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Original article

Maternal near-miss and death among women with hypertensive disorders in pregnancy: a secondary analysis of the Nigeria Near-miss and Maternal Death Survey

AN Adamu,[a] BO Okusanya,[b] J Tukur,[c] AO Ashimi,[d] OA Oguntayo,[e] KA Tunau,[f] BA Ekele,[g] OT Oladapo[h]

[a] Department of Obstetrics and Gynaecology, Federal Medical Centre, Birnin Kebbi, Nigeria [b] Department of Obstetrics and Gynaecology, College of Medicine, University of Lagos, Lagos, Nigeria [c] Department of Obstetrics and Gynaecology, Bayero University, Kano, Nigeria [d] Department of Obstetrics and Gynaecology, Federal Medical Centre, Birnin Kudu, Nigeria [e] Department of Obstetrics and Gynaecology, Ahmadu Bello University Teaching Hospital, Shika,, Nigeria [f] Department of Obstetrics and Gynaecology, Usmanu Danfodiyo University, Sokoto, Nigeria [g] Department of Obstetrics and Gynaecology, University of Abuja Teaching Hospital, Gwagwalada, Nigeria [h] UNDP/UNFPA/UNICEF/WHO/World Bank Special Programme of Research, Development and Research Training in Human Reproduction (HRP), Department of Reproductive Health and Research, World Health Organization, Geneva, Switzerland
Correspondence: Dr AN Adamu, Department of Obstetrics and Gynaecology, Federal Medical Centre, Birnin Kebbi, Nigeria.
Email nanaadamu@gmail.com. Tel. +2348035978715

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Objective To investigate life-threatening maternal complications related to hypertensive disorders of pregnancy (HDP) in Nigerian public tertiary hospitals.

Design Secondary analysis of a nationwide cross-sectional study.

Setting Forty-two tertiary hospitals.

Population Women admitted for pregnancy, childbirth or puerperal complications.

Method All cases of severe maternal outcome (SMO: maternal near-miss or maternal death) due to HDP were prospectively identified using the WHO criteria over a 1-year period.

Main outcome measures Incidence of SMO, health service events, case fatality rate, and mortality index (% of maternal death/SMO).

Results Out of 100 107 admissions for maternal complications, 6753 (6.8%) women had HDP. Pre-eclampsia (PE) (54.5%) and eclampsia (E) (30.4%) were the most common HDP recorded. SMO occurred in 587 women with HDP: 298 maternal near-misses and 289 maternal deaths. The majority (93%) of the women with SMO due to HDP were admitted in a critical condition. The median diagnosis–definitive intervention interval was over 4 hours in a quarter of women who died from HDP. For PE and E, case fatality rates were 1.9 and 10.4%, respectively, although both conditions had a similar mortality index of 49.3%. Lack of antenatal care and place of residence further than 5 km from the hospital were associated with maternal death.

Conclusions Severe maternal outcomes from HDP were due to late presentations and health system challenges. To reduce maternal deaths from HDP, health system strengthening that would engender early hospital presentation and prompt treatment is recommended.

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Keywords Eclampsia, hypertensive disorders, maternal mortality, maternal near-miss, pre-eclampsia, pregnancy toxaemia, severe maternal outcome.

Tweetable abstract Eclampsia is the leading cause of maternal death in Nigerian hospitals.

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Introduction

Nigeria accounted for a substantial proportion of estimated 303 000 maternal deaths that occurred globally in 2015.[1] Hypertensive disorders of pregnancy (HDP) have been reported to account for 14% of maternal deaths and a significant proportion of morbidities worldwide, although the magnitude of their contributions to severe maternal complications varies between regions.[2,3] HDP include chronic hypertension, gestational hypertension, pre-eclampsia, and eclampsia,[4] with pre-eclampsia and eclampsia being responsible for the majority of poor maternal and fetal outcomes.[5] In high-income countries, eclampsia is rare, presumably because of early detection and control of pre-eclampsia.[4] However, in many resource-constrained countries such as Nigeria, it remains a major contributor to adverse maternal and perinatal outcomes in spite of measures to mitigate its incidence and impact.

In Nigeria, several institution-based retrospective studies have shown that eclampsia is an important cause of maternal death,[6–8] and especially in the Northwestern region, where it is one of the three leading causes.[9–11] Effective and efficient planning of any intervention to control the morbidities and mortalities from HDP would therefore require accurate and reliable data.[12]

Women sometimes suffer life-threatening maternal complications and somehow survive them;[13] a maternal near-miss is one in which there is an organ dysfunction or failure during pregnancy, childbirth or postpartum.[14] It has been found to be a good measure of obstetric performance where maternal deaths occur both frequently and infrequently.[7,15]

At present, no national data exist on the incidence of pre-eclampsia and eclampsia, or on the associated maternal and perinatal outcomes, in Nigeria. There are also no national data available on maternal near-misses related to HDP. Strategies to reduce maternal deaths, however, require improvement in quality of care and strengthened healthcare delivery system,[16] both of which are impossible to achieve without reliable and generalizable morbidity and mortality data to guide planning.

This analysis was conceived to provide countrywide data for HDP in a population of pregnant or puerperal women who were treated for maternal complications in a network of Nigerian tertiary healthcare facilities. The information would be useful to healthcare providers concerned with managing these pregnancy complications, and to policymakers and other stakeholders involved in maternal and newborn health programmes. The objectives were to determine the incidence of maternal death and near-miss from HDP, associated health service events, and fetal consequences of severe maternal outcomes from HDP in Nigerian public tertiary hospitals.

Methods

Our study was a secondary analysis of data from a multicentre prospective surveillance of severe maternal outcomes that was conducted in 42 tertiary health institutions in Nigeria between June 2012 and August 2013. The study population consisted of women who were admitted for delivery or within 42 days of delivery or termination of pregnancy regardless of the duration of the pregnancy. Other methodological details have been published elsewhere.[17,18] The current analysis was focused on women with HDP, and there was no public or patient involvement in conduct of this research, nor were core outcome sets used to define the choice of outcomes of interest.

The main outcomes of interest for this analysis were frequencies of pre-eclampsia and eclampsia, maternal death, maternal near-miss, fetal and neonatal outcomes, and pattern of organ dysfunctions. Hypertensive disorders were categorized into three groups; chronic hypertension, pre-eclampsia, and eclampsia. Chronic hypertension was defined as a blood pressure (BP) measurement of 140/90 mmHg or more in a pregnancy without proteinuria with the BP recording predating the pregnancy or recorded before the 20th week of pregnancy. Pre-eclampsia was defined as the occurrence of BP recording of 140/90 mmHg or more during the second half of pregnancy on two occasions with an interval of at least 6 h, and demonstrable proteinuria in a woman without previous hypertension and/or proteinuria. Eclampsia was defined as the occurrence of generalized tonic-clonic seizures in a woman with the features of pre-eclampsia.

We conducted descriptive analyses of maternal characteristics according to the type of severe maternal outcome (SMO) and evaluated their association with maternal survival. We determined the frequencies of organ dysfunction markers among women with SMO. We assessed the care performance for (1) each organ dysfunction marker by estimating the mortality index and (2) types of HDP by estimating the mortality index and case fatality rates. Mortality index was calculated as the number of deaths divided by the number of SMO, expressed as a percentage. We expressed variables related to time intervals as median (with interquartile range) and compared findings between cases of maternal near-miss and maternal death. Categorical variables were compared with the chi-square test, Fisher's exact test and odds ratio (OR) as appropriate. We considered differences between observations statistically significant when the P-value was < 0.05. Statistical analyses were performed using EPI INFO 7.1.4 (CDC, Atlanta, Georgia, USA).

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Results

Overall, there were 100 107 admissions for pregnancy, childbirth or puerperal complications during the study period as shown in Supporting Information Figure S1. Of these, 94 835 women were admitted for deliveries and 91 724 live births were recorded.[17] A total of 6753 (6.8%) of all admissions for pregnancy, childbirth or puerperal complications were due to HDP: 1026 (15.2%) women with chronic hypertension, 3674 women (54.4%) with pre-eclampsia, and 2053 (30.4%) women with eclampsia. Figure S1 also shows that 587 (8.7%) women admitted due to HDP experienced a severe maternal outcome: 298 maternal near-misses and 289 maternal deaths.

Table 1 shows the relative contributions of HDP to all SMO recorded during the study period, indicators of their burden on the health system and care performance in terms of their management. About a quarter of SMO recorded in all participating institutions was due to HDP. HDP contributed close to one-third of all maternal deaths, with eclampsia alone responsible for one-fifth of all deaths. The maternal near-miss to maternal death ratio for all HDP and for each of the different categories of HDP was approximately 1, suggesting an equal number of maternal deaths for every case of near-miss. However, all other indicators were poorer for eclampsia compared to the other categories. The mortality index for both pre-eclampsia and eclampsia was similar (approximately 50%), a reflection of a large proportion of pre-eclampsia and eclampsia that ended in a maternal death.[18]

Table S1 presents the demographic characteristics, past reproductive history, and their association with fatality among women with SMO due to HDP. The table shows that most women with SMO were within the 20- to 35-year age bracket, married, belonged to a low social class, lived beyond 5 km radius of the hospital, were not registered for care at the hospital, and were admitted in a critical condition. The characteristics were generally comparable between women who died and those who survived, except for the place of residence being further than 5 km to hospital and a lack of any form of antenatal care, which appeared to be associated with increased risk of maternal death. Unmarried status, secondary school education, and caesarean section appeared to be associated with maternal survival.

Table 2 shows that neurological, respiratory, and cardiovascular dysfunctions were the most frequent organ dysfunctions recorded among women with SMO due to HDP. Cardiovascular dysfunction had the highest mortality index, followed by respiratory dysfunction. In all, 133 (22.7%) women with SMO were admitted to the intensive care unit: 59 of these women survived and 74 died.

Among women with SMO and delivery outcomes, two-thirds of their babies were born alive (Table 3). Stillbirth, early neonatal death, and perinatal mortality were generally more frequent among women who died than among those who survived severe complications. Of the babies born alive, fewer than half were admitted into a special care baby unit.

As shown in Table 4, the time intervals between the diagnosis and 'definitive intervention' and attention by senior personnel were variable for women with severe complications due to HDP. Approximately one-quarter of these women did not receive definitive intervention or attention by senior personnel until 4 hours after the diagnosis of a severe obstetric event. Women who died were, however, more likely to receive definitive intervention and attention of senior personnel at or within 30 minutes of diagnosis of a severe obstetric event. Although the median time between diagnosis and intervention to avert death from all HDP

Table 1. Prevalence of hypertensive disorders of pregnancy complications and near-miss indicators

	All HDP admissions *n* = 6753 (%)	All SMO *n* = 2449 (%)	All MNM *n* = 1451 (%)	All MD *n* = 998 (%)	MNM ratio (per 1000 LB)	MMR (per 100 000 LB)	SMOR (per 1000 LB)	MNM:MD ratio	Mortality index	Cause-specific CFR (%)
Chronic hypertension	1026 (15.2)	15 (0.6)	8 (0·6)	7 (0·7)	0.09	7.63	0.16	1.14	46·7	0·7
Pre-eclampsia	3674 (54.4)	140 (5.7)	71 (4·9)	69 (6·9)	0.77	75.23	1.53	1.03	49·3	1·9
Eclampsia	2053 (30.4)	432 (17.6)	219 (15·1)	213 (21·3)	2.39	232.22	4.71	1.03	49·3	10·4
All HDP	6753 (100.0)	587 (24.0)	298 (20.5)	289 (29.0)	3.30	315.10	6.40	1.03	49.2	4.3

CFR, case fatality rate; HDP, hypertensive disorders of pregnancy; LB: live birth; MD, maternal death; MNM, maternal near-miss; MMR, maternal mortality ratio; SMO, severe maternal outcome; SMOR, severe maternal outcome ratio.
Reference is total live births in study population: 91 724.[17]

was 30 minutes shorter among those who died compared with those who survived, this difference was not statistically significant.

Discussion

Main findings

Our study shows that HDP was responsible for a substantial proportion of maternal near-misses and deaths despite the fact that it accounted for a small fraction of hospital admissions for maternal complications. The overall performance of the hospitals in the management of HDP can be significantly improved, as women with life-threatening complications due to HDP had a 50% chance of survival. Although neurological dysfunction was the most common organ dysfunction marker experienced by affected women, cardiovascular dysfunction was associated with the least chance of maternal survival. There were significant delays in the provision of interventions to avert maternal death for women with life-threatening complications due to HDP.

Strengths and limitations

The strength of our study was the prospective and meticulous nature of the data collection process in all regions across Nigeria. This methodological step not only increased the internal validity of our findings but also challenged the claim that facility-based data lacked strong external validity.[19] The 1-year data collection period also limited the influence of any seasonal variability and thus provided a more accurate overall picture of HDP in the country. One major limitation of this secondary analysis was the application of WHO criteria to identify women with a severe maternal outcome due to HDP. As these criteria included the use of some laboratory tests that could not be readily performed in all participating hospitals, it is possible that some women with near-misses were missed and the incidence of SMO from HDP underreported.

Table 2. Mortality index according to organ dysfunctions associated with hypertensive disorders in pregnancy

Organ dysfunction	MNM *n* = 298 (%)	Maternal death *n* = 289 (%)	SMO *n* = 587 (%)	Mortality index (%)
Cardiovascular dysfunction	52 (17.5)	138 (47.8)	190 (32.4)	72.6
Respiratory dysfunction	85 (28.5)	152 (52.6)	237 (40.4)	64.1
Renal dysfunction	47 (15.8)	67 (23.2)	114 (19.4)	58.8
Coagulation dysfunction	33 (11.1)	42 (14.5)	75 (12.8)	56.0
Uterine dysfunction	4 (1.3)	2 (0.7)	6 (1.0)	33.3
Hepatic dysfunction	26 (8.7)	26 (9.0)	52 (8.9)	50.0
Neurological dysfunction	156 (52.4)	125 (43.3)	281 (47.9)	44.5

Organ dysfunctions are not mutually exclusive.

Table 3. Fetal and neonatal outcomes among women with delivery outcomes

Women with delivery outcomes	MNM *n* = 279*	MD *n* = 197*	SMO *n* = 476*
Neonatal conditions at birth			
Alive	196 (70.25)	120 (60.91)	316 (66.4%)
Fresh stillbirth	47 (16.85)	47 (23.86)	94 (19.70)
Macerated stillbirth	36 (12.90)	30 (15.23)	66 (13.90)
Early neonatal death (END) at hospital discharge or ≤day 7	72 (25.81)	65 (32.99)	137 (28.78)
Perinatal mortality (stillbirth + END) at hospital discharge or ≤day 7)	155 (55.56)	142 (72.08)	297 (62.39)
	***n* = 196**	***n* = 120**	***n* = 316**
Newborn admission to SCBU among neonates born alive	93 (47.45)	49 (40.83)	142 (44.94)

MNM, maternal near-miss; MD, maternal death; SCBU, special care baby unit; SMO, severe maternal outcome.
*Excluding second and higher order fetuses.

Table 4. Time between diagnosis of hypertensive disorders of pregnancy and intervention to avert maternal death and attention by senior personnel

Time to definitive intervention (minutes)	SMO *n* = 560 (%)	MD *n* = 273 (%)	MNM *n* = 287 (%)	Odds Ratio, 95% CI	*P*-value MD vs. MNM
≤30	259 (46.25)	141 (51.65)	118 (41.11)	1.51, 1.10–2.13	0.0125
31–60	63 (11.25)	26 (9.52)	37 (12.89)	0.71, 0.41–1.21	0.2074
61–120	54 (9.64)	18 (6.59)	36 (12.54)	0.49, 0.27–0.89	0.0171
121–180	29 (5.18)	8 (2.93)	21 (7.32)	0.38, 0.17–0.88	0.0192
181–240	26 (4.64)	11 (4.03)	15 (5.23)	0.76, 0.34–1.69	0.5009
>240	129 (23.04)	69 (25.27)	60 (20.91)	1.28, 0.86–1.90	0.2197
All SMO, median (IQR)	45 (15–242.5)	30 (12.5–252)	60 (17.5–202.5)	*	0.2902
Time to attention by senior personnel (minutes)	***n* = 553 (%)**	***n* = 267 (%)**	***n* = 286 (%)**	**Odds ratio, 95% CI**	***P*-value MD vs. MNM**
≤30	204 (36.89)	111 (41.57)	93 (32.52)	1.48, 1.04–2.09	0.0274
31–60	89 (16.09)	47 (17.60)	42 (14.69)	1.24, 0.78–1.95	0.3508
61–120	58 (10.49)	20 (7.49)	38 (13.29)	0.53, 0.29–0.93	0.0262
121–180	36 (6.51)	15 (5.62)	21 (7.34)	0.75, 0.38–1.49	0.4113
181-240	21 (3.80)	9 (3.37)	12 (4.20)	0.80, 0.33–1.92	0.6119
>240	145 (26.22)	65 (24.34)	80 (27.97)	0.83, 0.57–1.21	0.3324
All SMO, median (IQR)	60 (20–307.5)	60 (22.5–258)	72 (30–307.5)	*	0.0126

HDP, hypertensive disorders of pregnancy; MD, maternal death; MNM, maternal near-miss; SMO, severe maternal outcome; 95% CI, 95% confidence interval.
*Undefined.

Interpretation of findings

The African regional estimate for PE and E of 4.0 and 2.7% respectively, reported by Abalos et al.[20] in their study would appear close to our current estimates. However, the applicability of these values to our setting could be challenged because they were derived from model-based estimates which included only a few countries from the African region.

Our surveillance indicated that ICU admission was not associated with higher odds of survival, perhaps as a result of late presentation. It may also be because participating health facilities in our study had different ICU resources, including human resources. However, it is likely that a low threshold for ICU admission would result in a low case fatality rate for ICU admissions.[21]

A better outcome for SMO from HDP could be more assured not only by strengthening secondary and primary health facilities accurately to diagnose HDP, provide initial treatment and promptly refer challenging cases to tertiary health facilities, but also by bringing these facilities closer to the populace. This would reduce the need to travel far to receive appropriate and timely care. Our findings indicated higher odds of surviving an SMO when the distance to the health facility was shorter than 5 km.

The association of unmarried status and caesarean section with maternal survival needs to be interpreted with caution. Our study showed that being unmarried was linked to higher likelihood of surviving an SMO, and this finding is similar to that of Asamaoh et al.[22] in a study conducted in Ghana. Elsewhere, being married (rather than being unmarried) had a significant protective effect against maternal death.[23] The restriction of analysis to only women who had SMO from HDP in our study might have accounted for this finding, especially as unmarried women constituted just 7% of women. Similarly, participating institutions are tertiary health facilities and one expects caesarean section to be safe at these settings, though the same may not apply to caesarean section at private health facilities or even secondary health facilities. Therefore, our findings should not be misconstrued as supporting routine caesarean birth for women with HDP. Further research may be necessary to study the nature of these relations with SMO from HDP, and information derived from such research should inform policy issues on maternal health care.

Having a higher level of education has been documented to improve the chances of survival, with an inverse relation between maternal death and educational status.[22] In our study, only secondary level education was specifically associated with reduced odds of SMO. The significant association between lack of antenatal care and maternal death from HDP is not an unusual finding.[9] Receiving antenatal

care affords the opportunity for early diagnosis and treatment of pre-eclampsia, which may prevent the progression to eclampsia and reduce the risks of potential complications associated with this latter condition.[24] Poverty is a recognized contributor to poor maternal outcome when complications arise.[25] Despite this, there was no clear relation between social class and survival among women with SMO in our study. The reason for this is unclear but may be related to late presentation in the health facility and the challenge of appropriate socio-economic categorization in our setting.

The high mortality indices from cardiovascular, respiratory, renal, hepatic, and neurological dysfunctions suggest their importance in contributing to the death of a woman with HDP. Eclampsia, rather than PE, is more implicated, and these disorders have long been associated with increased risk of maternal death.[25]

Conclusions

This study has reported a nationwide incidence of HDP and related severe maternal outcomes in low resource hospital settings. A combination of early presentation to the hospital and improved quality of care in participating tertiary hospitals would reduce severe maternal complications in women with HDP. Further research into quality of care could advise policy and practice at these hospitals, and could lead to a better outcome for women with HDP.

Disclosure of interests

No conflict of interest declared. Completed disclosure of interest forms are available to view online as Supporting information.

Contribution to authorship

ANA – conception and design, acquisition of data, interpretation of data and drafting of the first version of the article. BOO – revision of the manuscript for important intellectual content. TJ – conception and design, acquisition of data and revision of the manuscript for important intellectual content. AAO – acquisition of data and revision of the manuscript for important intellectual content. OO – acquisition of data and revision of the manuscript for important intellectual content; KAT – acquisition of data and revision of the manuscript for important intellectual content. BAE – conception and design of study and revision for important intellectual content. OTO – conception and design, data analysis and interpretation. All the authors gave final approval of the version to be published and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Details of ethics approval

This study was a secondary analysis of data generated by the Nigeria Near-miss and Maternal Death Surveillance Network. Ethical clearance for the original protocol was granted by the WHO Research Ethics Review Committee (protocol ID: A65745, version 4 on 3 May 2012), and also by the ethics review authorities in the 42 hospitals that participated in the study.

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Supporting Information

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

Figure S1. Flow chart of hypertensive disorders in pregnancy outcomes among women admitted for pregnancy, childbirth, and puerperal complications.

Table S1. Maternal characteristics and their association with fatality among women with severe maternal complications due to hypertensive disorders. ■

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