Profile of Maternal Near Miss and Determinant Factors in a Teaching Hospital, Southwestern Nigeria

Olusola Peter Aduloju¹, Tolulope Aduloju³, Oluwadare Martins Ipinnimo²
¹,²Department of Obstetrics and Gynecology, Ekiti State University Teaching Hospital, Ado-Ekiti, Nigeria
³Medical Social Services Department, Ekiti State University Teaching Hospital, Ado-Ekiti, Nigeria

Corresponding author: Aduloju Olusola Peter
Department of Obstetrics and Gynaecology, Ekiti State University Teaching Hospital, Ado-Ekiti, Nigeria
Email: peter.aduloju@yahoo.com or olusola.aduloju@eksu.edu.ng

Abstract

Maternal near miss (MNM) concept is becoming a tool for the assessment of severe maternal morbidity. The study examined the profile of MNM cases and their determinant factors. A cross-sectional study of pregnant women with near miss cases and maternal death using the WHO criteria between 1st January 2015 and 31st December, 2016. Relevant data was collected using a structured data form, analyzed using SPSS version 22 and logistic regression was done to determine factors associated with MNM. The MNM incidence ratio was 17.4/1000 live births with overall mortality index of 17.5%. Hemorrhage (39.4%) was the commonest cause of MNM while uterine rupture (42.8%) was the most common cause of maternal death. Also, dystocia had the highest mortality index of 33.3%. Older age group, low education, rural dwellers and unbooked status of women were the significant determinants of MNM, p < 0.05. MNM mortality ratio was 4.7:1. The worst perinatal outcome occurred in women who suffered maternal death. The study showed suboptimal level of care for women with life threatening conditions. There is a need to develop evidence based protocol for their management and provision of high dependency unit.

Keywords

Maternal near miss; Maternal death; Determinant factors; EKSUTH; Southwestern Nigeria
I. Introduction

Pregnancy and childbirth complications are major causes of maternal morbidity and mortality globally and especially in the developing countries. Women who survive these complications could serve as surrogates to help us gain a better understanding of the set of conditions and preventable factors that contribute to maternal death and this is known

**Abbreviations**

CS - Caesarean Section

EKSUTH - Ekiti State University Teaching Hospital

HDU – High Dependency Unit

ICD - International Classification of Diseases

MI - Mortality Index

MNM - Maternal Near Miss

MMR - Maternal Mortality Ratio

PLTC - Potential Life Threatening Conditions

PPH - Postpartum Haemorrhage

SMO - Severe Maternal Outcome

SPSS - Statistical Package for Social Sciences

WHO – World Health Organization
as maternal near miss concept. Maternal near
miss (MNM) concept is gradually becoming a
tool for the assessment of severe acute
maternal morbidity [1,2]. The World Health
Organization (WHO) defines MNM as “a
woman who almost dies but survives a
complication during pregnancy, childbirth or
within 42 days after termination of pregnancy
[3].

In the past, MNM was defined using different
criteria [4]. There were three major approaches
to the identification of near miss cases:
Clinical criteria related to a specific disease
entity (pre-eclampsia, postpartum hemorrhage);
Management-based criteria
(admission to intensive care (ICU), need for a
blood transfusion); or Organ system
dysfunction based criteria [5, 6]. Depending on
these different approaches, prevalence of near
miss varies. The MNM concept has helped in
overcoming these challenges and WHO has
adopted this as a tool in the assessment of
quality of obstetric care [3, 7].

However, in 2009, the WHO working group
for maternal mortality and morbidity
classifications developed a consensus on
maternal near-miss identification. This is
based on two components: Identification of
potentially life-threatening conditions, which
may or may not be near-miss cases (specific
complications such as severe preeclampsia
and/or critical interventions such as blood
transfusion) and identification of near-miss
cases based on organ system dysfunction and
organ-dysfunction proxies including clinical,
laboratory and management criteria [8]. The
investigation of near miss events provides
important details on factors that may
contribute to both maternal death and near
miss. Knowledge on the prevalence and causes
of near miss may indeed constitute a new form
of evaluating obstetric care [9].

The prevalence of MNM varies among
different countries and regions depending on
the health care quality and availability. The
prevalence also depends on the different
approaches used and only few studies have
been done in low income countries of the
world including Nigeria. The prevalence rates
of MNM ranged between 6 and 149.8/1000
live births for disease specific criteria, between
0.4 and 45.4/1000 live births for management
based criteria and between 1.4 and 9.2/1000
live births for organ based dysfunction based
on Mantel criteria [3]. The prevalence of
MNM from a study done in Sagamu, Nigeria
by Oladapo et al [10] was 173/1000 live births.

II. Material and Methods

This was a cross-sectional study of cases of all
pregnant women admitted for deliveries or
pregnancy related complications in the
Department of Obstetrics and Gynaecology of
Ekiti State University Teaching Hospital
(EKSUTH), Ado-Ekiti, Nigeria was
established in 2008 and there has been no
known publication on MNM or maternal death
enquiries till date. Therefore, this study was
aimed at evaluating the quality of obstetric
care in this centre by examining the profile of
MNM cases and the determinant factors.
and Kogi. The Department of Obstetrics and Gynecology has eight consultants divided equally into two firms. The Department runs Antenatal and Postnatal Clinics on Wednesdays and Fridays and a Booking Clinic on Tuesdays. About 150 women register for antenatal care monthly in this centre with a monthly delivery rate of 130-155 deliveries, out of which about 30-35 are unbooked. The hospital provides a 24hr services for obstetric and gynecological care. The hospital has a functioning blood transfusion service that provides blood from its limited stock. This is complemented with the ones that are sourced from the National Blood Transfusion Centre located not too far from the hospital and donated by patients’ relatives. The hospital also has a two bedded high dependency unit (HDU) of the hospital located within the main theatre complex and patients with critical conditions requiring intensive care are admitted there from various units including the maternity unit.

The eligibility criteria for the study included women with MNM events based on WHO criteria [7,8] and maternal deaths according to WHO definition [11] among all women with complications during pregnancy, childbirth and within 42 days of termination of pregnancy. Women who developed complications after 42 days of termination of pregnancy were excluded from the study.

Ethical approval for the study was obtained from Ethics and Research Committee of Ekiti State University Teaching Hospital, Ado-Ekiti.

Definition of terms
Maternal near miss events were defined as acute obstetric complications that immediately threaten a woman's survival but do not result in her death because of hospital care she receives during pregnancy, labour or within 6 weeks after termination of pregnancy.

Potential life threatening obstetric conditions (PLTC) referred to maternal complications severe enough to result in near-miss morbidity and maternal death.

Maternal death was defined according to the tenth revision of International Classification of Diseases (ICD- 10) by the World Health Organization [11].

Severe maternal outcome was defined as maternal near miss and maternal death.

Data was extracted from the case notes by trained House Officers and Specialist Registrars using a data collection format. This was reviewed at intervals by the principal investigator to check for completeness and consistency of the collected data. The data collection format has two sections. The first section obtained information on the sociodemographic characteristics of the women such as age, parity, marital status, tribe, religion, educational level, occupation, spouse’s educational level and occupation and referral status while the second section extracted information about the obstetric history such as present mode of delivery, gestational age at presentation, fetal outcome (birth weight, Apgar scores at birth) and maternal outcome; as well as process indicators regarding prevention and treatment of the main causes of MNM and death, giving magnesium sulfate for treatment of eclampsia, oxytocin for prevention and treatment of postpartum hemorrhage, and antibiotics for prophylaxis (during cesarean section) and treatment of sepsis.

The data collected was entered into and analysed using Statistical Package for Social Sciences (SPSS, IL) version 22. Continuous data was analysed using mean and standard
deviation while categorical data were presented as frequency and percentages. Test of significance was done for continuous data using Student t test while Chi square test or Fischer's exact test was used for categorical data. Logistic regression was done for determinant of severe maternal outcome using Odd ratio and 95% Confidence interval. Statistical level of significance was set at a P value < 0.05.

III. Results

There were 1897 deliveries, 89 women presented with spontaneous miscarriages and 47 women had ruptured ectopic pregnancy during the study period. Out of the 1897 deliveries, 1855 were singletons and 42 were twin deliveries. There were 151 women with potential life threatening obstetric conditions (PLTC) PLTC and 40 women had severe maternal outcomes; 3331 maternal near misses and 76 maternal deaths.

There was no statistical significance difference in the mean age, parity and gestational age at delivery among the women who had no complications, women with potential life threatening conditions and those with severe maternal outcomes. Other socio-demographic variables are as shown in table 1.

Table 2 shows that hemorrhage was the commonest cause of MNM accounting for (13) 39.4% followed by hypertensive disorders. Uterine rupture was the leading cause of maternal mortality accounting for 3(42.8%) cases and PPH accounted for 2(28.6%) cases. DystociaUterine rupture had the highest mortality index (MI) of 33.3% closely followed by infections with a MI of 25%.

Cardiovascular dysfunction (58.1%) was the most common organ dysfunction among the women with MNM followed by neurologic dysfunction (35.5%). The MI was highest among women who had dystocia and hysterectomy accounting for 40% while the maternal near miss/ mortality ratio was highest in women with renal dysfunction (10:1) and followed by hematologic dysfunction (7:1) and multiple organ dysfunctions (7:1) as seen in table 3.

Caesarean section (CS) was the commonest mode of delivery in women with PLTC (42.4%) and MNM (42.4%) while maternal death was highest in women who had laparotomy for uterine rupture (42.8%). Neonatal outcomes (perinatal deaths) were worst among women with maternal deaths in table 4.

The SMO ratio was 21.1 per 1000 live birth and the MNM ratio was 17.4 per 1000 live birth. The maternal mortality ratio (MMR) was 932 per 100 000 live birth, the mortality index (MI = maternal deaths/MNM + maternal deaths) was 17.5%, the maternal near miss/mortality ratio was 4.7:1. Among the 151 women with potential life threatening conditions, 53 (35.1%) had blood transfusions and laparotomies were done in 13.9%. The HDU admission rate was 1.6% (33/2033) among all women, whereas HDU admission rate among women with SMO was 17.5 % (7/40) as in table 5.
IV. Discussion

The incidence of MNM in this study was 17.4/1000 live births and is comparable to reports from urban Ghana [12] and Northern Tanzania [13] but higher than findings from the developed countries [3,14]. This high rate might be partly due to differences in definition and identification of cases which are major limitations in comparison of near-miss data across institutions [3]. Also, it may also be as a result of the fact that the study centre is a referral hospital that receives complicated cases from the primary and secondary hospitals within the state and the surrounding states. The mortality index recorded in this study was 17.5% and is comparable to findings from studies done in other low resource settings in Africa [4, 15, 16] but higher than findings in developed countries [17, 18]. This might due to the fact a lot of women with critical conditions in low resource setting still die from these complications as was expressed in some previous studies [18, 19].

Hemorrhage and hypertension were the major causes of potential life threatening conditions in this study with hemorrhage still the leading cause. This was similarly reported in some studies done in Africa [13,15,20] but differs from similar studies carried out in Brazil and India where hypertensive disorders were mostly associated with near miss [21,22]. However, postpartum hemorrhage and uterine rupture were the leading causes of maternal deaths in this study. This might still be a reflection of poor management of labour cases in the peripheral health centre with majority of them being referred in critical conditions. This implies that efforts need to be focused on improving the protocols and resources for combating postpartum haemorrhage and uterine rupture at the tertiary centres, while improving the management of labour at the peripheral centre by ensuring women in rural areas have access to antenatal care in pregnancy and skilled birth attendants at delivery. The use of Magnesium sulphate - which has been shown to reduce eclampsia related risk of maternal mortality [23] - in our centre in the treatment and prevention of eclampsia resulted in the reduction of contribution of eclampsia to maternal morbidity and mortality. This is unlike study done in Sagamu by Oladapo et al [10] where eclampsia was the leading cause of maternal death and it was due to non-adoption of the evidence based protocol on the use of Magnesium Sulphate in the management of eclampsia.

Women with severe maternal outcomes were mostly unbooked that were transferred from the peripheral hospitals, private hospitals and faith based homes. This might be due to delay in seeking and reaching appropriate care because of lack of proper referral system and early detection of potentially life threatening complications in these women outside the tertiary health centre. This also accounted for the higher mortality index among them when compared to women that were managed from within the hospital. This was similarly reported in a study by Adisasmita et al [24] but in contrast to findings of Jabir et al [25] who reported in their study that there was no difference in the mortality index among them.

The maternal death-near miss ratio is a useful indicator of the quality of care received by near-miss cases irrespective of their primary source of antenatal or labour care [10]. A maternal death to near-miss ratio of approximately 1:4.71:5 recorded in this study shows that for every 5 women who survived life-threatening complications, one maternal
death occurred. The same ratio was similarly reported in Sagamu, Nigeria [10] and is poorer than 1:11-22 reported from similar centres in Niger [26], Cote d'Ivoire and Benin [27]. It is also a far cry from the 1:17-223 reported in Europe [28]. There is need to improve the quality of obstetric care services offered in this centre so as to improve the chances of survival of the near miss cases.

The caesarean section (CS) rate in this study was 34.1% which is higher than the recommended WHO CS rate [29] but is comparable to rate reported by Kalisa et al [16] in Rwanda and lower than that of Litorp et al [18] in Tanzania. This high rate might be because this was the most common mode of delivery in women with PLTC and maternal near miss and that instrumental delivery is becoming a dying art. The mortality associated with caesarean section in this study was twice that of vaginal delivery and this further confirmed the previous findings of association between MNM and deaths attributed to CS complications due to the increasing CS rates especially in developing countries including Nigeria [18]. The estimated risk of death of 3.1/1000 due to CS complications was comparable to that reported in Tanzania by Litorp et al [18] but higher than the United States reported figure by Clark et al [30] and this is a reflection of the potential danger associated with CS in developing countries.

About 42.8% of maternal deaths recorded in this study occurred in women who had hysterectomy as a form of treatment for PPH and uterine rupture. Prolonged obstructed labour which was the main factor leading to uterine rupture occurred mostly in the referred cases and is a reflection of the level of care at the referring centre. A Malawian study recommended training of healthcare workers in order to reduce delay in diagnosing and treatment of obstructed labour as well as implementation of local guidelines for augmentation of labour [31]. This increased supervision would lead to improved documentation and labour management and eventual reduction in cases of obstructed labour and uterine rupture [13, 20].

All the women who had vaginal and caesarean deliveries were given oxytocic drugs (oxytocin or ergometrine) as recommended by WHO for the prevention and treatment of postpartum hemorrhage [32]. In addition to this, women who had risk factors for PPH and few who developed PPH had sublingual misoprostol since misoprostol has been recommended by WHO in its treatment and prevention [32]. So, the use of uterotonic agents was quite high in our centre which was in agreement with findings in Rwanda [16] but unlike the study in Tanzania where the use of oxytocics was reportedly low [13]. This might explain why the contribution of PPH to maternal death in our centre was low.

Women with PLTC and MNM might require levels of care that differ from one to another, ranging from basic obstetric care to comprehensive obstetric care including surgery and intensive care as the case may be. Women with organ dysfunction are better managed in the intensive care unit (ICU) [17, 33]. There was low HDU admission observed in this study and this reflected the shortage of HDU beds such that women experiencing organ dysfunctions did not have access to intensive care before their eventual death. This was similarly recorded in previous studies in developing countries [17, 24, 26]. They opined that the provision of adequate ICU, trained personnel, equipment and management protocols would result in a better outcome.
among women with life-threatening conditions [17, 32].

Advancing maternal age was found to be a determinant of MNM in this study where more than half of the maternal death occurred in the older age group. This was similarly reported in previous studies [26, 34]. This might be due to the fact a lot of medical conditions like hypertension and diabetes mellitus that may complicate pregnancy are commoner in the older age group. Higher parity (grandmultiparity) with its attendant complications may also be associated with advancing maternal age. However, studies by Adisasmita et al and Naderi et al reported that primiparity was associated with increased frequency of MNM cases [26, 34].

The occurrence of MNM was commonly found among women with low education. This is because lack of education will limit access to information about their health and female education has been shown to be associated with better knowledge of their health, improved decision-making capabilities and increased utilisation of maternal health services [35]. In contrast, WHO global survey revealed that the near miss ratio was significantly associated with higher educational levels. This finding was attributed to the fact that women with higher educational levels might want to undergo caesarean section, which increases the probability of near miss events [35]. This is very unlikely in our setting where a lot of women irrespective of their educational level have strong aversion for CS [36].

Women who resided in rural areas had more SMO compared to the women who resided in the urban areas and attended antenatal clinic sessions. This was consistent with findings from previous studies conducted in Ethiopia and Iraq [25, 37]. This could be due to the fact that women in the urban areas have more access to information and better health care services unlike the rural women that might be influenced by cultural belief and practices [37]. Also, women who did not have their antenatal care at the centre and were referred had severe outcomes in this review. This is because many of these women were critically ill or unstable at admission due to delayed referrals or late arrival at the referral centre. The late arrival at the referral centre might be due to the distance between their place of residence and this referral centre and lack of transportation. Lack of money to access good health care could also be contributory to the late arrival at the referral centre since spousal unemployment was significantly associated with MNM in this review. This is keeping with three phases of delay of maternal mortality delay in reaching health facility and this was similarly reported in other studies [37, 38].

The strength of this study lies in the fact WHO criteria used helped us to identify women with organ dysfunctions, which is more reliable in reflecting PLTC than using a diagnosis-based inclusion. This first maternal near miss review will serve as baseline findings with which subsequent reviews can be compared as a monitor of the improvement in the quality of obstetric care. The limitations of this review included the fact that no follow up was done for the women after their discharge from hospital and some women may have died at home or at another institution within 42 days. This might have underestimated the number of maternal deaths. Also, autopsies were not performed such that the underlying cause of death was based only on information obtained from their case record.
In conclusion, the overall maternal near miss death ratio shows a suboptimal level of care for women with PLTC. This was also reflected by the low HDU admissions due to absence of space for those who were critically ill. This study also revealed that reducing maternal mortality will involve a good referral system, proper management of the near miss cases and access to reliable contraceptive methods like implants, intrauterine devices and sterilization. There should be provision of evidence based protocols and HDU within the obstetric unit for the management of the critical conditions. Staff in the obstetric unit should undergo regular training in emergency obstetric services and emergency drills should be conducted too. Since this is the first maternal near miss review in this center, it would be suggested that it should be done at intervals and it would help to evaluate and monitor the quality of obstetric care in this center.
Table 1 Sociodemographic characteristics of the women with maternal near miss experiences

| Variables                          | No maternal complications n = 1842 | Potential life threatening conditions (PLTC) n = 151 | Maternal near miss (MNM) n= 33 | Maternal death (MD) n = 7 | p value |
|-----------------------------------|-----------------------------------|-------------------------------------------------|-----------------------------|--------------------------|---------|
| **Age (year)**                    | 30.80 ± 4.38                      | 28.15 ± 6.01                                    | 26.59 ± 7.04                | 29.35 ± 5.34            | 0.358   |
| **Parity**                        | 1.73 ± 0.96                       | 1.12 ± 0.85                                     | 1.02 ± 0.89                 | 1.09 ± 0.92             | 0.078   |
| **Gestational age (weeks)**       | 39.19 ± 1.65                      | 38.01 ± 1.25                                    | 29.63 ± 1.23                | 38.17 ± 1.34            | 0.623   |
| **Age (years)**                   |                                  |                                                |                             |                          |         |
| ≤ 19                              | 181 (9.8)                         | 14 (9.3)                                        | 3 (9.1)                     | 2 (28.6)                | 0.048*  |
| 20-35                             | 1321 (71.7)                       | 105 (69.5)                                      | 21 (63.6)                   | 1 (14.3)                | 0.065   |
| > 35                              | 340 (18.5)                        | 32 (21.2)                                       | 9 (27.3)                    | 4 (57.1)                |         |
| **Marital status**                |                                  |                                                |                             |                          |         |
| Married                           | 1715 (93.1)                       | 70 (46.4)                                       | 15 (45.5)                   | 3 (42.9)                | 0.065   |
| Single (not married)              | 127 (6.9)                         | 81 (53.6)                                       | 18 (54.5)                   | 4 (57.1)                |         |
| **Education of women**            |                                  |                                                |                             |                          |         |
| Primary                           | 339 (18.4)                        | 73 (48.4)                                       | 17 (51.5)                   | 4 (57.2)                | 0.034*  |
| Secondary                         | 649 (35.2)                        | 38 (25.2)                                       | 9 (27.3)                    | 1 (14.3)                |         |
| Tertiary                          | 854 (46.4)                        | 40 (26.4)                                       | 7 (21.2)                    | 2 (28.5)                |         |
| **Occupation of women**           |                                  |                                                |                             |                          |         |
| Unemployed                        | 319 (17.3)                        | 50 (33.1)                                       | 14 (42.4)                   | 3 (42.8)                | 0.423   |
| Self employed                     | 578 (31.4)                        | 44 (29.1)                                       | 8 (24.2)                    | 2 (28.6)                |         |
| Privately employed                | 538 (29.2)                        | 32 (21.2)                                       | 7 (21.2)                    | 1 (14.3)                |         |
| Civil servants                    | 407 (22.1)                        | 25 (16.6)                                       | 4 (12.1)                    | 1 (14.3)                |         |
| **Occupation of husband**         |                                  |                                                |                             |                          |         |
| Unemployed                        | 247 (13.4)                        | 47 (31.4)                                       | 14 (42.4)                   | 3 (42.8)                | 0.035*  |
| Self employed                     | 378 (20.5)                        | 44 (29.1)                                       | 9 (27.3)                    | 2 (28.6)                |         |
| Privately employed | 416 (22.6) | 32 (21.2) | 6 (18.2) | 1 (14.3) |
|--------------------|------------|-----------|----------|----------|
| Civil servants     | 801 (4.35) | 28 (18.6) | 4 (12.1) | 1 (14.3) |

**Place of residence**

| Urban       | 1334 (72.4) | 59 (39.1) | 13 (39.4) | 2 (28.6) | 0.012* |
|-------------|-------------|-----------|-----------|----------|--------|
| Rural       | 508 (27.6)  | 92 (60.9) | 20 (60.6) | 5 (71.4) |

**Booking status**

| Unbooked     | 530 (28.8)  | 81 (53.6) | 21 (63.6) | 5 (71.4) |
|--------------|-------------|-----------|-----------|----------|
| Booked       | 1312 (71.2) | 70 (46.4) | 12 (36.4) | 2 (28.6) | 0.047* |

Table 2 Causes of maternal near miss and maternal death

| Underlying causes | Women with PLTC n =151 (%) | Women with MNM n = 33 (%) | Maternal death n = 7 (%) | MNMR/1000 live births | Mortality index |
|-------------------|----------------------------|---------------------------|--------------------------|-----------------------|----------------|
| Haemorrhage       | 65 (43.0)                  | 13 (39.4)                 | 2 (28.6)                 | 6.8                   | 13.3           |
| Organ dysfunction          | Maternal near miss* | Maternal death* | Maternal near miss ratio | Mortality index |
|----------------------------|---------------------|-----------------|--------------------------|-----------------|
| Abortion                   | 14 (9.3)            | 1 (3.0)         | 0 (0)                    | 0.5             |
| Ectopic pregnancy          | 12 (7.9)            | 2 (6.1)         | 0 (0)                    | 1.1             |
| Placenta abruption         | 9 (6.0)             | 2 (6.1)         | 0 (0)                    | 1.1             |
| Placenta praevia           | 7 (4.6)             | 1 (3.0)         | 0 (0)                    | 0.5             |
| Postpartum haemorrhage     | 23 (15.2)           | 7 (21.2)        | 2 (28.6)                 | 3.7             |
| Hypertensive disorders     | 41 (27.2)           | 9 (27.3)        | 1 (14.3)                 | 4.7             |
| Severe preeclampsia        | 18 (11.9)           | 2 (6.1)         | 0 (0)                    | 1.1             |
| Eclampsia                  | 23 (15.3)           | 7 (21.2)        | 1 (14.3)                 | 3.7             |
| Dystocia                   | 24 (15.9)           | 6 (18.2)        | 3 (42.8)                 | 3.2             |
| Prolonged obstructed labour| 17 (11.3)           | 2 (6.1)         | 0 (0)                    | 1.1             |
| Uterine rupture            | 7 (4.6)             | 4 (12.1)        | 3 (42.8)                 | 2.1             |
| Infections                 | 13 (8.6)            | 3 (9.0)         | 1 (14.3)                 | 1.6             |
| Anaemia                    | 8 (5.3)             | 2 (6.1)         | 0 (0)                    | 1.1             |

Table 3 Frequency of maternal near miss and maternal death by organ dysfunction
Table 4 Mode of pregnancy termination and neonatal outcome

| Variables                  | No maternal complications n = 1842 (%) | Women with PLTC n = 151 (%) | Women with MNM n = 33 (%) | Maternal death n = 7 (%) |
|----------------------------|----------------------------------------|----------------------------|----------------------------|--------------------------|
| Mode of pregnancy termination |                                        |                            |                            |                          |
| Vaginal delivery           | 1172 (63.6)                            | 59 (39.1)                  | 8 (24.2)                   | 1 (14.3)                 |
| Caesarean delivery         | 566 (30.7)                             | 64 (42.4)                  | 14 (42.4)                  | 2 (28.6)                 |
| Vacuum aspiration          | 73 (4.0)                               | 14 (9.3)                   | 2 (6.1)                    | 1 (14.3)                 |

*some women had more than one organ dysfunction
| Severe maternal outcome, near miss indicator and facility related indicator |
|---------------------------------------------------------------|
| **Maternal outcomes and indicators** | **Value** |
| **Severe maternal outcomes (SMO)** | 40 |
| Maternal near miss (MNM) | 33 |
| Maternal death | 7 |
| **Overall near miss indicator** | |
| $^c$SMO ratio/1000 live births | 21.1 (18.2-25.1) |
| MNM incidence ratio/1000 live births | 17.4 (15.3-20.2) |
| Maternal mortality ratio/100 000 live births | 932 |
| $^d$MNM mortality ratio | 4.7:1 |
| $^c$Mortality index | 17.5 (15.3-23.4) |
### Hospital access indicator\(^b\)

| Description                                                                 | Value               |
|----------------------------------------------------------------------------|---------------------|
| SMO cases with organ dysfunction or maternal death within 12 h of hospital stay (SMO12) | 27                  |
| Percentage of SMO12 cases among all SMO cases                               | 67.5 (64.7–70.1)    |
| SMO12 mortality index                                                       | 7.5 (3.1–14.3)      |

### Intensive care use

| Description                                                                 | Value               |
|----------------------------------------------------------------------------|---------------------|
| Percentage of high dependency unit (HDU) admission                          | 1.6 (1.3–1.9)       |
| Percentage of HDU admission among women with SMO                             | 17.5 (15.3–23.4)    |
| Treatment offered to women with potential life threatening conditions (n=151) |                     |
| Blood                                                                       | 53 (35.1%)          |
| Laparotomy                                                                  | 21 (13.9%)          |

\(^a\) Based on data from all women (n = 2033)

\(^b\) The denominator for these 2 indicators is ‘live births’ (n = 1901)

\(^c\) Severe Maternal Outcome Ratio (SMOR): The number of women with life threatening conditions (MNM+ MD) per 1000 live births (LB).

\(^d\) Maternal near miss mortality ratio (MNMR): The number of maternal near miss cases per 1000 live births (MNMR = MNM/LB).

\(^e\) Mortality index (MI): The number of maternal deaths divided by the number of women with life-threatening conditions expressed as a percentage (MI = MD/ MNM+MD).
Table 6 Socio-demographic characteristics associated with near miss cases on logistic regression

| Variables                  | Adjusted Odd ratio (95% Confidence interval) | p value |
|----------------------------|-----------------------------------------------|---------|
| Age of women (years)       |                                               |         |
| < 35                       | 1                                             |         |
| ≥ 35                       | 1.95 (1.50 – 2.30)                            | 0.001*  |
| Education of women         |                                               |         |
| Primary and below          | 1.58 (1.20 – 2.30)                            | 0.012*  |
| Post-primary               | 1                                             |         |
| Occupation of husband      |                                               |         |
| Unemployed                 | 0.53 (0.32 – 0.64)                            | 0.058   |
| Employed                   | 1                                             |         |
| Place of residence         |                                               |         |
| Rural                      | 1.48 (1.08 – 1.98)                            | 0.039*  |
| Urban                      | 1                                             |         |
| Booking status             |                                               |         |
Peter et. al., Profile of Maternal Near Miss and Determinant Factors in a Teaching Hospital, Southwestern Nigeria

### Table 1

|                | Unbooked | Booked |
|----------------|----------|--------|
| Unbooked       | 1.73 (1.53 – 1.88) | 0.025* |
| Booked         | 1        |        |

*Statistically significant

### Acknowledgement

The authors acknowledged the Specialist registrars, the House Officers and staff of the Medical Record Department that assisted in the collation of the data.

### Conflicts of interest statement

The authors declare that there is no conflict of interests regarding the publication of this paper.

### V. References

[1]. Pattinson RC, Buchmann E, Mantel G, Schoon M, Rees H (2003). Can enquiries into severe acute maternal morbidity act as a surrogate for maternal death enquiries? Br J Obstet Gynecol, 110, 889-93.

[2]. Khan KS, Wojdyla D, Say L, Gülmezoglu AM, Van Look PF (2006). WHO analysis of causes of maternal death: a systematic review. Lancet, 367, 1066-1074.

[3]. Say L, Pattinson RC, Gülmezoglu AM (2004). WHO systematic review of maternal morbidity and mortality: the prevalence of severe acute maternal morbidity (near miss). Reprod Health 2004, 1, 3.

[4]. Tuncalp Ö, Hindin MJ, Souza JP, Chou D, Say L (2012). The prevalence of maternal near miss: a systematic review. BJOG, 119, 653-661.

[5]. Waterstone M, Bewley S, Wolfe C (2001). Incidence and predictors of severe obstetric morbidity: case–control study. BMJ 2001, 322, 1089-1093.

[6]. Mantel GD, Buchmann E, Rees H, Pattinson RC (1998). Severe acute maternal morbidity: a pilot study of a definition for a near-miss. Br J Obstet Gynecol, 105, 985-990.

[7]. WHO, World Health Organization (2001). Evaluating the Quality of Care for Severe Pregnancy Complications: The WHO Near-Miss Approach for Maternal Health. Geneva: World Health Organization, http://apps.who.int/iris/bitstream/10665/
Peter et al., Profile of Maternal Near Miss and Determinant Factors in a Teaching Hospital, Southwestern Nigeria

A cross-sectional study. BMC Pregnancy Childbirth, 13, 141.

[8] Say L, Souza JP, Pattinson RC (2009). Maternal near miss - towards a standard tool for monitoring quality of maternal health care. Best Pract Res Clin Obstet Gynecol, 23, 287-296.

[9] Pattinson R, Say L, Souza JP, Van Den Broek N, Rooney C (2009). WHO Working Group on Maternal Mortality and Morbidity Classifications: WHO maternal death and near-miss classifications. Bull World Health Org, 87, 734.

[10] Oladapo OT, Sule-Odu AO, Olutunji AO, Daniel OJ (2005). “Near-miss” obstetric events and maternal deaths in Sagamu, Nigeria: a retrospective study. Reprod Health, 2, 9.

[11] World Health Organization (1993). ICD-10: International statistical classification of diseases and health-related problems. In Tenth Revision Volume 2. Geneva: World Health Organization, http://www.who.int/classifications/icd/ICD10volume2_en_2010.pdf accessed on March 10, 2017

[12] Tunçalp O, Hindin MJ, Adu-Bonsaffoh K, Adanu RM (2013). Assessment of maternal near-miss and quality of care in a hospital-based study in Accra, Ghana. Int J Gynecol Obstet, 123, 58-63.

[13] Nelissen EJT, Mduma E, Ersdal HL, Evjen-Olsen B, van Roosmalen JJM, Stekelenburg J (2013). Maternal near miss and mortality in a rural referral hospital in northern Tanzania:

[14] Chhabra P (2014). Maternal Near Miss: An Indicator for Maternal Health and Maternal Care. Ind J Comm Med, 39, 132-137.

[15] Rulisa S, Umuziranenge I, Small M, van Roosmalen J (2015). Maternal near miss and mortality in a tertiary care hospital in Rwanda. BMC Pregnancy Childbirth, 15, 203.

[16] Kalisa R, Rulisa S, van den Akker T, van Roosmalen J (2016). Maternal Near Miss and quality of care in a rural Rwandan hospital. BMC Pregnancy Childbirth, 16, 324.

[17] Lotufo FA, Parpinelli MA, Haddad SM, Surita FG, Cecatti JG (2012). Applying the new concept of maternal near-miss in an intensive care unit. Clinics, 67, 225-230.

[18] Litorp H, Kidanto LH, Rööst M, Abyeid M, Nyström L, Essén B (2014). Maternal near-miss and death and their association with caesarean section complications: a cross-sectional study at a university hospital and a regional hospital in Tanzania. BMC Pregnancy Childbirth, 14, 244.

[19] Ali AA, Khojali A, Okud A, Adam GK, Adam I (2011). Maternal near-miss in a rural hospital in Sudan. BMC Pregnancy Childbirth, 11, 48.

[20] van den Akker T, Beltman J, Leyten J, Mwagomba B, Meguid T, Stekelenburg J, van Roosmalen J (2013). The WHO maternal near miss approach: consequences at Malawian District level. PLoS One, 8, e54805.

[21] Cecatti JG, Souza JP, Parpinelli MA, de Sousa MH, Amaral E (2007).
Research on severe maternal morbidities and near-misses in Brazil: what we have learned. Reprod Health Matters 15, 125-133.
[22]. Jyoti B, Garima S (2016). Clinical and Etiological Study of Maternal Near-Miss at a Tertiary Referral Hospital of Central India. Ind J Obstet Gynecol Res, 3, 28-31.
[23]. Duley L, Gülmezoglu AM, Henderson-Smart DJ (2003). Magnesium sulphate and other anticonvulsants for women with preeclampsia. The Cochrane Database Syst Rev, Art. No.: CD000025. DOI: 10.1002/14651858.CD000025
[24]. Adisasmita A, Deviayn PE, Nandiay F, Stanton C, Ronsmans C (2008). Obstetric near miss and deaths in public and private hospitals in Indonesia. BMC Pregnancy Childbirth, 8: 10.
[25]. Jabir M, Abdul-Salam I, Suheil DM, Al-Hill W, Abul-Hassan S, Al-Zuheiri A, Al-Ba’aj R, Dekan A (2013). Maternal near miss and quality of maternal health care in Baghdad, Iraq. BMC Pregnancy Childbirth, 13, 11.
[26]. Prual A, Huguet D, Gabin O, Rabe G (1998). Severe obstetric morbidity of the third trimester, delivery and early puerperium in Niamey (Niger). Afr J Reprod Health, 2, 10-19.
[27]. Filippi V, Ronsmans C, Gohou V, Goufodji S, Lardi M, Sahel A, Saizonou J, De Brouwere V (2005). Maternity wards or emergency obstetric rooms? Incidence of near-miss events in African hospitals. Acta Obstet Gynecol Scand 2005; 84: 11-16.
[28]. Say L, Pattinson RC, Gülmezoglu AM (2004). WHO systematic review of maternal morbidity and mortality: the prevalence of severe acute maternal morbidity (near miss). Reprod Health, 1, 3.
[29]. World Health Organization (2015). WHO statement on caesarean section rates. World health Organization, Geneva, http://apps.who.int/WHO.RHR.5.02 eng.pdf accessed on August 2, 2017.
[30]. Clark SL, Belfort MA, Dildy GA, Herbst MA, Meyers JA, Hankins GD (2008). Maternal death in the 21st century: causes, prevention, and relationship to cesarean delivery. Am J Obstet Gynecol, 199, 36.
[31]. Van den Akker T, Mwagomba B, Irlam J, Van Roosmalen J (2009). Using audits to reduce the incidence of uterine rupture in a Malawian district hospital. Int J Gynaecol Obstet, 107, 289-294.
[32]. World Health Organization (2007). WHO recommendations for the prevention of postpartum hemorrhage. World Health Organization, http://apps.who.int/iris/bitstream/10665/75411/1/9789241548502eng.pdf accessed on March 12, 2012.
[33]. Zeeman GG (2006). Obstetric critical care: a blueprint for improved outcomes. Crit Care Med, 34, S208-S214.
[34]. Naderi T, Foroodnia S, Omidi S, Samadani F, Nakhae N (2015). Incidence and Correlates of Maternal Near Miss in Southeast Iran. Int J Obstet Gynecol Scand 2005; 84: 11-16.
Reprod Med, Article ID 914713, 5 pages.

[35]. Mpembeni RNM, Killewo JZ, Leshabari MT, Massawe SN, Jahn A, Mushi D, Mwikipa H (2007). Use pattern of maternal health services and determinants of skilled care during delivery in southern Tanzania: implications for achievement of MDG-5 targets. BMC Pregnancy Childbirth 2007; 7: 29.

[36]. Sunday-Adeoye I, Kalu CA (2011). Pregnant Nigerian women’s view of caesarean section. Niger J Clin Pract, 14, 276-279.

[37]. Gedefaw M, Gebrehana H, Gizachew A, Taddess F (2014). Assessment of Maternal Near Miss at Debre Markos Referral Hospital, Northwest Ethiopia: Five Years’ Experience. Open J Epidemiol, 4, 199-207.

[38]. Abdella A (2010). Maternal Mortality Trend in Ethiopia. Eth J Health Dev, 24, 115-122.