BMC Pregnancy and Childbirth

RESEARCH

Open Access

Admission pattern and outcome of hypertensive disorders of pregnancy: a retrospective study of admitted cases at the Princess Christian Maternity Hospital in Freetown, Sierra Leone

Ahmed Vandy[1*], Michael Lahai[1], Abibatu Rahman Bangura[2], Alvin Turay[1], Onome T. Abiri[1], Eugene Conteh[1], Marie I. Kolipha-Kamara[1], Foday Marah[1], Princess A. Wilson[1], Augustus Osborne[3] and Don Eliseo III Lucero-Prisno[4,5]

Abstract

Background Hypertensive disorders of pregnancy (HDP) are major contributors to maternal and neonatal mortality, particularly in low-resource settings. Pregnancy-induced hypertension accounted for 16% of maternal deaths in 2016, ranking as the second leading cause of maternal mortality in Sierra Leone. The country faces challenges of HDP management due to limited primary healthcare resources. This study investigated the admission patterns and outcomes of HDP at the Princess Christian Maternity Hospital (PCMH) in Freetown, Sierra Leone.

Methods A retrospective cross-sectional study was conducted, reviewing medical records of 572 pregnant women admitted with HDP at PCMH from January to December 2022. Hypertensive patients were classified according to established criteria for hypertensive pregnancy. Maternal and neonatal outcomes were categorised as favourable and unfavourable outcomes based on set criteria. The Chi-square Test and Fisher's exact test were performed to determine the association between admission patterns/management with maternal and neonatal outcomes using Statistical Package for Social Sciences version 27.

Results Out of the 572 HDP patients admitted cases reviewed, preeclampsia was the most common type of HDP 446 (78%). The majority of admissions occurred in the third trimester (95.6%) with common presenting symptoms including headache 64 (11.2%) and oedema 45 (7.9%). Most patients were treated with antihypertensive medications 547 (96%), predominantly combinations of two or more antihypertensive drugs 435 (76.0%). Maternal outcomes were favourable in 488 (85.3%), while neonatal outcomes were favourable in 396(69.2%). Gestational age on admission ($p < 0.001$), prolonged hospitalisation ≥ 7 days ($p < 0.001$), and elevated diastolic BP ($p < 0.001$) significantly predicted

*Correspondence:
Ahmed Vandy
ahmedvandy@gmail.com

Full list of author information is available at the end of the article

adverse neonatal outcomes, while gestational age on admission ($p < 0.001$) and prolonged hospitalisation ≥ 7 days ($p < 0.001$) were significantly associated with maternal outcome.

Conclusion This study underscores the substantial burden of hypertensive disorders of pregnancy in Sierra Leone, with preeclampsia as the most common presentation, largely diagnosed in the third trimester. Despite favourable maternal outcomes, neonatal outcomes remain suboptimal. These findings underscore the need for improved antenatal screening, enhanced neonatal care, and adoption of predictive tools to support early detection and targeted intervention, particularly among younger, previously overlooked at-risk populations.

Keywords Maternal health, Hypertensive pregnancy, Non-communicable disease, Sierra leone

Background

Hypertensive disorders of pregnancy (HDP) remain a significant global health challenge, particularly in low- and middle-income countries (LMICs) where more than 90% of HDP-related deaths occur [1–3]. It has been estimated that about 10% of pregnancies globally are affected by HDP, of which gestational hypertension and preeclampsia are the most reported types [4]. According to the World Health Organisation, HDP accounts for about 14% of all maternal deaths worldwide [5]. About 1 in every 10 maternal deaths in Africa is related to HDP, with 5.6% and 2.9% of pregnancies complicated by preeclampsia and eclampsia, respectively [6].

Sierra Leone has one of the highest maternal mortality rates in the world, with about 1120 maternal deaths in 100,000 live births in 2017 [6]. According to the World Bank, the current maternal mortality rate of Sierra Leone as per the 2023 report is about 354 maternal deaths in 100,000 live births [7]. This reduction in maternal mortality rate is a milestone success of the Reproductive, Maternal, Newborn, Child and Adolescent Health (RMNCAH) strategy 2017–2021 achieved by the country's national healthcare system [8]. However, HDP among many other related factors still contributes to the high mortality rate in Sierra Leone.

The Princess Christian Maternity Hospital in Freetown, Sierra Leone, serves as a key healthcare facility for maternal and child health in the region. While previous studies in Sierra Leone have explored risk factors for HDP [6], limited data exist on maternal and neonatal outcomes of HDP. Studies in other LMICs report significant associations between HDP severity and adverse outcomes like cesarean section rates, preterm birth, low birth weight, and neonatal mortality [9–11]. Our current study aimed to provide valuable information on admission patterns, management and outcomes of admission. Our study also identified the key admission patterns and management factors influencing the outcome of admitted cases. The result of our study provides evidence that policymakers can use to understand the burden of HDP on maternal and neonatal health in Sierra Leone and identify the gaps in the management of HDP at the PCMH. The study will also contribute to the existing knowledge on HDP in low-resource settings and inform the development of context-specific interventions and policies to address this important public health problem.

Methods

Study design, setting and period

This study used a retrospective cross-sectional study design to review cases of patients who were admitted with HDP between January 2022 to December 2022. This study was conducted at the Princess Christian Maternity Hospital in Freetown, Sierra Leone. PCMH serves as the primary referral maternity hospital for the country and also functions as a teaching hospital for the University of Sierra Leone, located in Freetown. Ward 2 is the primary ward for admission of all cases related to hypertension in pregnancy. The selection of this study site is due to the primary role it offers in obstetric and neonatal care services as the main referral hospital in Sierra Leone.

Criteria for classification of hypertensive disorders of pregnancy

Pregnancy-induced hypertension is characterised by a systolic blood pressure of 140 mmHg or higher and/or a diastolic blood pressure of 90 mmHg or higher, typically confirmed with two measurements taken at least four hours apart [12]. Normotensive women have a systolic blood pressure of ≤ 140 mmHg and a diastolic blood pressure of ≤ 90 mmHg. The following criteria from National Protocols and Guidelines for Emergency Obstetrics used at the hospital and Newborn Care and various other literature were used to classify HDP [13].

Chronic hypertension: A hypertension diagnosed before the occurrence of pregnancy or before 20 weeks of gestation [14].

Pre-eclampsia: Preeclampsia is diagnosed as a new onset of hypertension with blood pressure ≥ 140/90 mmHg on two occasions at least four hours apart after 20 weeks of gestation, along with any of the following signs and symptoms (significant proteinuria of at least + 2, headache, visual changes, or swelling in hands or face) [6, 14].

Eclampsia: Eclampsia is defined by the complication of preeclampsia with the occurrence of generalised seizures

and can be diagnosed without elevated blood pressure and proteinuria if other conditions are ruled out as differential diagnoses, such as epilepsy, cerebral malaria, meningitis, or hypoglycemia [6, 14].

Preeclampsia superimposed on chronic hypertension: Chronic hypertension with a characteristic of preeclampsia.

Gestational hypertension: New hypertension presenting after 20 weeks of gestation without significant proteinuria.

Study population, sample size, criteria for inclusion

Medical records of patients with HDP who had been admitted to ward 2 of PCMH from January 2022 to December 2022 were considered and reviewed. A total of 572 patient records were carefully selected without any order to reduce the risk of selection bias.

Patients with hypertensive disorders of pregnancy who were not admitted to the hospital or admitted patients with HDP but no pregnancy outcome recorded or incomplete records were excluded from the study.

Data collection

A data collection tool was developed from existing literature and modified to fit the objectives of the study [6, 15]. The tool consisted of three sections to fit the objectives of the study: patient sociodemographic, admission pattern and management of hypertensive disorders of pregnancy, maternal and neonatal outcomes of the hypertensive disorders of pregnancy. Three data collectors were trained to carry out the data collection process.

Table 1 Sociodemographic distribution of the participants

Variables	Options	Frequency ($n=572$)	Percentage (%)
Maternal age	< 20	86	15.0
	20–35	437	76.4
	> 35	49	8.6
Marital status	Married	481	84.1
	Unmarried	91	15.9
Residential area	Urban resident	389	68.0
	Rural resident	183	32.0
Occupation of the mother	Trader	296	51.7
	Housewife	226	39.5
	Employed	40	7.0
	Not stated	10	1.7
Gravidity	Primigravida	232	40.6
	Multigravida	340	59.4
Parity	Nulliparous	236	41.3
	Primiparous	131	22.9
	Multiparous	205	35.8

Data analysis

Descriptive statistics were used to analyse the data using the Statistical Package for Social Sciences (SPSS) version 27. The dependent variables, maternal and neonatal outcomes, were categorised as favourable or unfavourable as done in a similar study conducted in North West Ethiopia [16]. Maternal outcomes were categorised as favourable if the mother experienced no post-delivery complications and was discharged home alive. Unfavourable maternal outcomes included cases that led to death, admission due to complications such as stroke, blindness, wound sepsis, or referral. Similarly, neonatal outcomes were considered favourable if the newborn was alive, had no complications, and was discharged home. Unfavourable neonatal outcomes included cases of birth asphyxia, stillbirth, abortion, admission due to complications, or referral. Based on data fitness, the Chi-Square test and Fischer's exact test (when Chi-square assumptions were not met) were used to determine the association between the admission and management factors and the maternal and neonatal outcomes of hypertensive pregnancy when the P-value is less than 0.05.

Results

Sociodemographic distribution of the participants

As shown in Table 1, most of the hypertensive patients admitted were aged 20–35 years 437(76.4%) with a mean age of 25.9 years. The majority of the patients were married (84.1%) and had been pregnant more than once (59.4%).

Admission pattern and management of patients with HDP

Preeclampsia was the most common type of hypertensive disorder admitted 446(78%) and most of the cases admitted were in their third trimester 547(95.6%), at an average gestational age of 35.64 weeks SD (± 4.31). The most common symptoms patients presented with include headache 64 (11.2%), oedema 45(7.9%) and epigastric pain 32 (5.6%). Most of the cases were admitted for less than 7 days 449 (78.5%), and the patients were given antihypertensive medications 549 (96.0%) for which 76.0% were a combination of two or more antihypertensives. See Table 2 for detailed information.

Maternal and neonatal outcomes of the hypertensive pregnancy

Figure 1 reveals the maternal and neonatal outcomes of hypertensive disorders of pregnancy. The outcomes of the maternal and neonatal cases found to be favourable were 488 (85.30%) and 396 (69.20%) respectively.

Table 2 Admission pattern and management of patients with HDP

Variables	Options	Frequency (*n* = 572)	Percentage (%)
Type of HDP	Preeclampsia	446	78.0
	Eclampsia	101	17.7
	Preeclampsia superimposed on chronic hypertension	12	2.1
	Gestational hypertension	11	1.9
	Chronic hypertension	2	0.3
Gestation age on admission	Second trimester	25	4.4
	Third trimester	547	95.6
Systolic blood pressure on admission	< 140	49	8.6
	140–159	242	42.3
	160–179	178	31.1
	≥ 180	103	18.0
Diastolic blood pressure on admission	< 80	17	3.0
	80–89	37	6.5
	90–119	369	64.5
	≥ 120	149	26.0
Clinical presentation	Headache	64	11.2
	Oedema	45	7.9
	Dizziness	27	4.7
	Loss of consciousness	13	2.3
	Epigastric pain	32	5.6
Duration of admission	< 7 days	449	78.5
	≥7 days	123	21.5
Patient on antihypertensive	Yes	549	96.0
	No	23	4.0
Type of antihypertensive given	Nifedipine	76	13.3
	Methyldopa (Aldomet)	33	5.8
	Labetalol	2	0.3
	Hydralazine	3	0.5
	Combination of two or more antihypertensives	435	76.0
	No antihypertensive	23	4.0
Magnesium sulphate given	Yes	498	87.1
	No	74	12.9

Admission and management factors associated with maternal and neonatal outcomes of hypertensive pregnancies

Table 3 provides detailed information about the admission and management factors associated with maternal and neonatal outcomes of hypertensive pregnancy cases. Gestational age on admission and duration of admission were found to be statistically significant with maternal outcomes. While Gestational age on admission, diastolic blood pressure on admission and duration of admission were found to be significant with neonatal outcome.

Discussion

Our current study has provided insights into admitted cases of hypertensive disorders of pregnancy in Sierra Leone, revealing a substantial burden of preeclampsia, with the vast majority of admissions occurring in the third trimester at an average gestational age of 35.64 weeks (± 4.31). While maternal outcomes were largely favourable, neonatal outcomes were significantly less, underscoring a crucial area for intervention. Importantly, gestational age at admission, prolonged hospitalisation (≥ 7 days), and elevated diastolic blood pressure were identified as key factors significantly associated with adverse neonatal outcomes, while gestational age and prolonged hospitalisation also significantly impacted maternal outcomes.

The high number of hypertensive disorders among young and nulliparous women in our study suggests a shifting epidemiological profile where hypertensive pregnancy is no longer limited to older or high-parity women. The increasing prevalence of hypertension among younger and reproductively active individuals may be influenced by behavioural lifestyle choices, urbanisation, and environmental stressors [17, 18]. This complements our findings, as most patients in the study were urban-based traders with prolonged stationary work patterns.

Preeclampsia and eclampsia emerged as the most common hypertensive disorders, similar to the observations made from studies conducted in Nnewi, Nigeria and in Northern India [19, 20]. However, this rate of admitted cases of preeclampsia and eclampsia in our study is quite alarming as it is considerably higher than reports from previous studies done in Nigeria, Ghana, Ethiopia, Pakistan, and the United States [21–24]. The majority of cases were admitted during the third trimester, consistent with the typical onset of hypertensive disorders of pregnancy, which commonly manifest at this stage due to peak cardiovascular and placental demands, increased plasma volume, and elevated vascular resistance [25, 26]. The predominance of late-term admissions raises concerns about the effectiveness of antenatal screening programs in Sierra Leone, suggesting a need for earlier and more rigorous monitoring to mitigate disease progression.

The study revealed a high rate of antihypertensive use, primarily combination therapy, reflecting adherence to the Sierra Leone Standard Treatment Guidelines (2021), which recommend the use of two agents from different classes for managing severe hypertension in pregnancy. Where monotherapy is indicated, methyldopa or nifedipine retard is preferred. A similar study in Sierra Leone reported the exclusive use of methyldopa, demonstrating compliance with national protocols and possibly contributing to the favourable maternal outcomes observed [27]. Furthermore, the administration of magnesium sulfate to 87.1% of patients reflects adherence to practice protocols

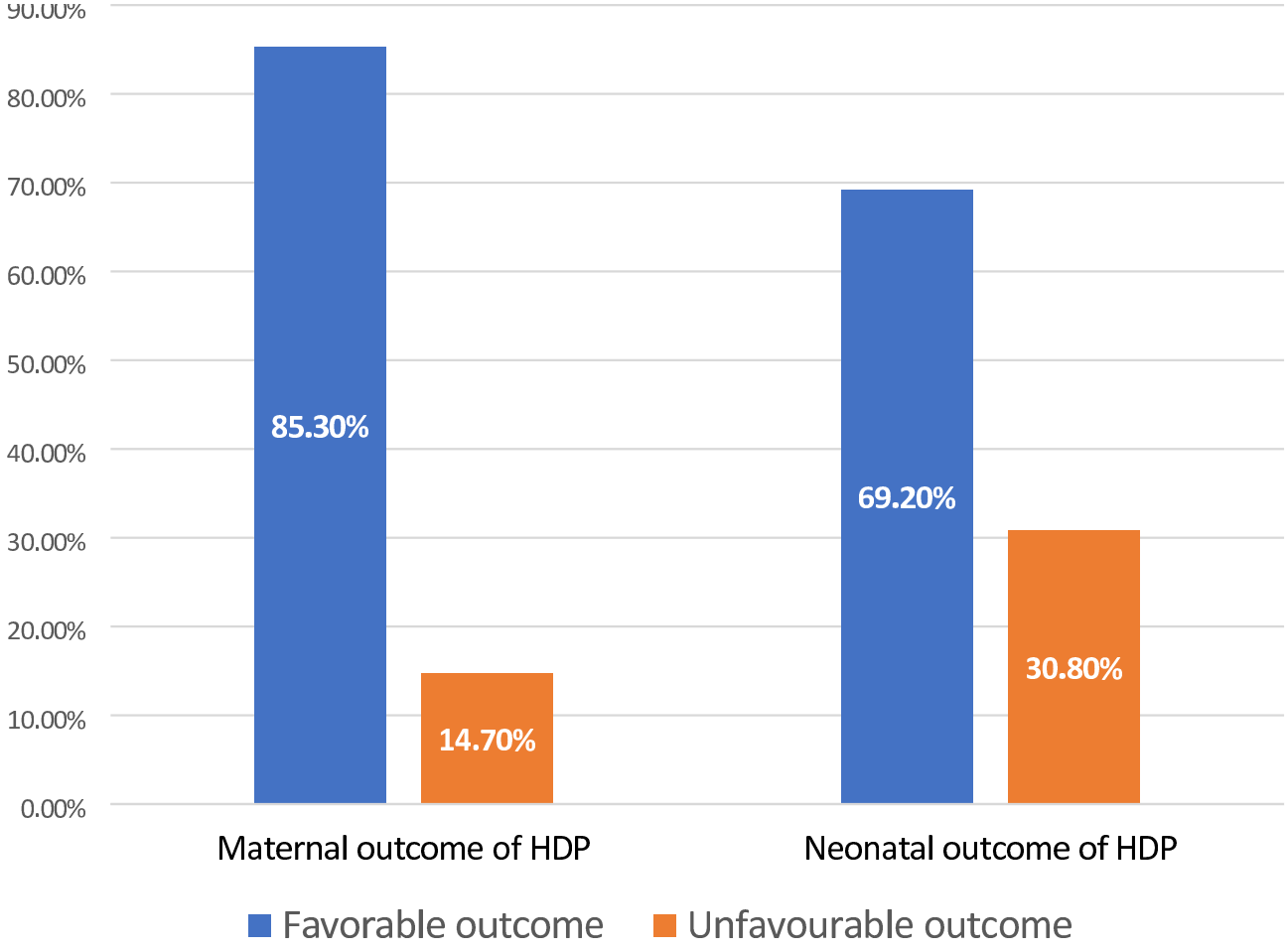

Fig. 1 Maternal and Neonatal outcomes of the hypertensive pregnancy

aimed at preventing eclamptic seizures, which is a significant concern in managing HDP. However, the reliance on pharmacological interventions indicates the need for a stronger emphasis on preventive public health measures, including lifestyle modifications, nutritional interventions, and early risk factor assessment that complement clinical management and improve maternal outcomes [28, 29].

Maternal and neonatal outcomes were generally favourable, with 85.3% and 69.2% positive outcomes, respectively. However, the disparity between maternal and neonatal outcomes suggests that while medical interventions often succeed in stabilising mothers, fetal or neonatal well-being may remain compromised. This underscores the need for improved neonatal care, including enhanced access to neonatal intensive care units, better fetal monitoring during pregnancy, and implementation of strategies to reduce the risk of adverse birth outcomes [26]. Although the rate of unfavourable neonatal outcomes in our study was lower than that reported in northwest Ethiopia (46.5%) [16], it remains concerning and below the targets set by Sustainable Development Goal 3. Progress toward reducing maternal mortality to fewer than 70 per 100,000 live births by 2030 has been slow, particularly in low-resource settings like Sierra Leone, where systemic gaps persist [2, 30].

Gestational age on admission and duration of admission were found to be a common factor significantly associated with both maternal and neonatal outcomes in our current study, underscoring the importance of early detection and prompt management of hypertensive disorders in pregnancy before their progression. Another significant factor was prolonged patients' admission > 7 days, which is a reflection of more severe cases or complications, necessitating extended care and monitoring duration. Diastolic blood pressure on admission was only found to be significantly associated with neonatal outcomes in our study. It is worth noting that early detection of elevated diastolic blood pressure can prompt timely interventions and closer fetal monitoring, which can mitigate risks to the newborn [31]. Healthcare providers should prioritise the assessment of diastolic blood

Table 3 Admission and management factors associated with maternal and neonatal outcomes of hypertensive pregnancies

Variables	Maternal outcome			Neonatal outcome		
	Favourable outcome (%)	Unfavorable outcome (%)	p value	Favourable outcome (%)	Unfavourable outcome (%)	p value
Type of HDP			0.762[b]			0.553[b]
Preeclampsia	84.3	15.7		70.0	30.0	
Eclampsia	86.2	14.8		64.4	35.6	
Preeclampsia superimposed on chronic hypertension	91.7	8.3		83.3	16.7	
Gestational hypertension	100	0.0		72.7	27.3	
Chronic hypertension	100	0.0		50.0	50.0	
Gestational age on admission			**< 0.001[b]**			**< 0.001**
Second trimester	56.0	44.0		12.0	88.0	
Third trimester	86.7	13.3		71.8	28.2	
Systolic blood pressure on admission			0.849			0.106
< 140	81.6	18.4		77.6	22.4	
140–159	86.4	13.6		71.5	28.5	
160–179	85.4	14.6		69.1	30.9	
180 and above	84.5	15.5		60.2	39.8	
Diastolic blood pressure on admission			0.090			**< 0.001**
< 80	76.5	23.5		58.8	41.2	
80–89	89.2	10.28		75.7	24.3	
90–119	87.5	12.5		75.1	24.9	
120 and above	79.9	20.1		54.4	45.6	
Duration of admission			**< 0.001**			**< 0.001**
< 7 days	89.8	10.2		75.3	24.7	
≥ 7 days	69.1	30.9		47.2	52.8	
Patient on antihypertensive			0.708			0.619
Yes	85.4	14.6		69.0	31.0	
No	82.6	17.4		73.9	26.1	
Magnesium sulphate given			0.270			0.198
Yes	85.9	14.1		68.3	31.7	
No	81.1	18.9		75.7	24.3	

Bold values indicate statistically significant p-values ($p < 0.05$). P^b = P value computed by Fisher's exact when expected cell > 20%

pressure as part of routine prenatal care for women with hypertensive disorders to ensure better neonatal outcomes.

Interestingly, neither antihypertensive therapy nor magnesium sulfate administration showed a statistically significant direct association with outcomes, suggesting that pharmacologic management alone may not be sufficient to ensure optimal results. This implies a need for comprehensive care approaches, including early risk stratification, community-based screening, patient education, and strengthened health system referral pathways. Predictive algorithms incorporating maternal history and biomarkers, as suggested by O'Gorman Neil et al. [32], could further enhance early detection and treatment care plans.

Limitations

While retrospective studies can provide valuable insights, they are subject to some biases such as selection bias and recall bias, which may affect the quality of the data collected. Moreover, the study's findings are specific to only admitted cases at the Princess Christian Maternity Hospital in Freetown, Sierra Leone, which may limit the generalizability of the results to other settings or populations. Also, due to the cross-sectional study design, causality cannot be inferred.

Conclusion

This study underscores the high burden of HDP in Sierra Leone, with preeclampsia being the most prevalent form, predominantly diagnosed in the third trimester. While current management strategies—primarily antihypertensive combination therapy and magnesium sulfate—yield favourable maternal outcomes, neonatal outcomes remain suboptimal. Key factors associated with adverse outcomes included late gestational age at admission, prolonged hospitalisation, and elevated diastolic blood pressure.

The study highlights the need for enhanced antenatal screening to facilitate early detection and intervention,

strengthened neonatal care to bridge the gap between maternal and perinatal survival, and the adoption of novel predictive tools, such as integrated maternal history and biomarker-based risk assessment. There is also a need to expand hypertension screening beyond the high-risk groups traditionally identified, incorporating younger women in targeted prevention efforts. Addressing these determinants is essential to mitigating the impact of hypertensive disorders on maternal and neonatal health.

Abbreviations

HDP	Hypertensive disorders of pregnancy
PCMH	Princess Christian Maternity Hospital
LMICs	Low- and middle-income countries
SPSS	Statistical Package for Social Sciences
RMNCAH	Reproductive, maternal, newborn, Child and adolescent health

Acknowledgements
We would like to acknowledge the staff of the University of Sierra Leone.

Author contributions
Conceptualization: AV, ML, ARB, AT and OTA. Data curation: ARB, AV and PAW. Data analysis: AV, OTA, ML and AO. Preparation of manuscript: AV, MIKK, EC and FM. Writing review and editing: AV, ML, OTA, AO, DEL-III. All authors have reviewed and approved the final version of the manuscript before submission for publication.

Funding
This study did not receive any external funding from any source.

Data availability
Most of the data is included in the manuscript. Additional information can be found from the corresponding author based on reasonable request.

Declarations

Conflict of interest
The authors declare there are no conflicts of interest.

Ethical approval and consent to participate
Ethical approval for this study was obtained from the Institutional Review Board of the College of Medicine and Allied Health with review number COMAHS/IRB/021-2024. The purpose of the research was explained to the hospital in-charge management team, and consent to use the patient's data for research and publication purposes was granted. The data obtained was treated with anonymity and confidentiality by not revealing patients' identifiable information and the data obtained was used only for the purpose of this study. We maintain ethical standards throughout the study, complying with the Helsinki Declaration on research.

Consent for publication
Not applicable.

Author details
[1]College of Medicine and Allied Health Sciences, University of Sierra Leone, Freetown, Sierra Leone
[2]School of Clinical Sciences, Makeni, Sierra Leone
[3]Institute for Development, Western Area, Freetown, Sierra Leone
[4]Department of Global Health and Development, London School of Hygiene and Tropical Medicine, London, UK
[5]Office for Research, Extension and Innovations, Bukidnon State University, Malaybalay City, Bukidnon, Philippines

Received: 8 June 2025 / Accepted: 13 August 2025
Published online: 26 August 2025

References

1. Firoz T, Sanghvi H, Merialdi M, Von Dadelszen P. Pre-eclampsia in low and middle income countries. Best Pract Res Clin Obstet Gynaecol. 2011;25(4):537–48.
2. Vivian Ukah U, Payne B, Lee T, Magee LA, Von Dadelszen P. External validation of the fullpiers model for predicting adverse maternal outcomes in pregnancy hypertension in low- and middle-income countries. Hypertension. 2017;69(4):705–11. https://doi.org/10.1161/HYPERTENSIONAHA.116.08706.
3. Wang W, Xie X, Yuan T, Wang Y, Zhao F, Zhou Z, et al. Epidemiological trends of maternal hypertensive disorders of pregnancy at the global, regional, and National levels: a population-based study. BMC Pregnancy Childbirth [Internet]. 2021;21(1):1–10. https://doi.org/10.1186/s12884-021-03809-2.
4. Das S, Maharjan R, Bajracharya R, Shrestha R, Karki S, Das R, et al. Pregnancy outcomes in women with gestational hypertension and preeclampsia at Paropakar maternity and women's hospital, nepal: a retrospective study. PLoS ONE. 2023. https://doi.org/10.1371/journal.pone.0286287.
5. World Health Organization. WHO recommendations on drug treatment for non-severe hypertension in pregnancy. World Health Organization; 2020 [cited 2024 Jan 21]. Available from: https://www.who.int/publications/i/item/9789240008793
6. Stitterich N, Shepherd J, Koroma MM, Theuring S. Risk factors for preeclampsia and eclampsia at a main referral maternity hospital in freetown, Sierra leone: a case-control study. BMC Pregnancy Childbirth. 2021;21(1):413.
7. World Bank. Maternal mortality ratio (modeled estimate, per 100,000 live births) - Sierra Leone | Data [Internet]. 2023 [cited 2024 Apr 11]. Available from: https://data.worldbank.org/indicator/SH.STA.MMRT?locations=SL
8. Ministry of Health and Sanitation. SIERRA LEONE NATIONAL RMNCAH, strategy 2017 TO. 2021 [Internet]. 2017 [cited 2025 Jan 11]. Available from: https://portal.mohs.gov.sl/wp-content/uploads/2021/04/final-rmncah-strategy_may-2017-_word-doc.pdf
9. Adu-Bonsaffoh K, Ntumy MY, Obed SA, Seffah JD. Perinatal outcomes of hypertensive disorders in pregnancy at a tertiary hospital in Ghana. BMC Pregnancy Childbirth. 2017;17(1):1–7. https://doi.org/10.1186/s12884-017-1575-2.
10. Olusanya BO, Solanke OA. Perinatal outcomes associated with maternal hypertensive disorders of pregnancy in a developing country. Hypertens Pregnancy. 2012;31(1):120–30. https://doi.org/10.3109/10641955.2010.525280.
11. Singh S, Ahmed EB, Egondu SC, Ikechukwu NE. Hypertensive disorders in pregnancy among pregnant women in a Nigerian teaching hospital. Niger Med J. 2014;55(5):384.
12. Jaleta DD, Gebremedhin T, Jebena MG. Perinatal outcomes of women with hypertensive disorders of pregnancy in Jimma medical center, Southwest ethiopia: retrospective cohort study. PLoS ONE. 2021;16(8):e0256520. https://doi.org/10.1371/journal.pone.0256520.
13. Directorate of Reproductive and Child Health. Government of Sierra Leone Ministry of Health and Sanitation National Protocols and Guidelines for Emergency Obstetric and Newborn Care Government of Sierra Leone Ministry of Health and Sanitation [Internet]. 2018 [cited 2025 Jun 4]. Available from: https://mohs2017.wordpress.com/wp-content/uploads/2018/04/sl-emonc-protocols-and-guidelines-a4-final.pdf
14. Endeshaw G, Berhan Y. Perinatal outcome in women with hypertensive disorders of pregnancy: a retrospective cohort study. Int Sch Res Notices. 2015. https://doi.org/10.1155/2015/208043.
15. Subki AH, Algethami MR, Baabdullah WM, Alnefaie MN, Alzanbagi MA, Alsolami RM, et al. Prevalence, risk factors, and fetal and maternal outcomes of hypertensive disorders of pregnancy: a retrospective study in Western Saudi Arabia. Oman Med J [Internet]. 2018;33(5):409.
16. Melese MF, Badi MB, Aynalem GL. Perinatal outcomes of severe preeclampsia/eclampsia and associated factors among mothers admitted in Amhara region referral hospitals, North West ethiopia, 2018. BMC Res Notes. 2019;12(1):1–6. https://doi.org/10.1186/s13104-019-4161-z.
17. Shah LM, Kwapong YA, Boakye E, Ogunwole SM, Bennett WL, Blumenthal RS, et al. Racial disparities in prevalence of gestational diabetes by maternal nativity and length of US residence in an urban low-income population in the united States. CJC Open. 2022;4(6):540–50.
18. Cameron NA, Everitt I, Seegmiller LE, Yee LM, Grobman WA, Khan SS. Trends in the incidence of new-onset hypertensive disorders of pregnancy among rural and urban areas in the united states, 2007 to 2019. J Am Heart Association. 2022;11(2):e023791. https://doi.org/10.1161/JAHA.121.023791.

19. Mbachu I, Udigwe G, Okafor C, Umeonunihu O, Ezeama C, Eleje G. The pattern and obstetric outcome of hypertensive disorders of pregnancy in nnewi, Nigeria. Niger J Med. 2013;22(2):117–22.
20. Sharma C. Maternal & perinatal outcome in hypertensive disorders of pregnancy in a tertiary care hospital in Northern India. Obstet Gynecol Int J. 2017;6(6):170–4.
21. Wheeler SM, Myers SO, Swamy GK, Myers ER. Estimated prevalence of risk factors for preeclampsia among individuals giving birth in the US in 2019. JAMA Netw Open. 2022;5(1):e2142343.
22. Anto EO, Boadu WIO, Ansah E, Tawiah A, Frimpong J, Tamakloe VCKT, et al. Prevalence of preeclampsia and algorithm of adverse foeto-maternal risk factors among pregnant women in the central region of ghana: a multicentre prospective cross-sectional study. PLoS ONE. 2023;18(6):e0288079.
23. Vata PK, Chauhan NM, Nallathambi A, Hussein F. Assessment of prevalence of preeclampsia from Dilla region of Ethiopia. BMC Res Notes. 2015;8(1):816.
24. Khan B, Allah Yar R, Khakwani A, khan, Karim S, Arslan Ali H. Preeclampsia incidence and its maternal and neonatal outcomes with associated risk factors. Cureus. 2022;14(11):e31143.
25. Khedagi AM, Bello NA. Hypertensive disorders of pregnancy. Cardiol Clin. 2021;39(1):77–90.
26. Browne JL, Vissers KM, Antwi E, Srofenyoh EK, Van der Linden EL, Agyepong IA, et al. Perinatal outcomes after hypertensive disorders in pregnancy in a low resource setting. Tropical Med Int Health. 2015;20(12):1778–86. https://doi.org/10.1111/tmi.12606.
27. Klootwijk L, Charles E, Gessel B, Van. A baseline study assessing hypertension prevalence and management in five peripheral health units in Tonkolini district, Sierra Leone. Sierra Leone J Biomedical Res. 2023;14(1):52–8.
28. Yaghobieh N, Tarrahi MJ, Amani R. Relationship between food insecurity and the risk of pregnancy-induced hypertension: a prospective cohort study. BMC Pregnancy Childbirth. 2025;25(1):318. https://doi.org/10.1186/s12884-025-07340-6.
29. Zhang C, Guivarch C. Promoting healthy longevity should start young: a life course journey. Maternal-Fetal Med. 2024;6(1):1.
30. Rivera-Romero O, Olmo A, Muñoz R, Stiefel P, Miranda ML, Beltrán LM. Mobile health solutions for hypertensive disorders in pregnancy: scoping literature review. JMIR Mhealth Uhealth. 2018;6(5):e9671.
31. Chang KJ, Seow KM, Chen KH. Preeclampsia: recent advances in predicting, preventing, and managing the maternal and fetal life-threatening condition. Int J Environ Res Public Health. 2023;20(4):2994.
32. O'Gorman N, Nicolaides KH, Poon LCY. The use of ultrasound and other markers for early detection of preeclampsia. Women's Health. 2016;12(2):199–207.

Publisher's note