Persistent Postpartum Preeclampsia Occurrence and Associated Risk Factors in Ghana—A Retrospective Cross-Sectional Study

Health Science Reports

WILEY

Health Science Reports
Open Access

ORIGINAL RESEARCH OPEN ACCESS

Persistent Postpartum Preeclampsia Occurrence and Associated Risk Factors in Ghana—A Retrospective Cross-Sectional Study

Linda Ahenkorah Fondjo[1] | Samuel Ankomah Danso[2] | Alfred Effah[1] | Abraham Ameyaw Kwabena[2] | Benedicta Appiah[2] | Samuel Kwame Sopuruchi Agomuo[1] | Samuel Kwarteng[1] | Bismark Opoku Mensah[3] | Ebenezer Senu[1,4] | Enoch Awuah Ofori[1,5]

[1]Department of Molecular Medicine, School of Medical Sciences, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana | [2]Department of Medical Diagnostics, Faculty of Allied Health Sciences, Kumasi, Ghana, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana | [3]Department of Biological Sciences, University of Worcester, Worcester, UK | [4]Department of Biological Sciences, School of Natural Sciences and Mathematics, The University of Texas at Dallas, Richardson, Texas, USA | [5]Kumasi Technical University, Kumasi, Ghana

Correspondence: Linda Ahenkorah Fondjo (linda.ahenkorahfondjo@yahoo.com)

Received: 21 December 2024 | **Revised:** 10 November 2025 | **Accepted:** 27 November 2025

Funding: The authors received no specific funding for this work.

Keywords: maternal health | postpartum preeclampsia | risk factors | sub-Saharan Africa

ABSTRACT

Background and Aims: Postpartum preeclampsia poses serious health risks including eclampsia, stroke, pulmonary edema, renal failure, and eventually death. However, there is a paucity of data on persistent postpartum preeclampsia among Ghanaian women, limiting the development of tailored interventions to reduce associated morbidity and mortality. This study investigated the prevalence and risk factors associated with persistent postpartum preeclampsia in Ghana.

Methods: A hospital-based retrospective cross-sectional study was conducted at St. Joseph Hospital, Koforidua, involving 210 women. Medical records and folders were used to collect sociodemographic, clinical, and obstetric data of the study participants. Statistical analyses were performed using SPSS version 26.0. $p < 0.05$ was considered statistically significant.

Results: The prevalence of persistent postpartum preeclampsia was 15.2%. After adjusting for multiple confounders in the multivariate logistic model, cesarean section delivery [(aOR = 4.72, 95% CI (1.90–11.72), $p = 0.001$)] and chronic hypertension [(aOR = 2.56, 95% CI (1.14–5.75), $p = 0.022$)] were associated with significantly increased odds of persistent postpartum preeclampsia. However, sociodemographic factors such as age, religion, marital status, education level, and occupation were not significantly associated with postpartum preeclampsia.

Conclusion: Persistent postpartum preeclampsia affects a considerable proportion of women in Ghana with cesarean delivery and chronic hypertension emerging as independent predictors. These findings highlight the need for close monitoring and follow-up care for women with these risk factors during the postpartum period.

1 | Introduction

Preeclampsia, a hypertensive disorder occurring during pregnancy poses significant risks to maternal and fetal health worldwide [1]. Globally preeclampsia affects about 5%–8% of pregnancies, making it one of the leading causes of maternal morbidity and mortality [2]. The prevalence of preeclampsia in developing countries is estimated to be 2.8% of live births being seven times higher than in developed countries which is 0.4% of live births [2]. In Ghana, preeclampsia is a major cause of maternal and neonatal mortalities accounting for a prevalence

rate between 6.55% and 7.3% [3, 4]. Typically, antepartum PE resolves after childbirth; however, in some cases, it continues leading to persistent postpartum preeclampsia (PPE) [1].

PPE remains a significant yet often underrecognized complication of pregnancy. PPE is a rare but serious condition that occurs after childbirth [5]. It can develop up to 6 weeks after childbirth, and can lead to brain damage, stroke and death if not treated [6]. Various risk factors such as advanced maternal age, cesarean delivery, women with pre-existing medical conditions such as chronic hypertension, diabetes, kidney disease and autoimmune disorders increase the likelihood of developing persistent preeclampsia even after pregnancy [7, 8].

Adequate post-natal care and early identification of risk factors are essential for implementing appropriate preventive measures and monitoring strategies to reduce the occurrence of postpartum preeclampsia [9]. PPE has been documented to adversely affect maternal health, leading to high morbidity, and if untreated, could be fatal. Investigating the factors associated with PPE is therefore essential to develop tailored interventions and postpartum care that could promote maternal wellbeing and significantly reduce PPE-associated complications. Moreover, while preeclampsia during pregnancy has been well-studied in Ghana [4, 10], there is insufficient research regarding the prevalence and risk factors of persistent postpartum preeclampsia. This study aimed to determine the prevalence of PPE and identify its independent predictors among women previously diagnosed with preeclampsia in Koforidua, Ghana.

2 | Methods

2.1 | Study Design and Site

A retrospective cross-sectional design was conducted at the St. Joseph Hospital in Koforidua, Ghana. St. Joseph hospital is one of the major secondary healthcare facilities serving the Eastern Region of Ghana, located in Koforidua, Ghana. The hospital is an urban health center located on 6.10098° N, 0.27351° W. It receives referrals from neighboring towns such as Bonsu, Osiem, and Suhum. The hospital provides a range of medical services, including the obstetrics, gynecology, and antenatal care services.

2.2 | Study Population

The study included medical records of women diagnosed with preeclampsia during antenatal care before delivery and readmitted postpartum with a confirmed diagnosis of preeclampsia between 2020 and 2023.

2.3 | Inclusion and Exclusion Criteria

Medical records with complete sociodemographic and clinical data of women diagnosed with preeclampsia during antenatal care and readmitted with a confirmed diagnosis of postpartum preeclampsia between 2020 and 2023 were included. Medical records were excluded if they belonged to deceased individuals, mothers from other countries or incomplete medical information.

2.4 | Sample Size

The Cochran formula ($N = Z^2 \times P\,(1 - P)/E^2$) was used to obtain an initial sample size of 205.6 considering the average of a reported prevalence rate of postpartum preeclampsia between 0.3% and 27.5% [11]. Two hundred and ten (210) participants were finally recruited to increase statistical power.

2.5 | Ethical Considerations

Ethical approval was sought from the Committee on Human Research, Publication and Ethics (CHRPE/AP/962/24) at the School of Medicine and Dentistry of the Kwame Nkrumah University of Science and Technology (KNUST). The study was approved by the hospital's review committee.

2.6 | Data Collection

Medical records from the maternal birth register were inspected, and information on socio-demographics including age, gender, religion, level of education, occupation, and ethnicity were abstracted by trained research assistants. Obstetric information including parity, gravidity, gestational age of childbirth, maternal pre-pregnancy height and weight, family history of hypertension, readmission status and maternal medical history were also obtained. The retrieved information was organized using a structured questionnaire. Data were collected through structured questionnaire even though hospital records were used the questionnaire was used to record the data to maximize patient data confidentiality. To ensure accuracy and consistency, all completed forms were reviewed for completeness, and random samples of records were independently rechecked by a second reviewer. Discrepancies were resolved through consensus before data entry.

PPE was defined as the persistence or recurrence of hypertension (systolic BP $\geq$ 140 mmHg and/or diastolic BP $\geq$ 90 mmHg on at least two occasions, $\geq$ 4 h apart) and/or proteinuria ($\geq$ 300 mg/24 h or $\geq$ 1+ on dipstick) within 42 days postpartum [12].

2.7 | Data Management and Analysis

The data obtained was entered into Microsoft Excel 2019 for cleaning and coding. Further statistical analysis was performed using SPSS version 26.0 (SPSS Inc.) and GraphPad Prism version 8.0.1 (GraphPad LLC). Categorical data were presented as frequencies and percentages. Associations between sociodemographic and clinical characteristics and persistent postpartum preeclampsia were performed using the χ^2 or Fisher's exact test, with two-sided tests applied. Univariate and multivariate logistic regression analysis was performed to compare the odds ratio of clinical characteristics associated with PPE. Cases with missing data for key variables were excluded pairwise from relevant analyses. Statistical significance was considered at a p-value < 0.05.

3 | Results

3.1 | Sociodemographic Characteristics of Study Participants

Of the 210 participants recruited in the study, majority were in the 30–34 years age group (41.0%), followed by those aged 35–39 years (26.6%), ≤ 29 years (19.5%) and ≥ 40 (12.9%). Almost two-thirds of participants were Christians (70.5%) while 29.5% were Muslims. Regarding ethnicity, Akans (52.4%) were the predominant ethnic group followed by Ewe (20.5%) with Mole-Dagbani (12.9%) being the least. Majority (82.3%) had attained formal education, whilst over 46% were self-employed (46.2%) (Table 1).

3.2 | Clinical Characteristics of Study Participants

Considering the clinical characteristics of study participants, 33.8% had normal weight, 29.0% were overweight, 20.5% were underweight while 16.7% were obese. More than half of participants (53.3%) underwent vaginal delivery with 46.7% performing caesarian sections. Almost all participants (91.4%) had experienced multiple pregnancies (multigravida) whereas only 8.6% were first time pregnant women (primigravida). Again, majority were multiparous (62.9%), 25.7% were primiparous and 11.4% were nulliparous. Approximately 35% had a family history of hypertension. Chronic hypertension was reported in about 36% of the study participants. Most participants did not have STIs (91.9%) nor kidney disease (94.3%). Moreover, about 87% were anaemic while 70% had a preterm delivery. Prenatal care visits were categorized as high (33.3%), moderate (34.3%), or low (32.4%). Regarding the prevalence of PPE, 15.2% had PPE while majority (84.8%) of the study participants did not have (Table 2).

TABLE 1 | Sociodemographic characteristics of study participants.

Variable	Frequency ($n = 210$)	Percentage (%)
Age group (years)		
≤ 29	41	19.5
30–34	86	41.0
35–39	56	26.6
≥ 40	27	12.9
Religion		
Christian	148	70.5
Muslim	62	29.5
Marital status		
Married	151	71.9
Single	59	28.1
Ethnicity		
Akan	110	52.4
Ewe	43	20.5
Ga-Adangbe	30	14.3
Mole-Dagbani	27	12.9
Education level		
No formal Education	37	17.6
Formal Education	173	82.4
Occupation		
Civil Servant	65	30
Self-employed	113	46.2
Unemployed	32	23.3

Note: Data were presented as frequencies and percentages (%).

3.3 | Association Between Socio-Demographic Characteristics and Postpartum Preeclampsia

Women aged 30–34 had the highest postpartum preeclampsia rate (46.9%), while Christians were the majority in both non-postpartum preeclampsia (71.3%) and postpartum preeclampsia (65.6%) groups. Moreover, married women had a higher postpartum preeclampsia rate (81.3%) than single women (18.8%). However, none of the assessed socio-demographic characteristics—age group ($p = 0.379$), religion ($p = 0.513$), marital status ($p = 0.201$), ethnicity ($p = 0.291$), educational level ($p = 0.653$) and occupation ($p = 0.779$)—were significantly associated with postpartum preeclampsia ($p > 0.05$) (Table 3).

3.4 | Association Between Clinical Characteristics and Postpartum Preeclampsia

The association between clinical factors and postpartum preeclampsia is presented in Table 4. There was no significant association between BMI ($p = 0.296$), gravidity ($p = 0.488$), parity ($p = 0.488$), family history of hypertension ($p = 0.724$), STI status ($p = 0.678$), kidney disease ($p = 0.572$), gestational age ($p = 0.802$), prenatal care visits ($p = 0.855$). However, mode of delivery was significantly associated with postpartum preeclampsia ($p < 0.001$). Likewise, chronic hypertension ($p = 0.008$) and anaemic status ($p = 0.018$) were found to be significantly associated with postpartum preeclampsia.

3.5 | Clinical and Obstetric Predictors of Postpartum Preeclampsia

Table 5 presents the clinical and obstetric predictors of postpartum preeclampsia. In the univariate logistic regression analysis, women who delivered via cesarean section had 5.14 odds of developing postpartum preeclampsia compared to those who had a vaginal delivery (cOR = 5.14, 95% CI: 2.11–12.51, $p < 0.001$). Similarly, women with chronic hypertension were 2.73 times more likely to have postpartum preeclampsia compared to those without chronic hypertension (cOR = 2.73, 95% CI: 1.27–5.87, $p = 0.001$). After adjusting for multiple cofounders in the multivariate logistics analysis, having cesarean section (aOR = 4.72, 95% CI: 1.90–11.72, $p = 0.001$) and chronic hypertension (aOR = 2.56, 95% CI: 1.14–5.75, $p = 0.022$) still remained significant predictors of PPE.

TABLE 2 | Clinical characteristics of study participants.

Variable	Frequency ($n = 210$)	Percentage (%)
BMI (Kg/m^2)		
Underweight	43	20.5
Normal	71	33.8
Overweight	61	29.0
Obese	35	16.7
Mode of delivery		
Caesarian	98	46.7
Vaginal	112	53.3
Gravidity		
Primigravida	18	8.6
Multigravida	192	91.4
Parity		
Nulliparous	24	11.4
Primiparous	54	25.7
Multiparous	132	62.9
Family history of hypertension		
No	137	65.2
Yes	73	34.8
Chronic hypertension		
No	135	64.3
Yes	75	35.7
STIs		
No	193	91.9
Yes	17	8.1
Kidney disease		
No	198	94.3
Yes	12	5.7
Hb levels		
Anaemic	183	87.1
Non-anaemic	27	12.9
Gestational age		
Preterm	147	70.0
Term	63	30.0
Prenatal care visits		
High	70	33.3
Moderate	72	34.3
Low	68	32.4
Postpartum preeclampsia		
No	178	84.8
Yes	32	15.2

Note: Data were presented as frequencies and percentages (%). Prenatal care visits: High: ≥ 8 visits during pregnancy, Moderate: 4–7 visits during pregnancy, Low: < 4 visits during pregnancy.
Abbreviations: BMI, body mass index; Hb, haemoglobin; STI, sexually transmitted diseases.

TABLE 3 | Association between socio-demographic factors and postpartum preeclampsia.

	Persistent postpartum preeclampsia		
Variable	No ($n = 178$)	Yes ($n = 32$)	p value
Age group (years)			0.379
≤ 29	35 (19.7)	6 (18.8)	
30–34	71 (39.9)	15 (46.9)	
35–39	51 (28.7)	5 (15.6)	
≥ 40	21 (11.8)	6 (18.8)	
Religion			0.513
Christian	127 (71.3)	21 (65.6)	
Muslim	51 (28.7)	11 (34.4)	
Marital status			0.201
Married	125 (70.2)	26 (81.3)	
Single	53 (29.8)	6 (18.8)	
Ethnicity			0.291
Akan	98 (55.1)	12 (37.5)	
Ewe	34 (19.1)	9 (28.1)	
Ga-Adangbe	25 (14.0)	5 (15.6)	
Mole-Dagbani	21 (11.8)	6 (18.8)	
Education level			0.653
No formal education	30 (16.9)	7 (21.9)	
Formal education	148 (83.1)	25 (78.1)	
Occupation			0.779
Civil Servant	56 (31.5)	9 (28.1)	
Self-employed	94 (52.8)	19 (59.4)	
Unemployed	28 (15.7)	4 (12.5)	

Note: Data were presented as frequencies and percentages (%). p-values were computed using χ^2/Fisher's exact test.

4 | Discussion

Postpartum preeclampsia poses a significant threat to maternal health, necessitating a comprehensive examination of its sociodemographic, clinical and obstetric risk factors. Despite advances in obstetric care, the condition remains a leading cause of maternal morbidity and mortality worldwide [1]. Early identification and management of persistent PPE effectively is crucial since the ability to quickly recognize and respond this condition can be life-saving. Therefore, understanding the prevalence and its associated risk factors is essential for developing targeted interventions and improving maternal outcomes.

This study revealed a 15.2% prevalence rate of PPE, which is consistent with studies in developed countries with observed rates averaged around 10% to 20% [3, 4]. In the United Kingdom, a 13% rate was reported [13] while in the United States of America, a slightly higher figure was found at 19% [14]. These similarities could be attributed to the increased monitoring and postpartum maternal follow-ups as well as the use of

TABLE 4 | Association between clinical factors and postpartum preeclampsia.

Variable	Persistent postpartum preeclampsia		*p* value
	No ($n = 178$)	Yes ($n = 32$)	
BMI (Kg/m^2)			0.296
Underweight	38 (21.3)	5 (15.6)	
Normal weight	61 (34.3)	10 (31.3)	
Overweight	53 (29.8)	8 (25.0)	
Obese	26 (14.6)	9 (28.1)	
Mode of delivery			**< 0.001**
Caesarian	73 (41.0)	25 (78.1)	
Vaginal	105 (59.0)	7 (21.9)	
Gravidity			0.488
Primigravida	164 (92.1)	4 (12.5)	
Multigravida	14 (7.9)	28 (87.5)	
Parity			
Nulliparous	20 (11.2)	4 (12.5)	
Primiparous	47 (26.4)	7 (21.9)	
Multiparous	111 (62.4)	21 (65.6)	
Family history of hypertension			0.724
No	117 (65.7)	20 (62.5)	
Yes	61 (34.3)	12 (37.5)	
Chronic hypertension			**0.008**
No	121 (68.0)	14 (43.8)	
Yes	57 (32.0)	18 (56.3)	
STIs			0.678
No	163 (91.6)	30 (93.8)	
Yes	15 (8.4)	2 (6.3)	
Kidney disease			0.572
No	170 (95.5)	31 (96.8)	
Yes	8 (4.5)	1 (3.2)	
Anemic status			**0.018**
Anemic	151 (84.8)	32 (100)	
Non-anemic	27 (15.2)	0 (0.00)	
Gestational age			0.802
Preterm	124 (69.7)	23 (71.9)	
Term	54 (30.3)	9 (28.1)	
Prenatal care visits			0.855
High	58 (32.6)	70 (33.3)	
Moderate	62 (34.8)	72 (34.3)	
Low	58 (32.8)	68 (32.4)	

Note: Data presented as frequencies and percentages. *p*-values were computed using the χ^2 test/Fisher's exact test. $p < 0.05$ were considered statistically significant and bolded.
Abbreviations: BMI: Body Mass Index, STIs Sexually transmitted infection.

standardized diagnostic criteria in this study which resulted to consistent findings. Additionally, higher prevalence rates were observed in similar studies conducted in Africa. A study conducted in Cameroon found that 32.6% of women had persistent postpartum preeclampsia [15]. Other studies revealed prevalence rates of 28.8% and 27.7% in Zambia and Uganda respectively [16, 17]. In Ghana, PPE prevalence of approximately 11.9% have been documented [18]. These disparities might be due to genetic differences as the African population have the highest levels of genetic and phenotypic variation among all humans [19], potentially influencing susceptibility to hypertensive disorders. However, beyond biological factors, variations in postpartum preeclampsia prevalence may also reflect differences in health system capacity and postpartum care practices. Countries with more structured postpartum follow-up and blood pressure monitoring programs may identify and manage hypertensive cases earlier, thereby reducing recorded prevalence. Differences in access to and utilization of antihypertensive medications during the postpartum period could also contribute to observed variations. Moreover, sociocultural factors such as health-seeking behavior, traditional beliefs surrounding the postpartum period, and barriers to accessing facility-based care may further influence detection rates.

Our findings showed no significant association between sociodemographic variables such as age, religion, marital status, education, and occupation and persistent postpartum preeclampsia. Contrary to this, women aged 30 years and above were found to be at risk of PPE according to a Cameroonian study [15]. Several other global studies in Denmark [20], Cuba [21] and Israel [22] have documented similar findings. We only observed women aged 30–34 years to have the highest proportion of persistent PPE, although the differences across age groups were not statistically significant. Research indicates that higher maternal age increases the risk of hypertension and preeclampsia due to vascular stiffness, altered endothelial function, atherosclerosis accumulation, and higher baseline blood pressure due to reduced elastic arterial compliance and increased peripheral resistance [23, 24]. Further research with larger, prospective cohorts is warranted to elucidate the sociodemographic risk factors of PPE in Ghana.

Furthermore, several clinical and pregnancy-related factors have been implicated in the development of PPE. This current study revealed that cesarean delivery was associated with a 4.72 odds likelihood of PPE (aOR = 4.72, 95% CI: 1.902–11.715, $p = 0.001$). This is consistent with findings from Grum et al., (2017) in Ethiopia who reported a significant association between PPE and cesarean delivery [25]. A similar trend has also been found in Ghana [19]. The underlying pathology linking cesarean delivery to an increased risk of PPE may be potentially due to surgical stress, inflammation, or exacerbation of pre-existing endothelial dysfunction [26]. While our study highlights this association, further research is needed to clarify the underlying mechanisms as this likely reflects the use of cesarean delivery in more severe antenatal preeclampsia cases, indicating that CS is a marker of disease severity rather than a direct cause of PPE [27]. Therefore, careful monitoring and management strategies targeting women with a history of CS and PE are

TABLE 5 | Clinical and obstetric predictors of postpartum preeclampsia.

Variable	Postpartum preeclampsia				
	Yes ($n = 32$)	cOR (95% CI)	p value	aOR (95% CI)	p value
BMI (Kg/m^2)					
Underweight (Ref)	5 (15.6)	1.00		1.00	
Normal weight	10 (31.3)	1.28 (0.37– 4.37)	0.698	1.18 (0.32– 4.31)	0.807
Overweight	8 (25.0)	1.07 (0.35– 3.26)	0.909	0.89 (0.27– 2.89)	0.850
Obese	9 (28.1)	1.13 (0.39– 0.82)	0.823	0.94 (0.28– 2.90)	0.909
Mode of delivery					
Caesarian	25 (78.1)	5.14 (2.11– 12.51)	**< 0.001**	4.72 (1.90– 11.72)	**0.001**
Vaginal (Ref)	7 (21.9)	1.00		1.00	
Gravidity					
Primigravida	4 (12.5)	0.60 (0.18–1.95)	0.393	0.43 (0.12–1.64)	0.219
Multigravida (Ref)	28 (87.5)	1.00		1.00	
Parity					
Nulliparous (Ref)	4 (12.5)	1.00		1.00	
Primiparous	7 (21.9)	0.96 (0.25– 4.08)	0.955	0.97 (0.21– 4.56)	0.965
Multiparous	21 (65.6)	1.34 (0.54– 4.08)	0.528	1.59 (0.54– 4.69)	0.402
Family history of hypertension					
No (Ref)	20 (62.5)	1.00		1.00	
Yes	12 (37.5)	1.02 (0.46– 2.25)	0.960	0.93 (0.40– 2.18)	0.873
Chronic hypertension					
No (Ref)	14 (43.8)	1.00		1.00	
Yes	18 (56.3)	2.73 (1.27– 5.87)	**0.010**	2.56 (1.14– 5.75)	**0.022**
STIs					
No (Ref)	30 (93.8)	1.00		1.00	
Yes	2 (6.3)	3.06 (0.39– 23.94)	0.286	3.55 (0.42– 30.30)	0.247
Kidney disease					
No (Ref)	31 (96.8)	1.00		1.00	
Yes	8 (4.5)	0.52 (0.13– 2.02)	0.348	0.45 (0.11– 1.99)	0.215
Anemic status					
Anemic	32 (100)	2.45 (0.55– 10.90)	0.239	2.23 (0.48– 10.37)	0.308
Non-anemic (Ref)	0 (0.00)	1.00		1.00	
Gestational age					
Preterm	23 (71.9)	0.67 (0.31– 1.47)	0.317	0.55 (0.24– 1.28)	0.167
Term (Ref)	9 (28.1)	1.00		1.00	
Prenatal care visit					
High (Ref)	70 (33.3)	1.00		1.00	
Moderate	72 (34.3)	0.76 (0.30– 1.95)	0.571	0.75 (0.28– 2.01)	0.566
Low	68 (32.4)	0.93 (0.38– 2.28)	0.878	0.91 (0.36– 2.31)	0.835

Note: cOR and aOR were computed using the univariate and multivariate logistic regression. $p < 0.05$ was considered statistically significant and are in bold font. All clinically relevant covariates were included in the multivariate model.
Abbreviations: aOR, adjusted odds ratio; BMI, body mass index; CI, confidence interval; cOR, crude odds ratio;STIs, sexually transmitted infection.

essential to minimize postpartum complications effectively. Moreover, our study findings found chronic hypertension emerging as a significant risk factor for PPE development (aOR = 2.56, 95% CI: 1.14–5.75, $p = 0.022$). This is in agreement with a study by Grum et al., (2017) in Ethiopia which reported similar findings [25]. Careful blood pressure management throughout pregnancy and during the postpartum period is required to help in the early detection of persistent PPE. We observed significant association between anaemia and PPE in the χ^2 analysis, this relationship was not significant after adjusting for potential confounders in the multivariate logistics regression model. This suggests that the observed association may be mediated by other factors such as maternal nutritional status, antenatal care utilization, or coexisting obstetric complications. Prior studies have revealed contradictory findings regarding the relationship

between anemia and hypertensive disorders of pregnancy. Previous studies reported that maternal anemia was associated with an increased risk of preeclampsia, possibly due to shared pathophysiological pathways involving oxidative stress and endothelial dysfunction [28, 29]. Our findings may therefore indicate that, while anaemia could contribute to the risk profile in unadjusted analyses, its independent effect is less pronounced when accounting for other clinical and sociodemographic factors.

Although our study provides valuable insights into the prevalence and factors associated with postpartum preeclampsia, it has several limitations inherent to its retrospective design. Some medical records were excluded due to incomplete information, including the absence of detailed clinical data to assess antenatal disease severity, which limited both participant inclusion and evaluation of severity as a potential confounder. The exclusion of deceased individuals may have introduced selection bias by underrepresenting severe PPE cases, as their medical records were often incomplete or inconsistent. Moreover, as a retrospective study, our analysis was limited by the data available inpatient records. Biochemical parameters such as proteinuria quantification and liver enzyme levels were not consistently documented, and postpartum blood pressure trajectories were unavailable. These omissions restrict our ability to assess disease severity and blood pressure trends over time. However, the use of routinely collected clinical data provides valuable insights into PPE patterns within our setting.

5 | Conclusion

The study revealed a persistent PPE prevalence of 15.2% with preeclamptic women who had a caesarean delivery and those with chronic hypertension being at risk of reoccurrence. Therefore, tailored monitoring and management of high-risk women is necessitated for timely recognition of symptoms and signs to facilitate early diagnosis and management leading to better maternal health outcomes.

Author Contributions

Conceived and designed the study: L.A.F. Enrolled patients: S.A.D., A.A.K., B.A., S.K., E.S., A.E., S.K.S.A., B.O.M. and E.O.A. Analyzed the data: A.A.K., A.E., E.S., S.K. and S.K.S.A. Wrote the original draft of the manuscript: S.A.D, A.A.K., B.A., S.K., E.S., A.E., S.K.S.A, L.A.F. Agreed with manuscript results and conclusions: L.A.F., S.A.D., A.A.K., B.A., S.K., E.S., A.E., S.K.S.A, B.O.M and E.O.A.

Acknowledgments

The authors are grateful to staff of St. Joseph Hospital for their cooperation during the entire duration of the study.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

All data generated or analyzed during this study are included in this article and raw data can be requested from corresponding author.

Transparency Statement

The lead author Linda Ahenkorah Fondjo affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

References

1. A. Hauspurg and A. Jeyabalan, "Postpartum Preeclampsia or Eclampsia: Defining Its Place and Management Among the Hypertensive Disorders of Pregnancy," *American Journal of Obstetrics and Gynecology* 226, no. 2 (2022): S1211–S1221.

2. N. Zhang, J. Tan, H. Yang, and R. A. Khalil, "Comparative Risks and Predictors of Preeclamptic Pregnancy in the Eastern, Western and Developing World," *Biochemical Pharmacology* 182 (2020): 114247.

3. L. Ahenkorah, "Metabolic Syndrome, Oxidative Stress and Putative Risk Factors Amongst Ghanaian Women Presenting With Pregnancy-Induced Hypertension," (Kwame Nkrumah University of Science and Technology, 2009).

4. E. O. Anto, W. I. O. Boadu, L. K. Gyamfi, et al., "Preeclampsia in Ghana: A Study on the Prevalence and Risk Factors of Postpartum Readmission in the Ashanti Region," *Public Health Challenges* 3, no. 1 (2024): e154.

5. S. Tran, J. Fogel, S. Karrar, and P. Hong, "Comparison of Process Outcomes, Clinical Symptoms and Laboratory Values Between Patients With Antepartum Preeclampsia, Antepartum With Persistent Postpartum Preeclampsia, and New Onset Postpartum Preeclampsia," *Journal of Gynecology Obstetrics and Human Reproduction* 49, no. 5 (2020): 101724, https://doi.org/10.1016/j.jogoh.2020.101724.

6. M. Paçarada, et al., "Case Report of Severe Preeclampsia and Associated Postpartum Complications," *Journal of Case Reports and Studies* 4 (2016): 1.

7. F. A. English, L. C. Kenny, and F. P. McCarthy, "Risk Factors and Effective Management of Preeclampsia," *Integrated Blood Pressure Control* 8 (2015): 7–12.

8. A. Shiozaki and S. Saito, "Risk Factors for Preeclampsia," in *Preeclampsia: Basic, Genomic, and Clinical* (Springer 2018), 3–25, https://doi.org/10.1007/978-981-10-5891-2.

9. T. Wen, V. X. Yu, J. D. Wright, et al., "Postpartum Length of Stay and Risk for Readmission Among Women With Preeclampsia," *Journal of Maternal-Fetal & Neonatal Medicine* 33, no. 7 (2020): 1086–1094.

10. B. Ahenkorah, A. Donkor, and K. Opare-Asamoah, "Prevalences and Risk Factors Associated with Pre-eclampsia, low Birth Weight and Post-partum Haemorrhage Among Pregnant Women Seeking Antenatal Care in Northern Ghana: A Cross-sectional Descriptive Study," *Pharmaceutical Science: new Insights and Developments* 1 (2024): 1–23, https://doi.org/10.9734/bpi/psnid/v1/3138.

11. A. Hauspurg and A. Jeyabalan, "Postpartum Preeclampsia or Eclampsia: Defining Its Place and Management Among the Hypertensive Disorders of Pregnancy," *American Journal of Obstetrics and Gynecology* 226, no. 2s (2022): S1211–S1221.

12. L. A. Fondjo, B. Amoah, W. Tashie, and J. J. Annan, "Risk Factors for the Development of New-Onset and Persistent Postpartum Preeclampsia: A Case–Control Study in Ghana," *Women's Health* 18 (2022): 17455057221109362.

13. M. Girsberger, C. Muff, I. Hösli, and M. J. Dickenmann, "Short Term Sequelae of Preeclampsia: A Single Center Cohort Study," *BMC Pregnancy and Childbirth* 18 (2018): 177.

14. A. Hauspurg, M. E. Countouris, and J. M. Catov, "Hypertensive Disorders of Pregnancy and Future Maternal Health: How Can the Evidence Guide Postpartum Management?," *Current Hypertension Reports* 21 (2019): 96.

15. C. N. Nganou-Gnindjio, D. Kenmogne, D. B. Essama, J. R. Nkeck, N. Yanwou, and P. Foumane, "Persistent Hypertension After Pre-eclampsia in a Group of Cameroonians: Result of a Cross-Sectional Study and Perspectives to Reduce Its Burden in Limited Income Countries," *Journal of Clinical Hypertension* 23, no. 6 (2021): 1246–1251.

16. M. Mukosha, A. Hatcher, M. K. Lubeya, I. Maposa, B. H. Chi, and W. Mutale, "Persistent Hypertension Among Postpartum Women With Comorbid HIV and Preeclampsia in Zambia," *PLoS One* 19, no. 9 (2024): e0309915.

17. E. B. Ndayambagye, M. Nakalembe, and D. K. Kaye, "Factors Associated With Persistent Hypertension After Puerperium Among Women With Pre-Eclampsia/Eclampsia in Mulago Hospital, Uganda," *BMC Pregnancy and Childbirth* 10 (2010): 12.

18. L. A. Fondjo, B. Amoah, J. J. Annan, E. A. Adu-Gyamfi, and E. A. Asamaoh, "Hematobiochemical Variability and Predictors of New-Onset and Persistent Postpartum Preeclampsia," *Scientific Reports* 12, no. 1 (2022): 3583.

19. F. Gomez, J. Hirbo, and S. A. Tishkoff, "Genetic Variation and Adaptation in Africa: Implications for Human Evolution and Disease," *Cold Spring Harbor Perspectives in Biology* 6, no. 7 (2014): a008524.

20. I. Behrens, S. Basit, M. Melbye, et al., "Risk of Post-Pregnancy Hypertension in Women With a History of Hypertensive Disorders of Pregnancy: Nationwide Cohort Study," *BMJ* 358 (2017): j3078, https://doi.org/10.1136/bmj.j3078.

21. Y. Fajardo Tornes, D. Nápoles Mèndez, A. Alvarez Aliaga, D. Santson Ayebare, R. Ssebuufu, and S. Byonanuwe, "Predictors of Postpartum Persisting Hypertension Among Women With Pre-eclampsia Admitted at Carlos Manuel De Cèspedes Teaching Hospital, Cuba," *International Journal of Women's Health* 12 (2020): 765–771.

22. N. Shopen, E. Schiff, N. Koren-Morag, and E. Grossman, "Factors That Predict the Development of Hypertension in Women With Pregnancy-Induced Hypertension," *American Journal of Hypertension* 29, no. 1 (2016): 141–146.

23. E. Pinto, "Blood Pressure and Ageing," *Postgraduate Medical Journal* 83, no. 976 (2007): 109–114.

24. M. J. Joyner, B. G. Wallin, and N. Charkoudian, "Sex Differences and Blood Pressure Regulation in Humans," *Experimental Physiology* 101, no. 3 (2016): 349–355.

25. T. Grum, A. Seifu, M. Abay, T. Angesom, and L. Tsegay, "Determinants of Pre-Eclampsia/Eclampsia Among Women Attending Delivery Services in Selected Public Hospitals of Addis Ababa, Ethiopia: A Case Control Study," *BMC Pregnancy and Childbirth* 17 (2017): 307.

26. G. J. Cho, L. Y. Kim, K. J. Min, et al., "Prior Cesarean Section Is Associated With Increased Preeclampsia Risk in a Subsequent Pregnancy," *BMC Pregnancy and Childbirth* 15 (2015): 24.

27. M. M. Amorim, L. Katz, A. S. Barros, T. S. Almeida, A. S. Souza, and A. Faúndes, "Maternal Outcomes According to Mode of Delivery in Women With Severe Preeclampsia: A Cohort Study," *Journal of Maternal-Fetal & Neonatal Medicine* 28, no. 6 (2015): 654–660.

28. A. Libretti, L. Valsecchi, G. Zerbini, V. Remorgida, and M. Candiani, "Maternal Plasma Markers in Intrauterine Growth Restriction and Small for Gestational Age Complicated Pregnancy: The Role of sFlt-1/PlGF," *Minerva Obstetrics and Gynecology* 75, no. 6 (2023): 588–589.

29. D. Mannaerts, E. Faes, P. Cos, et al., "Oxidative Stress in Healthy Pregnancy and Preeclampsia Is Linked to Chronic Inflammation, Iron Status and Vascular Function," *PLoS One* 13, no. 9 (2018): e0202919.