



The burden of severe maternal outcomes and indicators of quality of maternal care in Nigerian hospitals: a secondary analysis comparing two large facility-based surveys

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Objective To compare severe maternal outcomes (SMOs) from two multi-centre surveys in Nigerian hospitals, and to evaluate how the SMO burden affects quality of secondary and tertiary hospital care.

Design Two facility-based surveys of women experiencing SMO (maternal near-miss or maternal deaths).

Setting Sixteen secondary and five tertiary facilities in Nigeria [WHO Multi-Country Survey on Maternal and Newborn Health (WHOMCS)] and 42 public tertiary facilities in Nigeria (Nigeria Near-Miss and Maternal Death Survey).

Population 371 women in WHOMCS-Nigeria and 2449 women in Nigeria Near-Miss and Maternal Death Survey who experienced SMO.

Methods Secondary analysis and comparison of SMO data from two surveys, stratified by facility level.

Main outcome measures Maternal mortality ratio (MMR) per 100 000 livebirths (LB), maternal near-miss (MNM) ratio per 1000 LB, SMO ratio per 1000 LB and mortality index (deaths/SMO).

Results Maternal mortality ratio and mortality indices were highest in tertiary facilities of the WHOMCS-Nigeria (706 per 100 000; 26.7%) and the Nigeria Near-Miss and Maternal Death Survey (1088 per 100 000; 40.8%), and lower in secondary facilities of the WHOMCS-Nigeria (593 per 100 000; 17.9%). The MNM ratio and SMO ratio were highest in secondary WHOMCS-Nigeria facilities (27.2 per 1000 LB; 33.1 per 1000 LB).

Conclusions Tertiary-level facilities in Nigeria experience unacceptably high maternal mortality rates, but secondary-level facilities had a proportionately higher burden of severe maternal outcomes. Common conditions with a high mortality index (postpartum haemorrhage, eclampsia, and infectious morbidities) should be prioritised for action. Surveillance using SMO indicators can guide quality improvement efforts and assess changes over time.

Keywords Maternal death, maternal health, maternal near-miss, quality of care, severe maternal outcome.

Tweetable abstract 2820 Nigerian women with severe maternal outcomes: high mortality in tertiary level hospitals, higher burden in secondary level.

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Introduction

Nigeria is the world's seventh most populous country, with an estimated population of 190.9 million (2017).¹ Of the estimated 303 000 women and adolescent girls who died as

a result of pregnancy and childbirth-related complications in 2015, around 19% of these deaths occurred in Nigeria.²

The estimated maternal mortality ratio (MMR) in Nigeria was the fourth-highest in the world at 814 per 100 000 live births (uncertainty interval 596–1180), and it had the highest absolute number of maternal deaths (approximately

[†]Deceased.

58 000) globally.² A Nigerian woman has a 1 in 22 lifetime risk of experiencing maternal death.

The WHO maternal near-miss approach is a tool that allows clinicians and health facilities to assess and improve the quality of maternal health care by calculating the prevalence and ratios of severe maternal outcomes (a maternal death or maternal near-miss).³ It operationalises a standard definition of maternal near-miss (i.e. a woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy) based on markers of organ dysfunction.⁴ Different health facilities or countries that use the standard WHO approach can be meaningfully compared to assess relative differences in burden and health service performance. Previous studies have been published on the burden of severe maternal morbidity in Nigerian hospitals. However, these studies have generally assessed individual morbid conditions or used variable definitions of severe maternal morbidities.⁵⁻⁸ Furthermore, most of the facility-based studies conducted in Nigeria on severe maternal morbidity predate the publication of the WHO maternal near-miss approach.

Two large multi-centre, facility-based surveys have applied the WHO maternal near-miss approach to measuring severe maternal outcomes in large samples of Nigerian women. The WHO Multi-Country Survey on Maternal and Newborn Health (WHOMCS) was conducted from 2010 to 2011 in 359 facilities in 29 countries, including 21 hospitals in Nigeria.⁹ The Nigeria Near-Miss and Maternal Death Survey was conducted from 2012 to 2013 in 42 hospitals in Nigeria.¹⁰ The aim of this paper is to compare severe maternal outcome data in Nigerian women from these two surveys in order to evaluate their prevalence and impacts on the quality of secondary and tertiary hospital care.

Methods

WHO Multi-Country Survey on Maternal and Newborn Health (WHOMCS)

The WHOMCS (2010–2011) was a cross-sectional survey conducted across 359 facilities in 29 countries that included 314 623 women. The primary aim was to collect data on maternal deaths and near-miss cases. The methodological details and primary findings of the WHOMCS have been described previously.^{9,11} In brief, a stratified, multistage cluster sampling approach was used to obtain a global sample of institutions with over 1000 deliveries per year and the capacity to perform caesarean section. Data were collected for 2 months in institutions with ≥ 6000 annual deliveries and 3 months in institutions with < 6000 annual deliveries. In countries where < 3000 annual deliveries were anticipated, it was extended to 4 months. Data from the 21 Nigerian facilities that participated (data collection

conducted from July 2011 to December 2011) have not been analysed separately. Individual data on all women presenting to the hospital (to give birth and/or with a severe maternal outcome) were abstracted from the medical records, with no contact between data collectors and participants. Individual-level data included socio-demographic, medical, obstetric, and birth characteristics, the use of essential interventions at the time of birth and immediate postpartum period, and intra-hospital maternal and newborn health outcomes until day 7, discharge or death (whichever came first). Aside from study participation, there was no patient or public involvement in the design and conduct of this survey.

Nigeria Near-Miss and Maternal Death Survey

The Nigeria Near-Miss and Maternal Death Survey was a nationwide, multi-centre, cross-sectional study that identified women who died or suffered a maternal near-miss due to pregnancy, childbirth or puerperal complications. The study protocol and primary findings have been published previously.^{10,12} In total, 42 public tertiary hospitals providing obstetric services participated in the study. Through a facility-based prospective surveillance system, the study identified women with severe maternal outcome (death or maternal near-miss, within 42 days of birth or spontaneous loss/termination of pregnancy) occurring in participating facilities over a 1-year data collection period (all 42 facilities completed data collection between June 2012 and August 2013). Individual-level data were collected on severe maternal outcome cases only, including socio-demographic, medical, obstetric, and birth characteristics, the timeliness of essential interventions to avert death from life-threatening complications, and intra-hospital maternal and newborn health outcomes. Follow up of participating women was until discharge or death, and their newborns were followed until discharge, transfer or death (whichever occurred first). Monthly records of the total number of births, live births, stillbirths, and distribution of all maternal complications managed at the facilities (regardless of their severity and final outcome) were also collected.

Definitions and analyses

For this analysis, we used the WHO definitions of the main maternal near-miss indicators.³ A maternal near-miss (MNM) case is defined as 'a woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy', although for pragmatic reasons the WHOMCS only captured data until Day 7, discharge or death (whichever came first). A maternal death is defined as 'death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and the site of the pregnancy, from any cause related to or aggravated by the

pregnancy or its management, but not from accidental or incidental causes'. In both surveys, these were intra-hospital maternal deaths only. A severe maternal outcome (SMO) is defined as a maternal near-miss or maternal death.

The main indicators of quality of maternal health care performance were the MNM ratio (MNM cases per 1000 live births), the intra-hospital maternal death ratio (maternal deaths per 100 000 live births), the SMO ratio (per 1000 live births), and the mortality index (the number of maternal deaths divided by the number of SMO cases, expressed as a percentage). A lower mortality index value implies that fewer women with life-threatening conditions die (i.e. the better the quality of care).

To standardise comparisons across the two surveys, we restricted the main comparisons to those participants with severe maternal outcomes (maternal death or near-miss) only. Characteristics of the study populations were described based on variables available in both datasets. We compared maternal and perinatal indicators between the two surveys based on the recommended WHO maternal near-miss approach indicators,^{3,9} stratified by facility level (the WHOMCS was conducted in secondary and tertiary facilities, whereas the Nigeria Near-Miss and Maternal Death Survey was conducted in public tertiary facilities only). To position the Nigerian survey findings in a global context, the key SMO indicators for other WHOMCS countries⁹ were also presented graphically.

Results

The WHOMCS-Nigeria captured data on 12 841 women (11 775 live births), 371 of whom experienced a SMO (Table 1). The Nigeria Near-Miss and Maternal Death Survey captured data on 100 107 women (91 724 live births), 2449 of whom experienced an SMO. Among women with SMO, the maternal age distribution in the two surveys was similar; however, the WHOMCS-Nigeria had fewer women without a partner (2.2 versus 10.4%) and more women who were primiparous (30.2 versus 23.7%).

The Nigeria Near-Miss and Maternal Death Survey (100 107 women) was nearly eight times larger than the WHOMCS-Nigeria (12 841 women), but it captured nearly 14 times the number of maternal deaths (998 versus 73) (Table 2). The intra-hospital maternal mortality ratio was higher in the tertiary facilities of the WHOMCS-Nigeria (706 per 100 000 live births) and the Nigeria Near-Miss and Maternal Death Survey (1088 per 100 000 live births), and somewhat lower in secondary facilities in the WHOMCS-Nigeria (593 per 100 000 live births). Conversely, the MNM ratio was highest in the WHOMCS-Nigeria secondary-level facilities (27.2 per 1000 live births) than the tertiary facilities in the WHOMCS-Nigeria (19.4 per 1000) or the Nigeria Near-Miss and Maternal Death Survey (15.8 per 1000).

Table 1. Maternal, neonatal, and delivery characteristics of women experiencing severe maternal outcomes in the two surveys

	WHOMCS – Nigeria	Nigeria Near-Miss and Maternal Death Survey		
Total number of hospitals	21	42		
Average period of time that each hospital recruited participants	3 months	12 months		
Total women*	12 841	100 107		
Total births	12 652	97 634		
Total live births	11 775	91 724		
Total stillbirths	856	5910		
Women with severe maternal outcomes (SMO)**	371	2449		
	<i>n</i>	%	<i>n</i>	%
Individual characteristics of women with SMO	371	100	2449	100
Maternal age (years)				
<20 years	40	10.8	238	9.7
20–35 years	287	77.4	1891	77.2
>35 years	43	11.6	317	12.9
Missing	1	0.3	3	0.1
Marital status***				
With partner	361	97.3	2179	88.9
Without partner	8	2.2	254	10.4
Missing	2	0.5	16	0.7
Number of pregnancies				
1	112	30.2	580	23.7
2–5	166	44.7	1265	51.7
>5	93	25.1	575	23.5
Missing	0	0	29	1.1
Range	1–15		1–15	

*All women admitted for pregnancy, childbirth or puerperal complication/or up to 6 weeks following birth or termination/loss of pregnancy.

**Severe maternal outcomes are maternal deaths plus maternal near miss cases. This is the denominator for individual characteristics.

***In the WHOMCS, women without a partner were defined as 'Single/Separated/Divorce/Widowed/Other' and with partner as 'married/cohabitating'. In the Nigeria Near-miss and Maternal Death Survey, marital status was defined as 'married' or 'not married'.

Similarly, the SMO ratio was highest in secondary facilities (33.1 per 1000 live births), whereas the tertiary facilities in the WHOMCS-Nigeria (26.5 per 1000) and the Nigeria Near-Miss and Maternal Death Survey (26.7 per 1000 live birth) were similar. The mortality index was highest in tertiary facilities—40.8% in the Nigeria Near-Miss and Maternal Death Survey and 26.7% in the WHOMCS-Nigeria. Figure 1 demonstrates that, relative to other countries that participated in the WHOMCS, Nigerian facilities consistently

Table 2. Maternal and perinatal indicators in two surveys

	WHO MCS – Nigeria		Nigerian Near-Miss and Maternal Death Survey	
	All facilities	Secondary facilities only	Tertiary facilities only	All facilities*
Total number of facilities	21	16	5	42
Total women	12 841	9823	3018	100 107
Live births	11 775	8940	2835	91 724
Stillbirths	856	707	149	5910
Births (unknown vital status)	210	176	34	0
Maternal near misses (MNM)**	298	243	55	1451
Intra-hospital maternal deaths***	73	53	20	998
Severe maternal outcomes (SMO)	371	296	75	2449
Indicators				
MNM ratio (per 1000 live births)	25.3	27.2	19.4	15.8
Intra-hospital MMR (per 100 000 live births)	620	593	706	1088
SMO ratio (per 1000 live births)	31.5	33.1	26.5	26.7
Mortality Index****	19.7	17.9	26.7	40.8

*All facilities in the Nigerian Near-Miss and Maternal Death Survey were tertiary facilities.

**Nigeria Near-Miss and Maternal Death Survey captured these outcomes until Day 42 postpartum, whereas the WHOMCS captured them until Day 7 postpartum, discharge or death (whichever came first).

***In the WHOMCS, maternal death was defined as death occurring during admission to hospital, before Day 7 or discharge (whichever came first). Deaths occurring in the community or during a subsequent re-admission of a participant were not captured. In the Nigeria Near-Miss and Maternal Death Survey, death was defined as death occurring during admission to hospital.

**** $(MD/MNM) + MD \times 100\%$.

experience some of the highest rates of severe maternal outcomes, and the highest MMRs (data provided in Supporting Information Appendix S1).

Figure 2A–C illustrates that in the WHOMCS-Nigeria, SMOs in secondary-level facilities were most commonly due to contributing factors/associated conditions (52.3%) (particularly anaemia), haemorrhagic conditions (31.4%), and hypertensive disorders (4.6%). In SMOs in WHOMCS-Nigeria tertiary level facilities, the contribution of haemorrhage was similar to that in secondary level facilities (29.5%), but infection (17.1%) and hypertensive disorders (13.3%) were more frequent. In the Nigeria Near-Miss and Maternal Death Survey, haemorrhagic conditions (39.0%), hypertensive disorders (24.0%), and contributing factors/associated conditions (14.0%) were the most common. Supporting Information Table S1 reports the prevalence and mortality indices for individual conditions among women with SMO in both surveys. In the WHOMCS-Nigeria, the most common conditions were anaemia (38.5%), PPH (21.6%), and eclampsia (17.5%), compared with eclampsia (17.6%), PPH (14.5%), and ruptured uterus (10.7%) in the Nigeria Near-Miss and Maternal Death Survey. In the WHOMCS-Nigeria, individual conditions with the highest mortality index (i.e. fatality) were HIV/AIDS (58.3%), heart disease (41.2%), placental abruption (31.3%), and PPH (30.0%). In the Nigeria Near-

Miss and Maternal Death Survey, mortality indices were generally higher for most conditions, notably infectious morbidities—chorioamnionitis (77.3%), puerperal genital sepsis (73.6%), systemic infections/sepsis (90.3%), abortion-related infection (56.8%), and HIV/AIDS (85.4%). It is noteworthy that the mortality index was high in both surveys for the most common causes of maternal death globally—postpartum haemorrhage (29.1 and 30%) and eclampsia (26.2 and 49.3%).

Discussion

Main findings

We compared indicators for the burden of severe maternal outcomes and the quality of maternal health service performance from two multi-centre, facility-based surveys in Nigeria, and quantified the burden of severe maternal outcomes at secondary and tertiary level facilities. Although the maternal mortality ratio and mortality index was highest in tertiary facilities, secondary-level facilities had a proportionately higher burden of maternal near-miss and severe maternal outcome cases. Haemorrhage contributed to 30–40% of severe maternal outcomes at both secondary and tertiary level; however, infectious morbidities and hypertensive disorders contributed more at tertiary level compared with secondary level. Nigerian health facilities

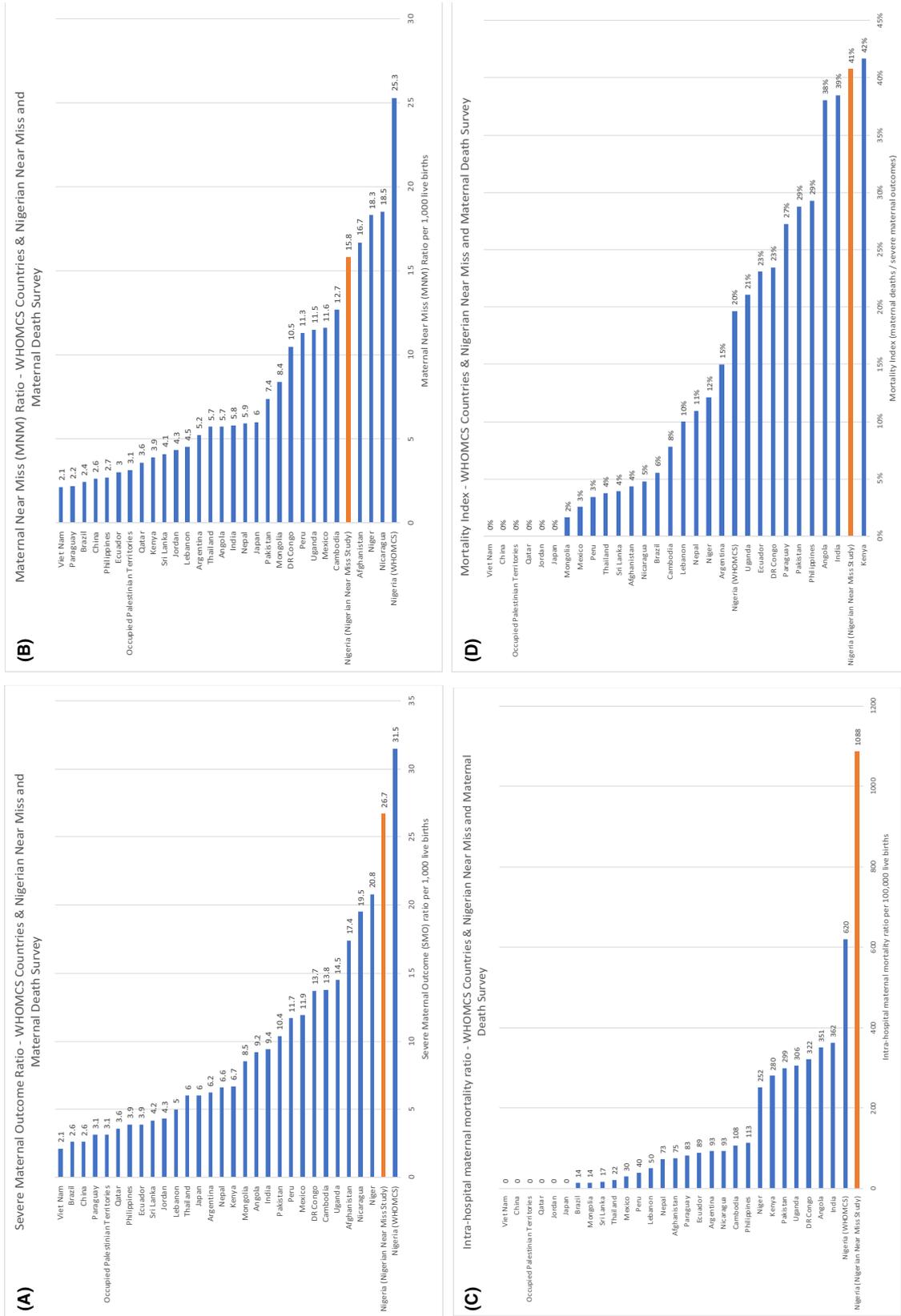


Figure 1. (A-D) Comparing Nigerian severe maternal outcome indicators with those in other countries in the WHO Multi-Country Survey Network.

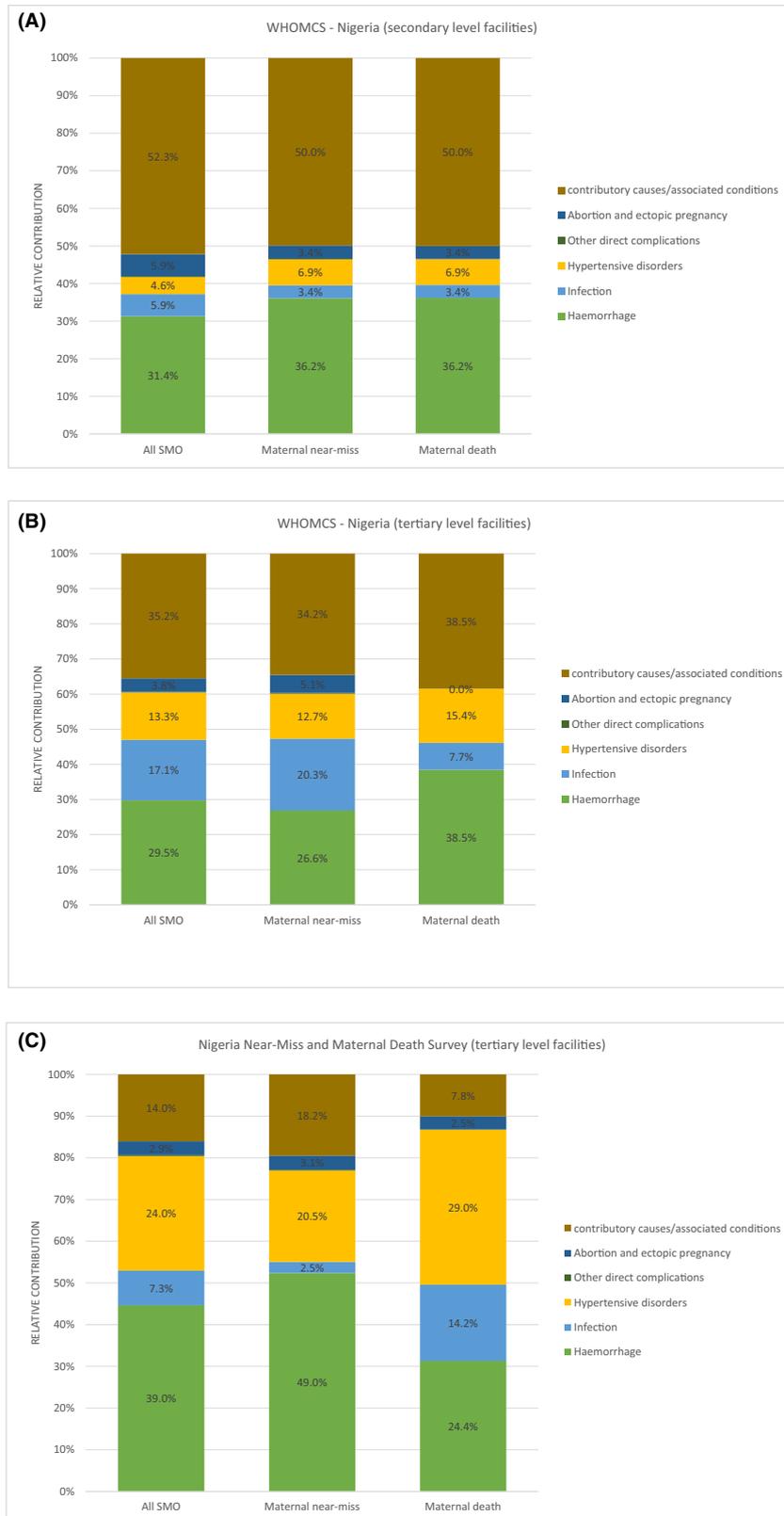


Figure 2. (A–C) Relative contribution of key groups of complications by outcome severity.

had a greater burden of near miss and maternal death relative to other countries.

Strengths and limitations

This secondary analysis has several strengths. Both datasets were multi-centre surveys that used standardised manuals and data collector training, and were based on the WHO maternal near-miss approach.³ Both surveys collected data prospectively, though the Nigeria Near-Miss and Maternal Death Survey primarily focused individual data collection on women experiencing severe maternal outcomes and was conducted over a longer time period.

Nonetheless, there are some limitations to this analysis. Slight differences in the design and definitions used in the two surveys should be kept in mind. The Nigeria Near-Miss and Maternal Death Survey captured severe maternal outcomes occurring at any point during admission, whereas the WHOMCS used a pragmatic cut-off for data collection (up to 7 days postpartum, discharge or death, whichever came first) and would therefore have captured fewer SMO cases (although the majority of SMOs will occur around the time of childbirth and first week of life). Neither survey collected data on maternal deaths or near-misses occurring after hospital discharge, hence it is likely that these two surveys slightly underestimate the true burden of severe maternal outcomes. There are few data available on the occurrence of maternal near-miss in community settings. A recent analysis by Goldenberg and colleagues used a more pragmatic set of near-miss criteria to identify severe maternal outcomes among 122 707 women in maternal registry data in seven lower-income countries (43% of whom delivered in a hospital).¹³ They reported an overall MMR of 187 per 100 000 live births, with 18 307 (15.0%) women experiencing at least one near-miss event (equivalent to a mortality index of 3.85%).¹³

Both surveys abstracted data from routine medical records which may be sub-optimal in some settings. In settings where certain laboratory tests are not available, under-identification of maternal health conditions and/or underestimation of their severity might have occurred. Similarly, in settings where some management options are unavailable (such as intubation, dialysis or blood transfusion), maternal near-miss cases may go unrecognised. In such settings, women may die because of unrecognised organ dysfunction, worsening the ratio of maternal deaths to maternal near-miss cases. There are a few differences between the two surveys in the health conditions recorded for each SMO case—the Nigeria Near-Miss and Maternal Death Survey collected data on the presence of dystocia (prolonged labour, labour obstruction) and additional infectious conditions (puerperal genital sepsis, chorioamnionitis) that were not recorded in the WHOMCS. We did not calculate the mortality index for conditions with fewer than five events (see Table S1). Additionally, in the WHOMCS some conditions had few maternal

deaths, hence the mortality index should be interpreted with a degree of caution. It is possible that an individual woman participated in both surveys (i.e. two pregnancies), although we believe that this number is small and unlikely to bias overall findings.

Interpretation

Since its development, the WHO maternal near-miss criteria have been applied in a range of countries and settings.^{14–16} The few previous studies of maternal near-miss conducted in Nigeria have been largely in single tertiary facilities and used different operational definitions of severe maternal morbidity,^{5–8} limiting the ability to compare these with other findings. Despite some slight differences in the predefined conditions used in the Nigeria Near-Miss and Maternal Death Survey, we consider the findings of these two surveys to be meaningfully comparable. While the findings should not be regarded as representative of all facilities in Nigeria, they indicate that the burden of severe maternal morbidity and mortality may vary considerably between secondary and tertiary levels.

Some recent near-miss studies (using or adapting the WHO maternal near-miss approach) have identified similar high rates of maternal near-miss and maternal death, generally in tertiary facilities in low-income countries.^{14,17–19} For example, a study of 8433 live births at three tertiary hospitals in Ghana reported a maternal near-miss ratio of 341 per 1000 live births and an MMR of 735 per 100 000 live births.¹⁴ We were unable to identify any previous studies that specifically compared differences in near-miss indicators between tertiary and secondary levels within a single health system.

A 2016 analysis of the Nigerian Master Health Facility List by Makinde et al.²⁰ reported that primary-level health facilities account for 88% of all facilities in Nigeria. Secondary-level health facilities (12% of all facilities) are typically the first level at which some specialist services are available; 76% of these are privately run.²¹ Public secondary-level facilities are usually (but not exclusively) administered by state governments. Conversely, 88% of Nigerian tertiary health facilities (i.e. specialist and teaching hospitals, accounting for 0.25% of all facilities) are public, generally administered by the Federal Government. Our findings suggest that secondary level facilities are often the first point-of-call for critically ill Nigerian women. Hence, while these facilities need to ensure prompt, effective care is available to all women, rapid identification and referral of the critically ill (after resuscitation and stabilisation) to tertiary-level care needs to be prioritised. Conversely, public tertiary care facilities require improvements in order to provide adequate supportive care for these critical ill women (as evidenced by the high mortality indices). The Nigeria Near-Miss and Maternal Death Survey findings can

be considered representative, as 42 of the 48 public tertiary hospitals that provided obstetric services in Nigeria during the survey period participated. While WHOMCS used a multi-stage sampling approach, information on public/private status of WHOMCS-Nigeria facilities is not known. It should not be assumed that our findings will generalise to other countries with different health system arrangements; there is a need for individual facilities to collect and assess their own data to guide quality improvement activities. We expect that primary-level facilities in Nigeria have a considerably lower burden of SMO cases, due to out-referral of women with life-threatening complications. However, these facilities have an important role to play in preventing, identifying, and rapidly referring life-threatening conditions. Operationalising the WHO maternal near-miss criteria in settings with limited or no access to laboratory tests or emergency interventions (as is the case for many lower-level health facilities in Nigeria) would be challenging.^{17,22}

WHO advises that secondary and tertiary facilities providing obstetric care use the maternal near-miss approach routinely and continuously.³ These two surveys demonstrate this is feasible at scale in Nigeria, and its implementation should be prioritised in national and state health policies and programmes. However, near-miss surveillance must be matched with efforts to improve the quality of maternal care more broadly if health outcomes are to be improved.^{9,10} Establishment of a maternal and perinatal database across selected referral hospitals for routine collection of data during labour, childbirth, and the postpartum period (as planned by WHO in collaboration with the Nigerian Ministry of Health) would facilitate such quality improvement strategy. There is evidence to suggest that implementing near-miss case reviews can improve the quality of maternity care and/or reduce maternal morbidity and mortality in low- and middle-income country hospitals.²³ Implementation of a near-miss case review system should consider not only the data requirements (i.e. the need for a reliable, functioning maternal near-miss surveillance system) but also the need for resources, staff training, and support in conducting effective near-miss case reviews.²⁴ Future research around maternal near-miss in Nigeria could include benchmarking the performance of health facilities based on their near-miss indicators in order to identify (and emulate) the best-performing health facilities, and further implementation research to ensure that the near-miss approach is widely and effectively used.

Conclusion

Tertiary-level facilities in Nigeria experience unacceptably high rates of maternal mortality; however, secondary-level facilities may have a proportionately higher burden of severe maternal outcomes overall. The WHO maternal near-miss

approach is a practical tool for assessing maternal health service performance, even in low-resource settings where the burden of maternal death is very high. Consistent implementation of maternal death and near-miss case reviews—as part of the efforts to improve facility-level quality of care—are the next logical step to reducing the unacceptably high mortality indices reported in these surveys. Those conditions that are commonly associated with SMO, with high fatality, and are preventable or treatable (such as infectious morbidities) should be prioritised for action. Continued surveillance using the SMO indicators would allow healthcare providers and facility administrators to assess improvements over time and prioritise quality improvement activities.

Disclosure of interests

The authors declare that they have no competing interests. Completed disclosure of interests forms are available to view online as Supporting information.

Contribution to authorship

This secondary analysis was conceived by JPV and OTO. JPV conducted the analysis with input from OTO, which was presented at a technical meeting of the Nigerian Near Miss and Maternal Death Survey collaborators, which included BF, ASA, and OA. JPV revised the analysis with input from BF, ASA, OA, and OTO. JPV and OTO drafted the initial version of the manuscript, with contributions from BF, ASA, and OA. JPV, ASA, OA, and OTO reviewed and approved the final paper prior to submission. Prior to his demise, BF input a near-final version of this paper. We confirm that the content and findings of the published paper do not differ from what was reviewed and approved by BF.

Details of ethics approval

The technical content of both protocols was reviewed and approved by the WHO HRP research project review panel and the WHO Ethics Review Committee (ERC). WHO ERC approvals were received on 27 October 2009 (A65661, the WHO Multi-Country Survey on Maternal and Newborn Health) and 10 May 2011 (A65745, the Nigeria Near-Miss and Maternal Death Survey). Both surveys were reviewed and approved by the relevant ethical clearance bodies in all participating hospitals. Written consent from individual women was not needed because there was no contact between the data collectors (who extracted routine medical record data) and individual women.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Table S1. Morbidity conditions in women with severe maternal outcomes (SMO) in two Nigerian surveys

Appendix S1. Severe maternal outcome (SMO) indicators for all WHOMCS countries and the Nigeria Near-Miss and Maternal Death Survey ■

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