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MATERNAL NEAR-MISS AND MORTALITY IN WOMEN WITH SEVERE MATERNAL MORBIDITY IN TWO TERTIARY HOSPITALS IN LUANDA

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Abstract: Introduction: The maternal near-miss approach is a valuable tool for assessing the quality of care among women experiencing severe maternal morbidity. **Objective**: We aimed to estimate the frequency of maternal near-miss and maternal death. **Methods**: A cross-sectional study was conducted in two referral hospitals in Angola, from June 10 to September 8, 2022, and included women who met at least one WHO near-miss criterion. Descriptive analysis provided indicators of maternal near-near miss and maternal death. **Results**: There were 12,746 live births, 245 maternal near-miss, and 86 maternal deaths, resulting in a maternal near-miss ratio of 19.2 per 1000 live births and a maternal mortality ratio of 674.7 per 100,000 live births. The ratio of maternal near-miss to maternal death and the mortality index were 2.8:1 and 26.0%, respectively. Bleeding (n=128; 38.7%) and hypertensive disorders (n=80; 24.2%) were the most frequent causes of maternal near-miss and maternal death. Anemia was the commonest underlying cause of maternal near-miss (n=231; 94.3%) and maternal death (n=78; 90.7%). A higher mortality index was observed among women with sepsis (36.6%) and complications of abortion (36.7%). Lower family income (p<0.001), being referred from other hospitals (p=0.024), and prolonged delays in seeking care (p=0.0319) were related to maternal death. **Conclusions**: The primary and underlying causes of severe maternal outcomes are preventable. Community interventions focused on overcoming barriers in seeking care should be prioritized for early management of obstetric complications. Access to routine reproductive health services and antenatal care is crucial for preventing unintended pregnancies and the early diagnosis of potentially life-threatening conditions.

Keywords: Severe maternal morbidity, Maternal near-miss, Mortality index, Luanda, Angola

INTRODUCTION

According to the World Health Organization (WHO), the global maternal mortality ratio has decreased by 34%, and in sub-Saharan Africa, the reduction stands at 33% between 2000 and 2020 [1]. Despite this progress, many countries, particularly in the developing world, remain distant from achieving the Millennium Development Goals for maternal health [2]. Sub-Saharan Africa persists as the most vulnerable region, with an estimated maternal mortality ratio of 545 per 100,000 live births in 2020, a figure considered alarmingly high [1].

The trajectory from a healthy pregnancy to maternal death involves various events. It initiates with an obstetric complication or clinical deterioration of a pre-existing condition, triggered by physiological changes in pregnancy. This leads to systemic inflammatory responses, resulting in organ dysfunction and, ultimately, death [3-5]. Advances in managing life-threatening conditions related to pregnancy have made maternal death rare, particularly in developed countries, thereby increasing the number of women surviving severe maternal morbidity (SMM) [4,6]. These survivors are classified as near-miss cases, defined by the WHO as women who, having been on the brink of death, survive a complication occurring during pregnancy, childbirth, or within 42 days post-pregnancy [7].

The WHO has established a standardized set of criteria for identifying maternal near-miss, utilizing clinical, laboratory, and management criteria [3,7,8]. The WHO also introduced a list of potentially life-threatening conditions, including bleeding, hypertension, and other systemic disorders, along with management indicators for better surveillance of near-miss cases [7,8]. This approach is instrumental in

assessing the quality of maternal care and comprehending the drivers of SMM [9, 10]. As near-miss cases share common events leading to organ dysfunction and failure [4,8], research based on such cases can provide valuable insights into preventing SMM, consequently reducing maternal deaths.

Angola, like most other sub-Saharan countries, witnessed a substantial decline in the maternal mortality ratio from 2000 to 2020 (74%), dropping from 860 to 222 maternal deaths per 100,000 live births. However, the 2020 maternal mortality ratio estimate necessitates increased efforts from stakeholders and policymakers to achieve the Sustainable Development Goal of an maternal mortality rate less than 140 per 100,000 live births by 2030 [1]. The causes of maternal death are largely preventable through early and adequate obstetric care to address the root causes and underlying factors of maternal morbidity [7].

There has been no prior research on SMM in Angola using the WHO's maternal near-miss criteria. Additionally, there is a dearth of knowledge regarding the frequency of maternal near-miss and the primary causes and associated factors. Hence, this study aims to estimate the frequency of SMM in two referral hospitals in Angola using the WHO near-miss approach. Furthermore, the study intends to evaluate the factors associated to maternal death among women experiencing SMM admitted to these two referral hospitals.

MATERIAL AND METHODS

STUDY SETTING

This study is part of a broader survey conducted from June 10 to September 8, 2022, at two tertiary-level public health referral hospitals in Luanda, the capital of Angola, catering to a population of 9,079,811 inhabitants. Both hospitals receive patients transferred and referred from secondary and primary-level health facilities across the country. Maternal and neonatal care is provided free of charge in both facilities.

Obstetric care is structured into three levels (primary, secondary, and tertiary) following the same hierarchical structure of the national health system. Women with low-risk pregnancies and routine obstetric care needs are assisted at the primary level (health centers, peripheral maternity units, and municipal hospitals), where midwives, under the supervision of a limited number of obstetricians, provide care. Pregnant women with high obstetric risk requiring urgent care are referred to secondary-level general or provincial hospitals, where midwives and obstetricians offer assistance. Complex cases of SMM are transferred to third-level reference hospitals. Tertiary-level hospitals provide more specialized care with better infrastructure, more equipment, and more qualified human resources. However, even tertiary-level care facilities experience shortages in equipment and highly specialized professionals.

The referral system is designed to manage or transfer pregnant women according to their healthcare needs to the appropriate facility. However, the referral system functions poorly; both primary and secondary-level facilities lack qualified human and material resources to manage obstetric emergencies. Consequently, many pregnant women self-refer to tertiary-level hospitals, even when there is no specific health risk, resulting in crowding and overload in these hospitals. More than half of births (53%) continue to occur at home and are unlikely to be attended by qualified health professionals [11].

IDENTIFYING WOMEN WITH LIFE-THREATENING CONDITIONS

Participants were women with potentially life-threatening conditions admitted to the labor ward, obstetrics wards, or to the intensive care unit (ICU) during pregnancy or within 42 days of its termination over the study period. The staff on duty utilizes WHO criteria of clinical, laboratory and management indicators of organ dysfunction for identifying life-threatening conditions based on a near-miss approach [7].

Women were included in the present analysis if at least one of the WHO criteria was met. A structured data abstraction form was filled out based on medical records and interviews with women by staff on duty. The form included sociodemographic characteristics, frequency of antenatal care, information on referral to the hospital, delay in seeking a healthcare facility, as well as details on severe pregnancy-related complications, use of critical interventions, underlying and contributing causes of severe maternal outcomes, and admission to intensive care unit, as proposed by WHO [7]. Then, all cases were classified according to the outcome at discharge: maternal death (MD) or maternal near-miss (MNM) for the women who survived SMM.

STATISTICAL ANALYSIS

The descriptive analysis included estimates of the maternal near-miss ratio per 1,000 live births and maternal mortality ratio per 100,000 live births based on the number of live births reported in both hospitals during the study period. The maternal near-miss mortality ratio and mortality index, as well as the respective 95% confidence interval (95% CI) were also obtained. Descriptive frequencies for sociodemographic and obstetric characteristics, the presence of clinical, laboratory, and management indicators of organ dysfunction, and the diagnosis of life-threatening conditions were obtained for each group according to the maternal outcome at discharge (MNM and MD). Groups were compared by using the chi-square test or Fisher's exact test. The mortality index was computed for each life-threatening condition. SPSS version 25 for Windows was used for data analysis, and the significance level was set to 5%.

ETHICAL CONSIDERATIONS

This research was approved by the Independent Ethics Committee of the Agostinho Neto University's Health School (Deliberation n.º 24/2022 of April 29), and the two hospital units authorized the data collection. Data were collected confidentially and anonymously. The women included in the study gave informed consent by signing or applying the fingerprint for illiterate women. For MNM cases, data collection was performed when the woman's health status allowed informed consent.

RESULTS

During the 3-month study period, 331 women with life-threatening conditions were identified (245 MNM and 86 MD). During the same period, 12746 live births were registered, resulting in a maternal near-miss ratio of 19.2 per 1000 live births (95% CI 16.8–21.6), a maternal mortality ratio of 674.7 per 100.000 live births (95% CI 5.3–8.2), a maternal near-miss mortality ratio of 2.8:1 (95% CI 2.5–3.2) and a mortality index of 26.0% (95% CI 21.3 – 30.7) as shown in Table 2.

Table 3 shows the comparison between the MNM and MD groups concerning sociodemographic and obstetric characteristics. Women in the MNM group had a higher family income (p<0.001) and were more frequently self-referred from home (p=0.024) than their counterparts. Moreover,

Severe maternal complications
- Severe postpartum hemorrhage
- Severe pre-eclampsia
- Eclampsia
- Sepsis or severe systemic infection
- Ruptured uterus
- Severe complications of abortion

Critical interventions or intensive care unit use
- Admission to an intensive care unit
- Interventional radiology
- Laparotomy (includes hysterectomy, excludes cesarean section)
- Use of blood products

Life-threatening conditions (near-miss criteria)
- Cardiovascular dysfunction – Shock, cardiac arrest (absence of pulse/heartbeat and loss of consciousness), use of continuous vasoactive drugs, cardiopulmonary resuscitation, severe hypoperfusion (lactate >5 mmol/l or >45 mg/dl), severe acidosis [pH <7.1)
- Respiratory dysfunction – Acute cyanosis, gasping, severe tachypnea (respiratory rate >40 breaths per minute), severe bradypnea (respiratory rate <6 breaths per minute), intubation and ventilation not related to anaesthesia, severe hypoxemia (O^2 saturation <90% for ≥60 minutes or PAO^2/ FiO^2<200)
- Renal dysfunction – Oliguria non-responsive to fluids or diuretics, dialysis for acute renal failure, severe acute azotemia (creatinine ≥300 μmol/ml or ≥3.5 mg/dl)
- Coagulation/hematological dysfunction – Failure to form clots, massive transfusion of blood or red cells (≥5 units), severe acute thrombocytopenia [100 μmol/l or >6.0 mg/dl)
- Hepatic dysfunction – Jaundice in the presence of pre-eclampsia, severe acute hyperbilirubinemia (bilirubin >100 μmol/l or >6.0 mg/dl)
- Neurological dysfunction – Prolonged unconsciousness (lasting ≥12 hours)/coma (including metabolic coma), stroke, uncontrollable fits/status epilepticus, total paralysis
- Uterine dysfunction – Uterine hemorrhage or infection leading to hysterectomy

Maternal vital status
- Maternal death

Table 1. Inclusion criteria for baseline assessment of quality of care

Source: WHO, 2011

MNM (n)	245
MD (n)	86
Live births (n)	12,746
MNMR (number of MNM/1,000 live births); (95% CI)	19.2 (16.8 – 21.6)
MMR (number of MD/100,000 live births; (95% CI)	674.7 (530.0 – 820.0)
MNM:MD (ratio between MNM cases and MD);(95% CI)	2.8:1 (2.5 – 3.2)
Mortality Index: MD/(MNM+MD) per 100 (95% CI)	26.0 (21.3 – 30.7)

Table 2. Maternal near-miss and maternal death indicators in two tertiary hospitals in Luanda, Angola

MNM-Maternal near-miss; MD-maternal death; MNMR-maternal near-miss ratio;

MMR-maternal mortality ratio.

a higher proportion of women in the MD group delayed more than 36 hours in seeking a healthcare facility (p=0.031).

Table 4 presents the distribution of severe maternal conditions between groups by outcome at discharge. The most frequent primary causes of severe maternal morbidity were bleeding disorders in MNM (41.6%; n=102) and MD (30.2%; n=26) followed by hypertensive disorders other systemic infectious disorders, corresponding to 22.9% (n=56) in MNM and 27.9% (n=24) in MD cases, respectively. Anemia was the most common underlying or contributing cause of severe maternal outcome (MNM+MD) affecting 9 out of 10 cases in both MNM and MD groups.

Table 5 shows the distribution of MNM and MD cases according to the clinical, laboratory, and management criteria of organ dysfunction. Women with one or two criteria were more frequent in the MNM group (62.8%), while in the MD group, 98.8% had three or more criteria. In the MNM group, the most common criteria were those related to hematologic dysfunction (93.5%, n=229), followed by uterine (42.9%, n=105) and cardiovascular (24.5%, n=60) dysfunctions. In the MD group, 8 out of 10 cases presented criteria related to cardiovascular dysfunction (82.6%, n=71), followed by hematologic (73.2%, n=63) and respiratory (62.8%, n=45) dysfunction. Overall, one out of four women with life-threatening conditions died (mortality index: 26.0%). Although hepatic dysfunction was the least frequently observed condition, this dysfunction was related to the highest mortality index (83.5%). Death was reported in half of women with cardiovascular (54.2%), respiratory (56.3%) and neurologic (49.3%) dysfunction.

DISCUSSION

In our study, the maternal near-miss ratio was 19.2 per 1,000 live births, and the maternal mortality ratio was 675 per 100,000 live births, while the maternal near-miss mortality ratio and mortality index were 2.8:1 and 26%, respectively. Compared with other facility-based studies conducted in sub-Saharan countries, the maternal mortality ratio observed in this study (19.2) was lower than that reported in Somalia (56.5) [12], Tanzania (35.6) [13], Ghana (34.2) [9], Northern (28.5) and Southern (37.9) Ethiopia [14, 15], but similar to the maternal near-miss ratio reported in Nigeria (19.4) [16]. We observed a lower maternal near-miss mortality ratio than that reported in similar studies from sub-Saharan countries [9,12-15], where the maternal near-miss mortality ratio ranged between 4.6 and 12.4. Also, the mortality index we observed (26%) is higher than reported in other studies conducted in sub-Saharan countries [9,12-15, 17-19]. A low maternal near-miss mortality ratio and high mortality index values indicate a low chance of survival among women with life-threatening conditions. The results observed in our study appear worse than similar settings for indicators of maternal near-miss. However, caution is needed in interpreting the results. For instance, a study conducted in Nigeria [16] reported similar values to those we observed for maternal near-miss ratio, and maternal near-miss mortality ratio in tertiary-level facilities but higher maternal near-miss ratio and lower maternal near-miss mortality ratio in secondary-level facilities. The Nigerian study [16] showed higher values for mortality index in tertiary facilities, although a higher burden of maternal near-miss was reported in secondary facilities. The lower maternal near-miss mortality ratio could be explained by the referral system where tertiary facilities receive only the most severe cases with a higher

Characteristics	MNM (n=245)	MD (n=86)	*p-value*
Maternal age (years)			0.651
< 20	37 (15.1)	15 (17.4)	
20 – 34	159 (64.9)	51 (59.3)	
≥ 35	49 (20.0)	20 (23.3)	
Maternal residence			0.127
Urban	69 (28.2)	17 (19.8)	
Peri-urban	176 (71.8)	69 (80.2)	
Schooling years			0.245
None	10 (4.1)	8 (9.3)	
1 – 8	100 (40.8)	32 (37.2)	
9 – 12	124 (50.6)	44 (51.2)	
> 12	11 (4.5)	2 (2.3)	
Marital status			0.637
Married/cohabitation	170 (69.4)	62 (72.1)	
Single	75 (30.6)	24 (27.9)	
Family income (dollars)			< 0.001
< 100	82 (33.5)	30 (34.9)	
100 –300	118 (48.1)	41 (47.6)	
> 300	45 (18.4)	9 (10.5)	
No information	0 (0.0)	6 (7.0)	
Referral status			0.024
Self-referred from home	120 (49.0)	30 (34.9)	
Referred from another facility	125 (51.0)	56 (65.1)	
Delay in seeking facility healthcare (hours)			0.031
< 24 h	100 (40.8)	32 (37.2)	
24 – 36 h	83 (33.9)	20 (23.3)	
> 36 h	62 (25.3)	34 (39.5)	
Number of pregnancies			0.372
Actual pregnancy	65 (26.5)	21 (24.4)	
2 – 3	74 (30.2)	19 (22.1)	
4 – 5	69 (28.2)	31 (36.0)	
>5	37 (15.1)	15 (17.4)	
Number of antenatal care visits			0.946
None	29 (11.8)	14 (16.3)	
< 4	110 (44.9)	37 (43.0)	
≥ 4	106 (43.3)	35 (40.7)	
First prenatal care visit			0.708
1st trimester	101 (41.2)	34 (39.5)	
2nd trimester	106 (43.3)	36 (41.9)	
3rd trimester	9 (3.7)	2 (2.3)	
No antenatal care	29 (11.8)	14 (16.3)	
Previous caesarean section			0.999
No	188 (76.7)	66 (76.7)	
Yes	57 (23.3)	20 (23.3)	

Table 3. Sociodemographic and obstetrics characteristics stratified by MNM and MD

	Severe maternal causes n (%)	MNM (n=245)	MD (n=86)	All (n=331)	*Mortality Index (%)*
Primary causes	**Bleeding Disorders,**	**102 (41.6)**	**26 (30.2)**	**128 (38.7)**	**20.3**
	Antepartum Hemorrhage	25 (10.2)	7 (8.1)	32 (9.7)	21.9
	Postpartum Hemorrhage	28 (11.4)	9 (10.4)	37 (11.2)	24.3
	Ruptured uterus	32 (13.1)	8 (9.3)	40 (12.1)	20.0
	Placental disorders	17 (6.9)	2 (2.3)	19 (5.7)	10.5
	Hypertensive Disorders	**56 (22.9)**	**24 (27.9)**	**80 (24.2)**	**30.0**
	Severe pre-eclampsia	22 (9.0)	9 (11.6)	31 (9.4)	29.0
	Eclampsia	34 (13.8)	15 (17.4)	49 (14.8)	30.6
	Systemic Infectious Disorders	**26 (10.6)**	**15 (17.4)**	**41 (12.4)**	**36.6**
	Endometritis and endomyometritis after vaginal delivery	2 (0.8)	3 (3.5)	5 (1.5)	60.0
	Surgical wound infection after caesarean section	24 (9.8)	5 (5.8)	29 (8.8)	17.2
	Other systemic infections*	0 (0.0)	7 (8.1)	7 (2.1)	100.0
	Severe complications of abortion	**19 (7.8)**	**11 (12.7)**	**30 (9.1)**	**36.7**
	Other Systemic Disorders	**42 (17.1)**	**10 (11.6)**	**52 (15.7)**	**19.2**
	Malaria	27 (11.0)	10 (11.6)	37 (11.2)	27.0
	Severe anemia (unrelated to hemorrhage)	15 (6.1)	0 (0.0)	15 (4.5)	0.0
Underlying or contributing factors ǂ	Anemia	231 (94.3)	78 (90.7)	309 (93.4)	
	HIV	10 (4.1)	12 (14.0)	22 (6.6)	
	Previous cesarean section	57 (23.3)	20 (23.3)	77 (23.3)	
	Obstructed labor	87 (35.5)	22 (25.6)	109 (32.9)	
	Sickle cell disease	20 (8.2)	0 (0.0)	20 (6.0)	
	Diabetes	2 (0.8)	3 (3.5)	5 (1.5)	

Table 4. Primary and underlying causes of maternal near-miss and maternal deaths in two tertiary hospitals of Luanda, Angola

*Pulmonary tuberculosis(n=4) and HIV(n=3).

ǂ Women can present more than one underlying or contributing factor.

WHO Near Miss Criteria	MNM	MD	Total	Mortality Index (%)
All	**245**	**86**	**331**	**26.0**
Number of criteria				
1	64 (26.1)	0 (0.0)	64	-
2	90 (36.7)	1 (1.2)	91	1.1
3	41 (16.7)	19 (22.1)	60	31.6
≥ 4	50 (20.4)	66 (76.7)	116	56.9

Admitted to UCI	39 (15.9)	29 (33.7)	68	42.6
Organ dysfunction ǂ				
Cardiovascular	**60(24.5)**	**71(82.6)**	**131**	**54.2**
Shock	52 (21.2)	46 (53.5)	98	46.9
Absence of pulse/heartbeat and loss of consciousness	9 (3.7)	52 (60.5)	61	85.2
Cardiopulmonary resuscitation	9 (3.7)	44 (51.2)	53	83.0
Continuous vasoactive drug use	13 (5.3)	0 (0.0)	13	0.0
Respiratory	**35(14.3)**	**45(62.8)**	**80**	**56.3**
Intubation and ventilation for ≥60 min, not related to anesthesia	35 (14.3)	43 (50.0)	78	55.1
Oxygen saturation (<90% for 60 minutes)	5 (2.0)	10 (11.6)	15	66.7
Renal	**47(19.2)**	**34(39.5)**	**81**	**42.0**
Oliguria non-responsive to fluids and diuretics	35 (14.3)	27 (31.4)	62	43.5
Creatinine ≥300 μmol/l (≥3.5 mg/dL)	47 (19.2)	34 (39.5)	81	42.0
Dialysis for acute renal failure	35 (14.3)	12 (14.0)	47	25.5
Hematologic	**229(93.5)**	**63(73.2)**	**292**	**21.6**
Acute thrombocytopenia (<50.000 platelets per μL)	11 (4.5)	31 (36.0)	42	73.8
Transfusion ≥1 red blood cell unit	229 (93.5)	58 (67.4)	287	19.5
Coagulation disorder	0 (0.0)	19 (22.1)	19	100.0
Hepatic	**1 (0.4)**	**5 (5.8%)**	**6**	**83.3**
Bilirubin ≥100 μmol/l (≥6.0 mg/dL)	1 (0.4)	3 (3.5)	4	75.0
Jaundice with pre-eclampsia	0 (0.0)	3 (3.5)	3	100.0
Neurologic	**38 (15.5)**	**37 (43.0)**	**75**	**49.3**
Loss of conscience for ≥12 h	33 (13.5)	31 (36.0)	64	48.4
Stroke	5 (2.0)	5 (3.5)	10	50.0
Uncontrollable seizures/status epilepticus	0 (0.0)	14 (16.3)	14	100.0
Uterine (Hysterectomy from infection/bleeding)	**105 (42.9)**	**29 (33.7)**	**134**	**21.6**

Table 5. Distribution of MNM and MD cases according to the clinical, laboratory and management criteria of organ dysfunction

ǂ Women can present more than one organ dysfunction.

chance of death.

Bleeding and hypertensive disorders were the most frequent causes of MNM and MD accounting for two-thirds of cases in our setting. Although these disorders were also reported as the leading causes of SMM in earlier studies conducted in similar settings [13-15, 19, 20], the mortality index we observed for each primary cause was higher than reported in such studies, and this finding is a matter of concern.

In line with international guidelines [21], the emergency management of hypertensive disorders in our setting is based on the use of magnesium sulfate and early delivery by caesarean section. However, pregnant women should have access to routine and adequate antenatal care (at least four antenatal visits) for early diagnosis, monitoring of hypertension (blood pressure measurement and proteinuria determination), and timely referral [22]. In our study, 87% of women with life-threatening conditions attended antenatal care, but less than half (49%) had at least four prenatal visits, as recommended, suggesting poor antenatal monitoring of women with potentially life-threatening conditions due to hypertension.

One in ten cases of SMM we observed was due to puerperal sepsis, and the majority of these cases were related to surgical wound infection after cesarean section. The use of prophylactic antibiotics administered before cesarean section decreases the risk of wound infection and endometritis, playing a role in preventing maternal severe infectious complications [23]. Besides ensuring an adequate supply and rational use of antibiotics (testing antimicrobial resistance), strengthening infection control practices, and training health workers on the recognition of signs and symptoms of sepsis and immediate intervention are key issues in preventing SMM and reducing the mortality index due to infection [24,25].

Complications of abortion also contributed to the near-miss burden in this study and constitute the primary cause of severe morbidity with the highest mortality index. This finding suggests using unsafe abortion due to unplanned pregnancy, a common situation in countries where abortion laws are highly restrictive, such as in Angola [26]. Low access to family planning and contraception methods increases the risk of unintended pregnancy, the main determinant of abortion with severe complications [5].

A highlight in our findings is the proportion of women with anemia; nine out of ten women had a diagnosis of anemia, the most frequent contributing factor to MNM and MD. Moreover, a non-negligible proportion of near-miss cases was due to severe anemia. Research conducted in sub-Saharan countries and summarized in a systematic review [27] showed a high prevalence of anemia among pregnant women (37%). However, anemia is a highly preventable condition. Iron-folate supplementation, nutritional counseling, and antihelminthic therapy programs emerged as key strategies for reducing the risk of anemia during pregnancy [27]. However, the implementation of these strategies requires the availability of and access to quality reproductive health services.

A high mortality index can indicate poor management of the most severe cases. Among women included in this analysis, 37% of MNM and 98% of MD cases presented three or more near-miss criteria, indicative of critically ill patients requiring admission to the ICU and more complex medical interventions. However, only 1 out of 3 of these women were admitted to the ICU. This finding suggests a shortage in ICU beds. Indeed, both tertiary hospitals enrolled in this research have a scarcity of ICU beds (less than 10 beds in each hospital).

Although the indicators of SMM we observed are worrying, they can be partly explained by the tertiary referral nature of the facilities enrolled in our analysis and the consequent high burden of SMM cases. Delay in seeking and receiving early and adequate emergency obstetric care has been considered a preventable determinant of severe maternal outcomes [20,28-30]. According to our results, women in the study group who delayed longer than 36 hours in seeking care were more likely to die. According to the literature, in most sub-Saharan African countries, as well as in our setting, women face numerous barriers to accessing health care [31]. Delay in seeking emergency obstetric care is often associated with poor knowledge about the warning signs of pregnancy or the complications of abortion [20,32]. Women's low autonomy in making reproductive health decisions and their lack of economic power make them dependent on third parties (spouses or family members) for decision-making, including access to health services [31]. Furthermore, previous negative experiences and perceived poor quality of care in health facilities with limited equipment and medical consumables and poorly performing technical staff can discourage women and their families from seeking care [31]. Community interventions adapted to the cultural context have been implemented in Sub-Saharan countries to overcome delays in seeking care [29, 33]. Further research in our setting would be important to understand the factors that influence delays in seeking care, informing appropriate strategies for community interventions.

To our knowledge, this is the first facility-based study describing maternal near-miss and mortality in Angola. During data collection, the identification of life-threatening conditions was based on the WHO near-miss approach. This approach has been widely used for monitoring severe maternal morbidity, particularly in low- and middle-income settings, allowing reliable and comparable data across settings [34]. In this study, the WHO tool was adjusted to include some frequent causes of severe maternal morbidity and mortality in Angola, such as antepartum bleeding and malaria. Additionally, due to the limitations of hemotherapy and laboratory services, we reduced the threshold of five or more units of blood and excluded some laboratory parameters. Other studies conducted in similar low-resource settings also reported adaptations to the WHO near-miss criteria [9,14,17,35]. These adaptations have been considered mandatory to avoid underreporting severe maternal morbidity [12,36,37].

Our study had some additional limitations that must be considered. The two hospitals included in this study serve as references to the network of provincial and national health units, and the caseload concentrates on the most severe and complicated obstetrics cases. In such circumstances, selection bias might cause an overestimation of the indicators in the analysis. Women's delay in deciding to seek healthcare (first delay) was assessed, but delays in reaching the health facility (second) and delays in receiving care within the health service (third) were not evaluated in our study. It is important to analyze the chain of delays that may contribute to poor outcomes for women with severe maternal morbidity. Despite these limitations, this study can help to take preventive care and influence the development of better obstetric care for early detection and monitoring of women with potentially fatal complications, thereby reducing the risk of progression to maternal death.

CONCLUSIONS

This study revealed a higher mortality index among women with SMM compared to that reported in similar settings. Although the most frequent causes of severe morbidity were hemorrhagic and hypertensive disorders, the highest mortality index was associated to complications of sepsis and abortion. Anemia was an extremely frequent contributing factor to severe maternal outcomes. Delay in seeking care appeared to be linked to maternal death. These findings suggest that there are opportunities to prevent severe maternal outcomes. Community interventions focused on overcoming barriers in seeking care should be prioritized for the early management of obstetric complications. Additionally, improving the availability and access to routine reproductive health services and antenatal care is a valuable strategy for preventing unintended pregnancy and for the early diagnosis and monitoring of potentially life-threatening conditions.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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