiopia, just north of Bahir Dar, which noted that women from rural areas had nearly twice the prevalence of HDP compared to their matched controls (OR=3.7, 95% CI; 1.9-7.1)[12]. Our study did not assess what factors may have caused rural women to have more adverse events; however, this is an area ripe for further study. Others have proposed interventions to improve transportation to bring rural women to skilled obstetric care,[13] as well as improved communication on transfer between rural health posts and higher-level care.[14] These provide potential models for future interventions.

The most significant contributors to maternal morbidity in our study were HDP with a prevalence of 15.7% (100 women). The WHO attributes 14% of all global maternal deaths to HDP[15]. A 2012 study showed that 19% of maternal deaths in Ethiopia were due to HDP[16], and a 2018 meta-analysis found that about 6% of all pregnancies in Ethiopia were complicated by a hypertensive disorder.[17] The TGSH prevalence rate is over twice that of the national average, which likely reflects TGSH being a referral hospital. The finding of an association of preterm gestational age with hypertension in this cohort is likely because serious hypertensive disorders could justify iatrogenic preterm delivery. Given the high prevalence of HDP in the cohort, and the fact that HDP were the biggest risk factor for MNM, improved care for HDP was identified as a major area to target future quality improvement projects. Implementation of a safety bundle to improve the care of HDP, for example, could help prevent MNM events and improve maternal and neonatal outcomes, as has been done elsewhere.[18] .

It was unexpected that the rate of postpartum hemorrhage in our study was quite low (1.73%). A recent chart review of 144 patients within the same region of Ethiopia showed a postpartum hemorrhage rate of 7.6%[19]; the rate in the United States is approximately 3%.[20] We did not evaluate methods for estimating blood loss and it has been noted elsewhere that even experienced clinicians frequently underestimate blood loss at time of delivery.[21,22] Another potential intervention may be to specifically evaluate blood loss quantification at time of delivery in order to recognize hemorrhage and assure that patients with a hemorrhage are managed in a timely fashion. A project that included quantification of postpartum blood loss in a similar setting in Malawi serves as a model.[23].

The implementation of this project as part of an international academic collaboration is itself notable. Others have recommended this type of collaboration as a way to address maternal health improvement goals in low-resource settings.[6, 24] While electronic records had not previously been used at TGSH due to unstable internet availability, REDCap mobile was identified as a feasible tool, given that data could be entered offline and uploaded later when internet was available. International collaborators helped with development of the database and trained local collaborators to implement the data collection system. Communication via international messaging applications, emails, and video calling was essential to maintain strong involvement and collaboration from both sides, particularly during the unprecedented travel restrictions of the COVID-19 pandemic.

Strengths of this study included prospective capture of all consecutive births during the study period. Limitations included the single center design, which may not completely reflect regional population-based maternal mortality or morbidity. While TGSH specializes in maternal care, it has limited Intensive Care Unit capacity. Thus, some critical obstetric patients may be routed to another regional hospital, which was not documented.

In conclusion, maternal morbidity and mortality were lower than elsewhere in Ethiopia in this study from Bahir Dar. The study findings emphasize the importance of antenatal care, maternal literacy and education, and perinatal care challenges for patients living in rural locations. HDP were common and led to significant morbidity; care for these HDP are an area ripe for future intervention and quality improvement projects. The PPH rate was unexpectedly low and merits further investigation. Antenatal care is not yet at the new target of the WHO's recommendations and can be improved. Thus, this cross-sectional study of maternal care in Bahir Dar, Ethiopia, illustrates current maternal care strengths and challenges and also highlights opportunities for future quality improvement initiatives.

DECLARATIONS

Author Contributions

JDH wrote the initial draft of the article and analyzed the data; MBR was the international principal investigator, helped conceive of the initial idea for the study, directed implementation, and significantly revised and edited the manuscript; AmM designed the REDCap database, helped implement the database on-site, did initial data collection, and edited the manuscript; EM, KK, and ASM helped conceive of the initial idea for the study, directed initial implementation of the study on site, and edited the manuscript; BW helped with REDCap on-site training, initial data collection, and manuscript editing; NA trained data collectors and assisted with initial project implementation and manuscript editing; CW performed statistical analysis and wrote key portions of the manuscript; AW was the on-site principal investigator for the study, oversaw all aspects of the study implementation and edited the manuscript.

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Conflicts of Interest

The authors report no conflicts of interest.

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