Original Research Article

PREVALENCE AND PATTERN OF MATERNAL NEAR MISS AT A TERTIARY CARE HOSPITAL IN SOUTHERN NIGERIA

ABSTRACT

Background: Maternal mortality was previously used as a critical indicator for measuring a country's maternal health. Studies have indicated it accounts for a small fraction of the burden of maternal morbidity.

Aim and Objectives: The study sought to determine the prevalence, pattern, and organ system dysfunctions associated with maternal near miss.

Material and Methods: A retrospective cross-sectional study was carried out at the University of Port Harcourt Teaching Hospital. Stratified sampling method was used to select the folders of 610 women who were managed during pregnancy, labour, or postpartum period, and for abortion and ectopic pregnancy between January 1, 2018, and December 31, 2020. Data collection tool was used to obtain information from folders and SPSS 25 used for analysis. Mean and standard deviation were used to summarize descriptive data.

Results: Majority 214 (35.1%) of the women were aged 30 - 34 years, with a mean age of 31.57 ± 5.0 years. Most 541, (88.7%) of the women were married, 335 (54.9%) had tertiary education, while 273 (44.8%) engaged in partly skilled jobs. About one-fifth 138 (22.6%) were booked. There were 123 maternal near miss (MNM) conditions, giving a prevalence of 20.2%. The MNM ratio was 227.8/1000 livebirths. Hypertensive disorders of pregnancy was the predominant 67 (54.5%) MNM condition, and cardiovascular dysfunction was the most common 43 (35%) organ system dysfunction.

Conclusion: There is a huge burden of maternal near miss at UPTH. Early detection and treatment may provide a window of opportunity to reduce maternal morbidity and mortality.

Keywords: Maternal Near miss, Pattern**,** Prevalence, Southern Nigeria

1. INTRODUCTION

In most women, pregnancy is often uncomplicated and will bring about the delivery of healthy babies at term. In some women, severe complications like hypertensive disorders, antepartum haemorrhage, ruptured uterus, primary postpartum haemorrhage may occur, which may be life-threatening for either the mother, baby, or both, thereby necessitating certain interventions to prevent morbidity or mortality.

Maternal mortality was previously used as an indicator to monitor the maternal health of a nation and has been of global concern for decades. Studies had shown that MM accounts for only a small fraction of the burden of maternal morbidity, since it represents only the end of a spectrum, because for every one of these maternal deaths, there is a huge burden of maternal morbidity which is a potential cause of long-term disabilities.[1,2] The World Health Organization (WHO), the United Nations Children's Fund (UNICEF), the World Bank Group, and the United Nations Population Fund (UNFPA) collaborated to assess the trend in maternal mortality from 1990 to 2015. The report revealed that 20 more women (approximately 7 million annually) experience acute and chronic life-threatening complications from both direct and indirect causes.[3] Postpartum haemorrhage, pre-eclampsia, eclampsia, obstructed labour, uterine rupture, unsafe abortion, and infection are the direct causes. The indirect causes include chronic diseases or diseases that developed during pregnancy and are not caused by direct causes but are exacerbated by the pregnancy or its management. Human immunodeficiency virus (HIV/AIDS) infection, tuberculosis, anaemia, and cardiac disease in pregnancy are examples of indirect causes. [4,5,6,7]

As a result, relying solely on maternal mortality to assess a country's quality of maternal healthcare service delivery overlooks the importance of maternal morbidity, which is not only the precursor to MD but also the possible cause of lifetime disability and poor quality of life.[1]

Previously, different criteria were used to define maternal near miss events. In 2011, the World Health Organization (WHO) developed a standardized systematic MNM approach. The concept of maternal “near-miss obstetric events” (MNM) is an assessment of women who nearly died but survived a life-threatening condition during pregnancy, labour, and puerperium.[6] The concept, which is also known as severe acute maternal morbidity (SAMM), is complementary to mortality indicators.[8] The WHO criteria include a set of clinical criteria, laboratory markers, as well as organ failure-based dysfunction, which reflect the severity of illnesses and allows for identification of MNM cases. [8]

The Maternal Near Miss instrument is a useful tool for assessing the quality of obstetric care and provides insight into the cascade of events that eventually lead to MDs. Because these near-miss cases occur more frequently, it gives the survivors an opportunity to tell their story unlike the cases of MDs. It allows for the evaluation of deficiencies in the standard of obstetric care, the reduction of maternal morbidity and mortality, and the improvement of pregnancy outcomes. It also enables comparisons between different studies, and between countries and regions. [9,10]

MNM incidence ratio varies by country and region, with higher rates in low-and-middle-income countries (LMICs), particularly in Africa and Asia. [11] According to several reports, the rate of MNMs in high-income countries ranged from 0.14% in Ireland to 0.71% in the Netherlands, [12,13] while it is 2.1% in Brazil and 12% in Nigeria. [14,15,16] The MNM ratio in Sub-Saharan Africa is 24.2 per 100,000 live births.

The Annual reports of the department of Obstetrics and Gynaecology of the University of Port Harcourt Teaching Hospital (UPTH) showed that there is an enormous burden and frequency of maternal near miss conditions. However, no such study has been conducted because the hospital did not participate in the one-year nationwide cross-sectional MNM survey that was conducted in forty-two tertiary hospitals.[18,19] It is in view of this, that this research sought to determine the prevalence and pattern of maternal near miss, as well as the organ system dysfunctions associated maternal near misses at UPTH.

2. MATERIAL AND METHODS

Study Area

The University of Port Harcourt Teaching Hospital (UPTH) is a tertiary healthcare facility in Alakahia community in Obio-Akpor Local Government Area (LGA) of Rivers state, Nigeria. The Hospital Management Board oversees the functioning of the hospital, which is carried out at the departmental level. It has an 884-bed capacity. It offers general and specialized services to patients and serves as a referral centre for most of the state's peripheral hospitals and health centres.

The Obstetrics and Gynaecology department is among the major clinical departments and accounts for 19.8% of the total hospital bed, with a total of 175 beds: 30 beds in the antenatal ward, 40 beds in the postnatal ward, 40 beds in the unbooked lying-in ward, 36 beds in gynaecological ward and 8 beds in the private/semi-private rooms. The labour ward complex has two admission rooms, 9 beds in the first stage room for booked patients, 4 beds in the first stage room for unbooked patients, 4 delivery suites and a theatre.

An average of 100-120 deliveries is conducted monthly with an average annual delivery of 1500. The hospital provides a 24-hour emergency and intensive care services, a functional blood bank,

neonatal intensive care unit and an intensive care unit. Women with risk factors or obstetric complications are referred to the hospital from surrounding clinics and hospitals, as well as from neighbouring states. There are five units in the department, each with consultants, resident doctors, and house officers. Each clinic day is staffed by a unit, and the Antenatal, Postnatal, and Gynaecology clinics are open Monday through Friday.

Study Design

This was a retrospective institution-based cross-sectional study conducted at the Obstetrics and Gynaecology department of UPTH from January 1, 2018, to December 31, 2020, to determine the prevalence and pattern of maternal near miss.

Study Population

All pregnant women managed at the UPTH during the antenatal period, delivery or within 42 days of termination of pregnancy from January 1, 2018, to December 31, 2020.

Inclusion criteria

Mothers who presented during the antenatal period, in labour or had delivered or aborted or presented within 42 days of termination of pregnancy with or without the conditions stated in the WHO criteria for near miss during the study period. Also included were women who presented with ectopic pregnancy.

WHO Maternal Near miss Criteria

- **Severe maternal complications:** Severe postpartum haemorrhage**,** Severe pre-eclampsia**,** Eclampsia**,** Ruptured uterus**,** Sepsis or severe systemic infection, Severe complications of abortion

- **Critical interventions or intensive care unit (ICU):** Admission into ICU**,** Laparotomy/Hysterectomy for severe obstetric conditions**,** Use of blood/blood products, Interventional radiology
- **Life-threatening conditions:** The markers of organ system dysfunction are shown below:
    a. Cardiovascular dysfunction (shock, cardiac arrest, use of continuous vasoactive drugs, cardiopulmonary resuscitation, severe hypoperfusion (lactate >5 mmol/l or >45 mg/dl), severe acidosis (pH <7.1)
    b. Respiratory dysfunction: Acute cyanosis, gasping, Severe tachycardia (respiratory rate > 40 breaths per minute), Severe bradycardia (respiratory rate < 6 breaths per minute), Intubation and ventilation not related to anaesthesia, Severe hypoxaemia (O2 saturation < 90% for ≥60 min or PAO2/FiO2 < 200)
    c. Renal dysfunction: Oliguria non-responsive to fluids or diuretics, dialysis for acute renal failure, Severe acute azotaemia (creatinine ≥300 μmol/ml or ≥3.5 mg/dl)
    d. Coagulation/Haematological dysfunction: Failure to form clots, massive transfusion of blood or red cells (≥5 units), Severe acute thrombocytopenia (<50,000 platelets/ml)
    e. Hepatic dysfunction: Jaundice in the presence of pre-eclampsia, Severe acute hyperbilirubinemia (bilirubin >100 μmol/l or >6.0 mg/dl)
    f. Neurological dysfunction: Prolonged unconsciousness (lasting ≥12 h)/coma (including metabolic coma), stroke, uncontrollable fits/status epilepticus, Total paralysis
    g. **Uterine dysfunction / hysterectomy:** Haemorrhage or infection leading to hysterectomy

Exclusion criteria

Mothers with complications unrelated to pregnancy, and women with incomplete case records were excluded from the study.

Method

The sample size of 610 was determined using the Cochran formula $n = Z^2 pq/d^2$ (Charan, J., & Biswas, T., 2013). Stratified sampling technique was used to stratify the women who presented with or without complication during pregnancy, delivery, and 42 days after termination of pregnancy, abortion and ectopic pregnancy into the three years of study and proportionate to size allocation of the sample to each year was done. This was followed by the selection of the allotted sub-samples for each stratum by simple random sampling technique using a table of random numbers from 4,598 case records. Thereafter, data was extracted from the selected case records using the standardized WHO Maternal Near Miss Tool (World Health Organization, 2011) which was adapted to include information on socio-demographic profile and obstetric history of the women.

Data Collection

Data was collected for eight weeks, from April 1 to May 31, 2021. Three house officers were recruited as research assistants, they received a one-day training on data gathering techniques and research protocol. The folders of selected sub-samples were retrieved from the hospital's Records department. Record review included information on socio-demographic characteristics, obstetrics history, diagnosis, laboratory findings, therapy and management, and near-miss criterion-based clinical audit. Occupational status was classified into six groups, these are:

a. professional/Higher managerial occupation e.g Doctors, Lawyers, Engineers, Accountants
b. Intermediate/Lower occupational occupation e.g Bankers, Teachers
c. Manual skilled occupation e.g Tailors, Masons/Bricklayers, Carpenters, Electricians
d. Partly skilled occupation e.g Clerical officers, Traders

e. Unskilled occupation e.g Janitors, day, or night watchmen

f. Never worked/Long term unemployed

To ensure anonymity and easy identification, each questionnaire was given a unique identity. During the evaluation period, data on total deliveries, total number of live births, and maternal mortality were obtained from ward, labour ward, ICU, and theatre records. The data collection tools were scrutinized daily for accuracy and completeness. The researcher and the three research assistants entered data in a sequential order. The research team had weekly meetings during the data collection period.

Data Analysis

Data was coded and entered in Microsoft Excel Spreadsheet, cleaned, and analyzed using SPSS version 25.0 software. Descriptive statistics such as means, median, percentages, frequencies, ratios, and standard deviation were used to describe the socio-demographic characteristics and pattern of MNM. Results are displayed in means and percentages and presented in tables.

3. RESULTS

3.1 Socio-demographic Characteristics

Table 1 showed that 214 (35.1%) women were aged 30 - 34 years which constituted the highest proportion, with a mean age of 31.57 ± 5.0 years. Majority 541, (88.7%) of the women were married. About 335 women had tertiary education and constituted the highest proportion (54.9%). With regards to occupational status, most of the women, 273 (44.8%) were engaged in partly skilled jobs, followed by 179 women who have never worked or were unemployed for a long time, constituting 29.3%.

The husbands' level of education correlated with those of the women, with majority, 393 (64.5%) of the men having tertiary education. About half of the women's spouses, 297 (48.7%)

were engaged in non-manual skilled occupation, while the lowest proportion was in the unskilled occupation group, constituting 0.8%. This is shown in Table 2.

3.2 Obstetric characteristics of the women

Table 3 showed the obstetric characteristics of the women. With regards to the number of pregnancy (gravidity), only the data for 549 (90%) women was available, which showed that most of the women, 264 (48.1%) had 2-3 pregnancies, while 93 women (16.9%) had either not been pregnant before or had only been pregnant once, with a mean gravidity of 3.07 ± 1.57. Most of the women, 273 (44.8%) were Para 2-4, only 11 (1.8%) of them were grand multiparous with a mean parity of 1.44 ± 1.28. Three hundred and eleven women had one to two living children, accounting for the highest proportion, while 9 (1.5%) of them had 5 or more living children.

Of the 610 women, 371 (60.8%) of them were booked while 101 (16.6%) booked elsewhere. Unbooked women made up 22.6%, accounting for about one-fifth of the study population. Additionally, 182 women were referred, of which 68 (37.4%) of them were from primary health centres, constituting the highest proportion, with 24 (13.2%) referrals from secondary health centres.

3.3 Prevalence of Maternal Near miss and Indicators

Of the 610 women, severe maternal outcomes were identified in 140 women, of which 123 (20.2%) were maternal near miss events and 17 (2.8%) were maternal deaths, giving a MNM prevalence of 20.2%. There were 586 deliveries with 540 (92.5%) live births, giving a maternal near miss ratio of 227.8/1,000 live births.

The maternal mortality ratio was 3,148.1/100,000 live births while the mortality index was 12%. This means that for every 100,000 live births, about 3,148 women will die. The higher the mortality index, the more women with life-threatening conditions die (indicating poor quality of care), whereas the lower the index, the fewer women with life-threatening conditions die (indicating good quality of care). The severe maternal outcome ratio was 259.3/1000 live births while maternal near miss mortality ratio was 7:1, implying that for every woman that dies, 7 others suffer severe morbidity. Higher ratios indicate better quality of care (Table 4).

3.4 Pattern of Maternal Near Miss

Table 5 showed that majority of the maternal near miss conditions resulted from hypertensive disorders in pregnancy 56 (54.5%), with severe preeclampsia and eclampsia accounting for 55 (44.7%) and 12 (9.8%) respectively. This was followed by obstetric haemorrhage which contributed 25 (20.3%), this was made up of severe primary postpartum haemorrhage 14 (11.4%) and ruptured uterus 11 (8.9%), while ruptured ectopic pregnancy contributed 23 (18.7%) to the maternal near miss burden. Sepsis or severe systemic infection which occurred in 8 (6.5%) resulted from puerperal sepsis and post-abortal sepsis.

3.5 Organ system dysfunctions

Organ system dysfunction has been shown to be associated with maternal near miss conditions. Table 6 showed that about one-third (35%) of the women had cardiovascular dysfunction manifesting as shock or cardiac arrest, making it the leading organ system dysfunction. Respiratory dysfunction was observed in 36 (29.3%) of the women, which manifested as acute cyanosis, gasping and severe tachypnoea. This was the second most common organ system dysfunction. Coagulation/haematologic dysfunction occurred in 21 (17.1%) of the women and manifested as failure to form clots and massive blood transfusion of more than five or more

blood cells. This was followed by renal and uterine dysfunction/hysterectomy, accounting for 14 (11.4%) and 11 (8.9%) respectively. Neurologic dysfunction was observed in 5 (4.1%) women who had eclampsia. Only one woman (0.8%) with eclampsia had hepatic dysfunction. It is important to note that some women had multiple organ dysfunctions.

Table 7a showed that cardiovascular dysfunction was most frequent in women with ruptured ectopic pregnancy, constituting 20 (46.5%) of the proportion of women with this morbidity. It was also observed that women with severe postpartum haemorrhage accounted for 12 (27.9%) of this complication, while those with ruptured uterus accounted for 9 (20.9%).

Respiratory dysfunction was observed to be associated with obstetric haemorrhages as well. The highest proportion of respiratory dysfunction was observed in women with ruptured ectopic pregnancy accounting for 10 (27.8%), while 9 (25%) women with severe postpartum haemorrhage and 8 (22.2%) with ruptured uterus also had respiratory dysfunction.

Coagulation/haematologic disorder was predominantly seen in women who had severe postpartum haemorrhage, accounting for 7 (33.3%). It was also observed in 6 (28.6%) women with ruptured uterus and 5 (23.8%) women with eclampsia. Sepsis or severe systemic infection accounted for the least 1 (4.8%). Regarding renal dysfunction, it was shown to be mainly associated with severe primary postpartum haemorrhage 5 (35.7%) and eclampsia 4 (28.6%).

Eleven (8.94%) women had hysterectomy, this was due to severe primary postpartum haemorrhage (54.6%) which could not be controlled with uterotonics and ruptured uterus (45.4%) which could not be repaired due to the nature of the tear. Neurologic dysfunction was observed in 5 women with eclampsia, while only 1 woman with eclampsia had hepatic dysfunction. This is shown in Table 7b.

Table 8 showed that severe anaemia was most associated with maternal near miss, accounting for 33 (26.8%). This was followed by prolonged/obstructed labour, 11 (8.9%) and previous caesarean section 8 (6.5%), both of which were responsible for some cases of severe postpartum haemorrhage and uterine rupture. With regards to pre-existing diseases, 18 (14.6%) of the women had chronic hypertension which was a predisposing factor for hypertensive disorders in pregnancy, while 5 (4.1%) women were retroviral positive.

Table 1: Socio-demographic characteristics of the women

Variable	Frequency *(n=610)*	Percent
Age as at last birthday (years)		
<20	10	1.6
20-24	45	7.4
25-29	147	24.1
30-34	214	35.1
35-39	170	27.9
≥40	24	3.9
Mean Age **31.57 ± 5.0**		
Marital status		
Married	541	88.7
Single	69	11.3
Level of education completed		
No formal education	2	0.3
Primary	36	5.9
Secondary	237	38.9
Tertiary	335	54.9
Occupational status		
Professional/higher managerial occupations	42	6.9
Intermediate/lower managerial occupation	114	18.7
Manual skilled occupation	2	0.3
Partly skilled occupation	273	44.8
Unskilled occupation	0	0.0
Never worked/long term unemployed	179	29.3
Religion		
Christianity	584	95.7
Islam	26	4.3

Table 2: Socio-demographic characteristics of their husbands

Variable	Frequency *(n=610)*	Percent
Husbands' Level of education completed		
No formal education	2	0.3
Primary	44	7.2
Secondary	171	28.0
Tertiary	393	64.5
Husbands' Occupational status		
Professional/higher managerial occupations	102	16.7
Intermediate/lower managerial occupation	135	22.1
Non-manual skilled occupation	297	48.7
Manual skilled occupation	71	11.7
Unskilled occupation	5	0.8

Table 3: Obstetric characteristics of the women

Variable	Frequency *(n=610)*	Percent
Gravidity (number of pregnancies) (n=549)$^{\gamma}$		
≤1	93	16.9
2-3	264	48.1
4 or more	192	35.0
Mean 3.07 ± 1.57		
Parity (number of delivery)		
Para 0	184	30.2
Para 1	142	23.2
Para 2-4	273	44.8
Para ≥ 5	11	1.8
Mean 1.44 ± 1.28		
Number of living Children		
None	190	31.1
1-2	311	51.0
3-4	100	16.4
≥ 5	9	1.5
Mean 1.41 ± 1.28		
Booking status		
Booked	371	60.8
Booked elsewhere	101	16.6
Unbooked	138	22.6
Gestational age at booking (n=371)		
Mean 18.49 ± 5.09 weeks		
Patient referred to the facility (n=239)		
Yes	182	76.2
No	57	23.8
Sources of Referral (n=182)		
Primary Health centre	68	37.4
Traditional Birth Attendants / Church	47	25.8
Private clinic / Maternity	43	23.6
Secondary Health centre	24	13.2

γ = number of pregnancies was not stated in some folders

Table 4: Prevalence of Maternal Near Miss and Indicators

Maternal Near Miss Indicators	Indices
Maternal Near-Miss (MNM)	123 (20.2%)
Maternal Death (MD)	17 (2.8%)
Live Birth (LB)	540 (92.2%)
Maternal Near-Miss Ratio (MNMR = MNM/LB)	227.8/1000 LB
Mortality Index (MI= MD/MNM + MD)	12%
Maternal Near Miss Mortality Ratio (MNM:MD)	7:1
Severe Maternal Outcome Ratio (SMOR= MNM+MD/LB)	259.3/1000 LB
Maternal Mortality Ratio (MD/LB per 100,000 LB)	3,148.1 /100,000 LB

Table 5: Pattern of Maternal Near Miss

Variable	Frequency *(n=123)*	Percent
Severe Pre-Eclampsia	55	44.7
Ruptured ectopic pregnancy	23	18.7
Severe Primary Postpartum Haemorrhage	14	11.4
Eclampsia	12	9.8
Sepsis or Severe Systemic Infection	8	6.5
Ruptured uterus	11	8.9

Table 6: Pattern of Organ system dysfunction in Maternal Near Miss

Variable	Frequency (123)	Percent
Cardiovascular dysfunction	43	35.0
Respiratory dysfunction	36	29.3
Coagulation / Haematologic dysfunction	21	17.1
Renal dysfunction	14	11.4
Uterine dysfunction / Hysterectomy	11	8.9
Neurologic dysfunction	5	4.1
Hepatic dysfunction	1	0.8

*Some women had more than one organ system dysfunction

Table 7a: Organ system dysfunction in specific Maternal Near miss conditions

Variable	Frequency *(n=123)*	Percent
Cardiovascular dysfunction *(n=43)*		
Ruptured ectopic pregnancy	20	46.5
Severe postpartum haemorrhage	12	27.9
Sepsis or severe systemic infection	2	4.7
Ruptured uterus	9	20.9
Respiratory dysfunction *(n=36)*		
Severe Pre-eclampsia	1	2.8
Eclampsia	5	13.9
Ruptured ectopic pregnancy	10	27.8
Severe postpartum haemorrhage	9	25.0
Sepsis or severe systemic infection	3	8.3
Ruptured uterus	8	22.2
Coagulation/Haematologic dysfunction *(n=21)*		
Eclampsia	5	23.8
Ruptured ectopic pregnancy	2	9.5
Severe postpartum haemorrhage	7	33.3
Sepsis or severe systemic infection	1	4.8
Ruptured uterus	6	28.6
Renal dysfunction *(n=14)*		
Eclampsia	4	28.6
Ruptured ectopic pregnancy	2	14.3
Severe postpartum haemorrhage	5	35.7
Sepsis or severe systemic infection	1	7.1
Ruptured uterus	2	14.3

*Some of the women had more than one organ system dysfunction

Table 7b: Organ system dysfunction in specific Maternal Near miss conditions

Variable	Frequency *(n=123)*	Percent
Uterine dysfunction/Hysterectomy *(n=11)*		
Severe Pre-eclampsia	0	0.0
Eclampsia	0	0.0
Ruptured ectopic pregnancy	0	0.0
Severe postpartum haemorrhage	6	54.6
Sepsis or severe systemic infection	0	0.0
Ruptured uterus	5	45.4
Neurologic dysfunction *(n=5)*		
Severe Pre-eclampsia	0	0.0
Eclampsia	5	100.0
Ruptured ectopic pregnancy	0	0.0
Severe postpartum haemorrhage	0	0.0
Sepsis or severe systemic infection	0	0.0
Ruptured uterus	0	0.0
Hepatic dysfunction *(n=1)*		
Severe Pre-eclampsia	0	0.0
Eclampsia	1	100.0
Ruptured ectopic pregnancy	0	0.0
Severe postpartum haemorrhage	0	0.0
Sepsis or severe systemic infection	0	0.0
Ruptured uterus	0	0.0

*Some of the women had more than one organ system dysfunction

Table 8: Contributory/Associated factors of maternal near miss

Variable	Frequency (n=123)	Percent
Severe anaemia	33	26.8
Prolonged / Obstructed labour	11	8.9
Previous caesarean section	8	6.5
Antepartum haemorrhage	3	2.4
Pre-existing diseases		
Chronic hypertension	18	14.6
HIV / AIDS	5	4.1
Gestational DM	1	0.8

4 DISCUSSION

The prevalence of maternal near miss in the current study is 20.2%. The maternal near miss ratio is 227.8/1000 live birth, which is slightly higher than the 198/1000 live births reported from Elele, Southern Nigeria. Whereas both hospitals are in the same state, the study centre is a referral hospital, a public facility, and located in an urban area, hence had more complicated cases. However, the finding of the current study is significantly higher than the findings of studies conducted in other parts of Nigeria, Africa (such as Chad, Egypt, South Africa, Ethiopia), Nepal, Iraq, Iran, and India.[15,20-23] It was also higher than in several developed countries, such as Canada, the United Kingdom and Scotland, where the MNM ratio was 0.7, 1.2 and 1.34 per 1000 live births respectively.[24]

The high maternal near miss incidence ratio could be attributed to differences in the socio-demographic characteristics of the study population, the duration, and the sample size of the study. It could also be because the research centre is a tertiary health care facility where complicated cases from primary and secondary health facilities within and outside the state are referred. Another plausible explanation is that many births continue to take place at home, in churches, or at the homes of traditional birth attendants. In resource-poor countries, many women's health condition deteriorates before they reach a higher-level health facility because of delays in recognizing the danger signs by these women, their family members, or the first-level health care provider who often fail to refer them early. Hence, these women are frequently referred at a late stage, when they are critically ill or even on the verge of death.

Compared to earlier research in Nigeria, Africa, Iran, and Iraq, the maternal mortality ratio of 3,148/100,000 live births is quite high. In this study, the MMR is around 3.5 times the generally stated Nigerian ratio of 910/100,000 live births. This could be attributed to a higher number of

severe cases. It is quite surprising that the maternal mortality ratio is higher than that of South Sudan which has a ratio of 1,007/100,000 live births, despite South Sudan being one of the least developed and poorest country in the world. This emphasizes the need of implementing policies targeted at improving maternal health by the government and institutions.

The maternal near-miss to maternal mortality ratio is a measure of the quality of obstetric care. This ratio reflects the proportion of maternal near-miss cases that resulted in maternal death; the higher the ratio, the better the quality of care the women received. [8] The current study found a maternal near misses to maternal mortality ratio of 7:1. This means that one out of every eight women with life-threatening conditions will most likely die. This same ratio of 7:1 was reported in Egypt, [25] while a ratio of 8:1 was reported in Calabar and in Mozambique.[21,26] It was lower than the 11.4:1 recorded in Elele, Southern Nigeria, [27] 44:1 in Ekiti, [20] 8.6:1 in South Africa, [28] and 13:1 in Namibia, [29] 9:1 in South Sudan, [30] 10:1 in Nepal, [31] 12:1 in Iran, [32] 13:1 in Iraq [33] and 24:1 in Malaysia.[34]

This implies that more women with life-threatening conditions died at the study centre, most likely because of poor health-seeking behavior and late presentation, as well as poor referral systems. As a result, rather than a single estimate, quarterly or annual estimates may be more useful for monitoring and improving the quality of care given. Surprisingly, a lower ratio of 2.14:1 was reported in Enugu, [23] implying that one out of every two women suffering from life-threatening conditions will die. This discrepancy could be explained by the reduced sample size. Lower ratios of 4.7:1, 4.5:1, and 2.5:1 was also reported in Ekiti, [20] Jos,[22] and Tuncalp et al. [10] These all indicate poorer ratios and the need to improve the quality of obstetric care provided at these facilities to improve maternal outcomes.

The mortality index is a measure of performance. The index is calculated by dividing the number of maternal deaths by the number of women who experienced a maternal near-miss or death and is expressed as a percentage. [8] A high index (more than 20%) suggests poor obstetric care for severe cases, with more women dying as a result. A low index (5%), on the other hand, implies better treatment, with fewer women dying from severe diseases.[8] This study found a mortality index of 12%, which is like the 12% reported in Egypt[25] but lower than the 41% reported by the Nigeria near miss network study, which was undertaken in public hospitals.[19]

However, it is slightly higher than the 8.8% reported from Elele, [27] despite both hospitals being in the same state. The reason for this may be because Elele is a rural area, it is a private health facility and may not have as many referrals as the study centre. Similarly, a lower index of 10.4% was reported in South Africa, [28] 11.2% in Mozambique, [26] and 8.33% in Iran, [32] implying better quality of care compared to the study centre. In contrast, some local research in Ekiti and Enugu reported a mortality index of 17.5% and 31.8% respectively, [20,23] both of which were notably higher than observed in the current study, thus reflecting very poor quality of care and more women dying from severe conditions. This may be attributed to the location of the hospitals, late referrals, and late presentation of critically ill patients.

Several studies have identified obstetric haemorrhages and hypertensive disorders of pregnancy as the most common causes of maternal near misses, particularly in resource-poor countries. The current study identified hypertensive disorders and obstetric haemorrhages as the two leading causes of maternal near miss. This is comparable to other published reports from local studies. [15,21,23,27] Similar findings were reported in Chad, Ghana, Namibia, South Africa, Rwanda, Uganda, Mozambique, Morocco, Ethiopia, and Egypt. [6,10,25,26,28,29,35-38]

A similar pattern was identified in cases of maternal death, highlighting the likelihood of maternal near miss cases progressing to the other end of the spectrum, maternal death. The similarity may be because they are all developing countries with poor health seeking behaviours and almost non-existent preconception care services. However, obstetric haemorrhage and hypertensive disorders were still identified as leading causes of maternal near miss conditions in Malaysia, Netherlands, and Australia. [34,39,40]

The most common cause of maternal near misses in our centre was hypertensive disorders, notably pre-eclampsia. This is comparable with the report in Elele. [27] The reason for this may be because both centres are in Southern Nigeria. Nonetheless, hypertensive disorders was also reported as the major cause of maternal near miss in Jos. [22] These findings contradict those of other local centres where haemorrhage was reported as the leading cause of maternal near miss. [15,21,23] Similar trends were observed in Ghana, South Africa, Egypt, India, Pakistan, Nepal, Iraq, and Brazil. [10,25,28,31,33,41,42] However, despite the high proportion of cases of pre-eclampsia, the proportion of cases of eclampsia was relatively low, implying that adequate measures were taken to prevent seizure.

With regards to obstetric haemorrhage, it was observed to be the second major cause of maternal near miss. These included severe primary postpartum haemorrhage, and uterine rupture. All the cases of severe primary postpartum haemorrhage were due to uterine atony in unbooked women. Similar findings were observed in Ghana.[10] In this study, severe anaemia, prolonged/obstructed labour, and previous caesarean section were contributory factors to maternal near miss conditions. This is consistent with findings from other studies. [10,15] Severe anaemia in this study was due to ruptured ectopic pregnancy and ruptured uterus, all the women with these contributory factors were unbooked and were referred to the study centre.

Prolonged/obstructed labour and previous or current caesarean section were also associated with uterine rupture and severe primary postpartum haemorrhage.

Chronic hypertension was observed as a contributory factor for the development of pre-eclampsia and eclampsia in the current study, as 18 of the 62 patients had hypertension predating the pregnancy. Chronic hypertension has been linked to an increased risk of pre-eclampsia, placental abruption, intrauterine growth retardation, and preterm birth. This is comparable with the report in Ife.[15] Two thirds of women were unbooked and the maternal near miss conditions were present upon arrival at the hospital, indicating either a delay in seeking or reaching care, or a delay in detecting life-threatening disorders and making appropriate referrals. This is like the findings reported in Iraq. [43]

The primary organ dysfunctions identified in the study were cardiovascular dysfunction (shock and cardiac arrest) and respiratory dysfunction (gasping, acute cyanosis, and severe tachypnoea). Haemorrhage, hypertensive diseases, and sepsis were all linked to these organ dysfunctions. Similar observations were made in Enugu.[23] It is also comparable to reports from Ghana, Egypt, Uganda, and Ethiopia, [10,25,37,44] all of which are developing countries. The proportion of women with shock and severe tachypnoea in this study suggests that a significant number of them were successfully resuscitated.

5 CONCLUSION

This study has given an insight into high burden of maternal near miss conditions at the University of Port Harcourt Teaching Hospital. Hypertensive disorders (pre-eclampsia and eclampsia) were the leading cause of MNM, followed by obstetric haemorrhages (severe primary postpartum haemorrhage and ruptured uterus). The authors recommend scaling up of peripheral health facilities to be able to provide comprehensive emergency obstetric care, with regular and

progressive assessment, and strengthening the health systems at all levels to ensure health workers promptly refer complicated cases by establishing linkages between peripheral health care facilities and the referral hospitals, to minimize delays.

Ethical Consideration

Ethical clearance was obtained from the Research and Ethics committee of the University of Port Harcourt before commencement of the study (UPH/CEREMAD/REC/MM74/111). The data collection tools were labeled with unique identifiers and did not include hospital numbers. There was no direct interaction with the women and the study simply analyzed their case records, hence informed consent from the women was not necessary. However, the study was conducted in compliance with the Helsinki Declaration.

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