

## Prevalence and Risk Factors Associated with Maternal Near Miss Events in the Upper East Region of Ghana

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### Abstract

A maternal near miss (MNM) event is a severe life-threatening maternal morbidity that reflects quality of obstetric care. It is considered a proxy of maternal mortality and predictor of quality obstetric care. The major underlying causes of MNM are hypertensive disorders, obstetric hemorrhage, sepsis and abortion complications. MNM is a more frequent event than maternal mortality and share several features together. Inquiries into deficiencies and critical assessment of health care quality, identify health system deficiencies, and help develop robust strategies for maternal care. We conducted a cross-sectional descriptive study to determine the prevalence and underlying causes of MNM. The study respondents were women aged 15 - 49 years with pregnancy experience in 2020 who had health facility care. Primary and secondary data were collected at households and health facilities respectively using electronic platform, KoBoCollect. STATA version 15.0 was used to analyze the data. The prevalence of MNM was 11.30%. The main underlying causes were complications of caesarean section, hypertensive disorders, anemia, obstructed labor, and antepartum hemorrhage. The main signal functions of emergency obstetric and newborn care (EmONC) employed to avert death were parenteral antibiotics, blood transfusion, caesarean section, and magnesium sulphate. The prevalence of MNM in the Upper East region was high. The region can reduce severe maternal morbidity and mortality by strengthening health systems, improving access to high-quality obstetric care and training healthcare providers to prevent and treat the major underlying causes of MNM identified in this study.

**Keywords:** Ghana, MNM, Mortality, Prevalence, Antepartum, Hemorrhage, EmONC.

### Introduction

Maternal near miss (MNM) is an important maternal health indicator which provides significant insight into maternal mortality [1, 2]. Maternal mortality is a global health issue that reflects health care quality inequalities and highlights the development gap between rich and poor nations [3]. The continued high maternal mortality ratios posted by least developed countries is indicative of underfunding of primary health care services, lack of skilled health providers, supply chain inefficiencies and

stockout of medical supplies [4]. As a result, maternal mortality ratio is regarded as the key measure of the level of quality obstetric care provided [5, 6]. The World Health Organization (WHO) defined MNM as a woman who nearly died but survived a complication that occurred during pregnancy, childbirth, or within 42 days of termination of pregnancy [6 - 8]. The survival could either be due to high quality obstetric care received or by chance [6, 7]. MNM is a more frequent event than maternal mortality and both share several features including association with

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inadequate and poor quality of obstetric care [1, 2, 7, 9]. In Ethiopia, MNM was estimated to be 12 times more frequent than maternal mortality [10, 11]. MNM is thus considered a proxy of maternal death and a predictor of the quality of obstetric care [1].

The global prevalence of MNM is 1.4% [10, 12, 13,] with higher burden in Africa and Asia [2, 7, 14]. In 2012, Tuncalp et al. found a hospital-based incidence of MNM in Accra, Ghana to be 3% [14]. It has been estimated that for every woman that dies, about 20 more experience acute and chronic obstetric complications from direct cause of obstetric complication [7, 13, 15]. MNM is a multifaceted issue associated with socio-economic status, health events, health worker competence and sub-standard facilities [16, 17, 18]. The markers of MNM include experience of a potentially life-threatening pregnancy condition, receiving a critical maternal intervention or signal function of EmONC and evidence of organ dysfunction [19-23]. The underlying causes of MNM include poverty, lack of maternal education, lack of maternal autonomy to seek medical care, poor access to high-quality obstetric care, obstetric hemorrhage, hypertensive disorders of pregnancy, poor practice of birth preparedness and complications readiness plan, pre-existing medical condition, induction of labor, sepsis, ruptured uterus, abortion complications, the three delays of obstetric care and previous caesarean section (1, 7, 8, 10, 15, 24-27). The provision of signal functions of EmONC such as blood transfusion, laparotomy, magnesium sulphate and parenteral antibiotics to manage obstetric complication is indicative of MNM [7, 10]. Based on the association between maternal death and MNM, lessons learnt from MNM studies can provide critical assessment of health care quality, identify health system deficiencies and help develop alternative strategies for combating severe maternal morbidity and mortality [1, 7, 8, 10, 28-30]. This paper therefore examined the prevalence of MNM and

its associated risk factors in Upper East region of Ghana.

## **Materials and Methods**

### **Study Area**

This study was conducted in Upper East region located in the northern part of Ghana. Ghana is a lower middle-income country in West Africa. The region occupies 2.7% of Ghana's land mass constituting 8,842 km<sup>2</sup>. The region had a projected population of 1,302,718 in 2020 with an annual growth rate of 1.2%. The total fertility rate was 4.9. Women in fertility age (WIFA) were 312,652 with annual expected pregnancy estimated as 52,109. The region had one (1) Regional hospital, 6 District hospitals, 48 Health centers and 233 demarcated CHPS zones or national primary health care divisions according to 2020 annual projections. This region is deprived with high levels of poverty [31].

### **Study Design**

This was a cross-sectional descriptive study conducted according to the STROBE guidelines [32]. We assessed the prevalence of maternal near miss and associated risk factors. This was part of a cost-effectiveness analysis of a community emergency transport system study. The adapted sub-Saharan Africa MNM criterion was used to classify women with life-threatening complications, critical interventions, or signal functions of EmONC as well as evidence of organ dysfunction [33].

### **Study Population and Sampling Strategy**

The study population was all women aged 15 - 49 years with experience of pregnancy within the period January to December 2020 in the Community-based Health Planning and Services (CHPS+) project area. CHPS zone is a national mechanism to deliver essential community-based health services involving planning and service delivery with communities. It refers to a demarcated geographical area of a 4-kilometer radius and between 4500-5000 persons or 750

households in densely populated areas [34]. The CHPS+ was a 5-year Primary Health Care (PHC) project implemented in 120 CHPS zones by Ghana Health Service in Upper East region with support from Korea International Cooperation Agency (KOICA) [31]. Using Taro Yamane formula,

$$n = \frac{N}{1 + Ne^2}$$

for proportions [35] at a precision level (e) of 0.05 with N, as the population (1,302,718), the sample size estimated was 400. The final sample size was 440 after adding 10% for non-response.

The study adapted the CHPS+ project implementation sampling strategy to select 100 CHPS zones out of the 120 covering all the districts in the region [31]. A multi-staged random selection was used to select at least one community and households from the selected CHPS zones. In each of the selected households, all females aged 15 - 49 years with pregnancy experience between January 1 – December 31, 2020, in the household who met the inclusion criteria were selected into the sample until a sample of 5 respondents was achieved. In all 440 respondents constituting the sample were selected for the study.

### Variables and Data Collection

Primary data were collected at the household level through face-to-face interviews and

secondary data were abstracted from obstetric records at respective health facilities. The electronic platform, KoBoCollect, was used for data collection. The data collected included socio-demographic, obstetric characteristics of women, means of referral transport to health facility for childbirth and obstetric emergency during the period.

### Data Analysis

STATA version 15.0 was used for statistical analysis. Descriptive analysis was conducted on socio-demographic characteristics, access to obstetric care and information variables, obstetric characteristics, transportation, and communication variables. The results were presented as frequencies and percentages for variables of interest.

### Results

#### Socio-demographic Characteristics of the Women

A total of 416 pregnant women were studied. The age of women ranged from 15 – 47 years with a mean of  $26.2 \pm 8.1$  years. Almost all the women were married, and majority were of Christian faith. In addition, majority of women had no formal education and less than 10% had tertiary education. Majority of the women were farmers followed by traders. The predominant ethnic groups among the respondents were the Kusaal and the Frafra (Table 1).

**Table 1.** Socio-demographic Characteristics of the Women

Variable	Frequency (n)	Percentage (%)
<b>Age of women (Years)</b>		
<b>Range:</b> 15 – 47		
<b>Mean:</b> $26.2 \pm 8.1$		
<b>Marital status</b>		
Married	407	97.84
Never Married	4	0.96
Separated/divorced	3	0.72
Co-habiting	2	0.48
<b>Religious affiliation</b>		
Christianity	258	62.02
Islam	140	33.65

Traditional	18	4.33
<b>Level of education</b>		
No education	171	41.11
Middle/JHS	89	21.39
Primary	67	16.11
SHS/Vocational	56	13.46
Tertiary	33	7.93
<b>Husband's educational status</b>		
No education	178	42.79
Middle/JHS	87	20.91
Primary	65	15.63
SHS/Vocational	54	12.98
Tertiary	32	7.69
<b>Husband's primary occupation</b>		
Farming	294	70.67
Trading	53	12.74
Salaried employee	38	9.13
Unemployed	16	3.85
Artisan	10	2.40
Others	5	1.2
<b>Monthly household income</b>		
Range (GHC): 7.00 - 2000.00		
Range (USD): 1.43 - 408.16		
Median (IQR) (GHS): 100.00 (40.00 - 150.00)		
Median (IQR) (USD): 20.41 (8.16 - 30.61)		
<b>Ethnicity</b>		
Kusaal	132	31.73
Frafra	117	28.13
Buli	45	10.82
Bimoba	43	10.34
Kasem	35	8.41
Nankani	15	3.61
Busanga	11	2.64
Others	18	4.33

GHC4.9 = 1USD

### Access to Obstetric Care and Information

Almost all the women had financial access to care by means of holding active National Health Insurance Scheme (NHIS) membership card. Majority, 70% of the women lived within 5 kilometers of an EmONC facility.

The place of care for the majority (60%) of pregnant woman was decided by the husband followed by self (35%). The most common

medium for obstetric information to households was the radio and almost all households own a phone.

The means of calling an ambulance during maternal emergency was by a cell phone (63%), followed by a health worker and lastly, by a community health volunteer (24%). The most common means of referral transportation during maternal emergency was motorbike (51%) and

motorking tricycle ambulance (34.62%) (Table 2).

### **Obstetric Characteristics of the Women**

Majority (54%) of the women were multipara and 94% of them carried their last pregnancy to maturity or term. The mode of delivery was mostly normal vaginal delivery while only 8.65% of the women had caesarean section. Majority of the neonates were of the male gender (54%).

The most common places for childbirth were the health centre (46%) and the hospital (38%). Almost all mothers had caregivers during health facility admission. All the women survived (Table 3).

### **Risk Factors Associated with Maternal Near Miss Events**

The underlying causes of potential life-threatening conditions of the women were hypertensive disorders of pregnancy, obstructed labor, antepartum hemorrhage, anemia, ruptured uterus, abortion and caesarean section complications (Table 4). The main critical interventions or signal functions provided to the women were caesarean section to manage obstetric complications, blood transfusion due to maternal anemia and caesarean section bleeding complication, hysterectomy, magnesium sulphate protocol for severe preeclampsia and eclampsia, and parenteral antibiotics for sepsis from abortion and caesarean section complication (Figure 1).

### **Prevalence of MNM**

Out of the 416 study respondents, 47 met the criterion for MNM giving a MNM prevalence of 11.3% (Figure 2).

### **Categorization of MNM**

The categorization of life-threatening complications experience and critical interventions or signal function received by the women based on MNM criterion led to the determination of 47 MNM (Table 5).

## **Discussion**

The objective of this study was to determine the prevalence and underlying causes of MNM in the Upper East region. The computed prevalence of MNM was 11.3%. The prevalence in this study was much higher than the global pooled prevalence of 1.4% [13] and the hospital-based incidence of 3% in Accra, Ghana [36]. The lower incidence in Accra could be due to better access and quality of obstetric care being the capital city of Ghana compared to the deprived northern part of the country where the study was conducted [31]. However, the MNM prevalence of 11.3% in this study was consistent with 12.2% reported for sub-Saharan Africa [10] but substantially lower than 16.1% in Sidama region of Ethiopia, 15.8% in northwest Ethiopia, 94.1% in South Sudan, 31.5% in northeast region of Brazil and 25.2% in east Iraq [1, 10, 27].

Majority of women enrolled in this study were of a younger maternal age. The young age of most mothers may have resulted in much lower prevalence compared to other regions such as Ethiopia, South Sudan, East Iraq since MNM prevalence has been reported to increase with advanced maternal age [1, 7, 8, 12, 14]. Furthermore, higher age especially above 35 years is associated with chronic maternal medical disorders such as hypertensive disorders of pregnancy; a major underlying cause of MNM [1, 7, 8, 12, 14]. The study also found that majority of the women and their husbands had no formal education. Low maternal and paternal education has implications for accessing obstetric information and health seeking behavior [12]. Additionally, 50% of the women and their husbands were engaged in subsistence peasant farming with low median monthly household income of GHC100.00 (20.41USD) and therefore mostly poor. Elsewhere, it has been reported that poverty and lack of maternal education are important underlying causes of MNM [1, 7, 10, 24, 25]. Although the study found good financial access to obstetric care and about 70% of the women also had good physical access since they lived within 5 km of an

EmONC facility nonetheless, weak maternal autonomy where in about 60% of households, husbands decided the place of care during pregnancy undermines prevalence of MNM. This is because poor physical access to care and low maternal autonomy are underlying factors of MNM [1, 7, 8].

The findings further showed that over 70% of the women were multipara and about 18% had some maternal complication with varying degree of severity. Additionally, over 46% of the women delivered at a Health centre and 8% had caesarean section delivery. Though caesarean section rate was lower than the 10 -15% recommended by the WHO, previous surgical delivery has been reported to increase the likelihood of MNM in the future from complications of hemorrhage, placental accreta in scar tissue, thromboembolism, uterine rupture and so on [10, 13, 37]. To minimize unnecessary risks for women, cesarean section particularly elective non-medical procedures should be undertaken with caution [37].

The main underlying causes of MNM identified in this study were caesarean section complications (45%), hypertensive disorders of pregnancy (21%), anemia (21%), obstructed labor (4.25%), antepartum hemorrhage (4.25%), ruptured uterus (2%) and abortion complication (2%). These findings are consistent with many other studies. Letorp et al. reported major causes of MNM in their study as eclampsia (42%), postpartum hemorrhage (13%) and iatrogenic complications of caesarean section (7.9%) [37]. In the study by Tolesa et al., nearly 50% of causes of MNM were due to hypertension disorder of pregnancy, then sepsis, obstetric hemorrhage, ruptured uterus and nearly with 75% occurring before arrival at the health care facility [10]. The Accra study also reported hypertensive disorders, obstetric hemorrhage, and anemia as major causes of MNM events [36]. The high proportion of caesarean section

associated with MNM has been thought to be probably confounded by the complication necessitating surgical intervention [37]. This study further found that the main critical interventions or signal functions of EmONC employed were parenteral antibiotics (32%), blood transfusion (28%), caesarean section (27%), magnesium sulphate (12%) and hysterectomy (2%). This finding is similar to that of Geleto et al. who reported the most frequent signal function performed in their study as parenteral antibiotics followed by parenteral anticonvulsants and lastly, blood transfusion [7].

### **Limitations of the Study**

The limitations of this study were recall biases from respondents and some poor documentations in secondary data sources. However, the probing techniques used in data collection reduced the recall biases. Therefore, we believe the limitations had minimal effect on the results.

### **Conclusion**

MNM provide considerable insight into the quality of obstetric care and underlying causes of maternal morbidity and mortality. In this study, the prevalence of MNM was high implying inadequate quality of obstetric care. The main underlying causes were complications associated with caesarean section, hypertensive disorders of pregnancy and maternal anemia. The most frequent signal functions used to avert maternal death was parenteral antibiotics, blood transfusion, caesarean section and magnesium sulphate. Severe maternal morbidity and mortality can be reduced by mobilizing additional resources to strengthen health systems, improving access to high-quality obstetric care and training healthcare providers to prevent and treat pregnancy and childbirth complications.

**Table 2.** Access to Obstetric Care and Information

<b>Variable</b>	<b>Frequency (n)</b>	<b>Percentage (%)</b>
<b>Possession of active NHIS card during pregnancy</b>		
Yes	411	98.80
No	5	1.20
<b>Distance from house to nearest health facility</b>		
Less than 1 km	83	19.95
1 – 5 km	208	50.00
Above 5 km	116	27.88
Don't know	9	19.95
<b>Person who decided place of care during pregnancy</b>		
Husband	245	58.89
Self	147	35.34
Mother-in-law	12	2.88
Health worker	8	1.92
Father-in-law	3	0.72
Brother-in-law	1	0.24
<b>Medium of maternal information to household (multi-response)</b>		
Radio	377	58.81
Television	132	20.59
Social media	87	13.37
Newspaper	12	1.87
Other media	33	5.15
<b>Household ownership of phone</b>		
Yes	402	96.63
No	14	3.37
<b>Household means of calling an Ambulance in an emergency</b>		
Mobile phone	263	63.22
Health staff/CHV	100	24.04
Use of Motorbike	8	1.92
None	45	10.82
<b>Means of transport to health facility during maternal emergency</b>		
Motorbike	212	50.96
Motorking ambulance	144	34.62
National ambulance	2	0.48
Private vehicle	6	1.44
Walking/bicycle	52	12.50

**Table 3.** Obstetric Characteristics of the Women

<b>Variable</b>	<b>Frequency (n)</b>	<b>Percentage (%)</b>
<b>Parity</b>		
1	113	27.16
2-4	223	53.61
≥5	80	19.23

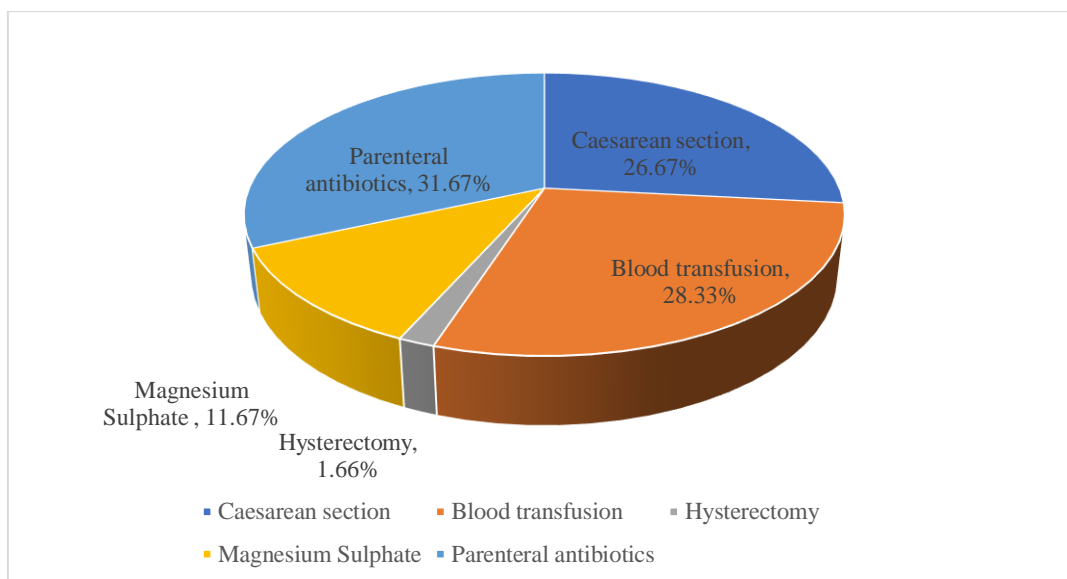
<b>Gestational age of last pregnancy</b>		
Full term	392	94.23
Post term	16	3.85
Preterm	8	1.92
<b>Final mode of delivery</b>		
Caesarean section	36	8.65
Vaginal delivery	380	91.35
<b>Maternal complications</b>		
No complication	340	81.73
Complication	76	18.27
<b>Sex of baby</b>		
Male	234	54.17
Female	198	45.83
<b>Place of delivery</b>		
Hospital	161	38.70
Health Centre	192	46.15
CHPS Compound	58	13.94
Others	5	1.20
<b>Number of accompanying care givers for delivery</b>		
1-2 caregivers	343	82.45
At least 3 caregivers	57	13.70
No caregiver	16	3.85
<b>Outcome of maternal care</b>		
Alive	416	100

**Table 4.** Underlying Causes of Maternal Near Miss Events

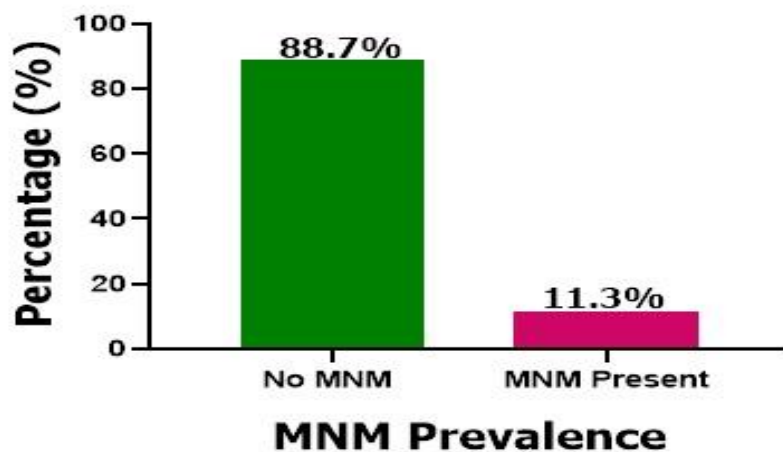
<b>Underlying causes of MNM</b>	<b>Frequency (n)</b>	<b>Percentage (%)</b>
Hypertensive disorders in pregnancy <sup>a</sup>	10	21.28
Obstructed labour <sup>b</sup>	2	4.25
Antepartum hemorrhage	2	4.25
Anemia	10	21.28
Ruptured uterus	1	2.13
Abortion complication <sup>c</sup>	1	2.13
Caesarean section <sup>d</sup>	21	44.68

<sup>a</sup>: Severe preeclampsia and eclampsia, <sup>b</sup>: Prolong labour and cephalo-pelvic disproportion, <sup>c</sup>: Septic abortion, <sup>d</sup>: Other indications of caesarean section; fetal distress, cord prolapse, bad obstetric history, poor progress of labour & failed induction of labour.





**Figure 1.** Critical Interventions or Signal Functions Associated with MNM Events



**Figure 2.** Prevalence of MNM

**Table 5.** Categorization of MNM

MNM	Frequency (n)	Percentage (%)
Severe pre-eclampsia or eclampsia	5	10.64
Severe pre-eclampsia or eclampsia & caesarean section	5	10.64
Prolong labor, cephalo-pelvic disproportion & caesarean section	2	4.25
Antepartum hemorrhage and caesarean section	2	4.25
Severe anemia + blood transfusion	10	21.28
Caesarean section + postpartum hemorrhage + blood transfusion	1	2.13
Cord prolapse + caesarean section	1	2.13
Emergency caesarean section + blood transfusion and parenteral antibiotics	19	40.42
Ruptured uterus + caesarean section + hysterectomy	1	2.13
Septic abortion + parenteral antibiotics	1	2.13

## Declarations

### Author Contribution Statement

WKO conceived and designed the study. WKO, POA and BA conducted the study. WKO, POA and BA analyzed and interpreted the data. WKO, BA, POA and JA contributed resources, materials, analysis tools or data. All authors read and revised the manuscript and gave final approval of the manuscript.

### Data Availability Statement

The datasets used and analyzed during the current study are available upon reasonable request.

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## Ethical Approval

Ethical approval was obtained for the study with number GHS-ERC:016/01/22 from the Ghana Health Service Ethics Committee.

## Declaration of Interest Statement

The authors declare that they have no competing interest.

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