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Original Research Article

Factors Associated with Maternal Complications in Preeclampsia: A Case-Control Study in Three Hospitals in Yaoundé

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Abstract: ***Background*:** Preeclampsia (PE) remains a leading cause of maternal and perinatal morbidity and mortality, mainly due to complication, especially in resource-limited settings. This study aimed to identify maternal factors associated with PE complications, to help identify ways to orient limited resources. ***Methods*:** We conducted a case-control study at three tertiary hospitals in Yaoundé: the Yaoundé Gynaeco-Obstetric and Paediatric Hospital, University Teaching Hospital, and Central Hospital. Records of women admitted for preeclampsia between January 2022 and December 2023 were reviewed. Cases were women with maternal complications of preeclampsia, while controls were those with preeclampsia and no complications, matched by maternal age. Data were analysed using R version 4.3.3. Pearson's chi-squared test and Student's t-test were used for comparisons, and adjusted odds ratios (aORs) determined using multiple logistic regression. ***Results*:** We recruited 291 participants (97 cases and 194 controls). The most frequent complications were eclampsia (59.2%) and HELLP syndrome (18.5%). Risk factors were alcohol consumption during pregnancy (aOR = 2.53; 95% CI: 1.19–5.40; p=0.016) and having a new partner (aOR = 3.63; 95% CI: 1.14–11.57; p=0.029). Age >20 years (aOR = 0.87; 95% CI: 0.80–0.94; p<0.001), and having ≥ 5 ANCs (aOR = 0.71; 95% CI: 0.58–0.88; p=0.001), were protective. ***Conclusion*:** Eclampsia was the most common complication of PE at these hospitals. Factors associated with complications were alcohol consumption, a new partner, and suboptimal ANC. We emphasize the importance of optimum antenatal care, and avoidance of alcohol, to promote prevention and early case detection and management.

Keywords: Preeclampsia, Maternal Complications, Risk Factors, Antenatal Care, Eclampsia, Cameroon.

INTRODUCTION

Hypertensive diseases in pregnancy (HDP) represent one of the three leading causes of maternal mortality, alongside postpartum haemorrhage and puerperal infections. Globally, HDP complicate approximately 10% of pregnancies [1] and are responsible for approximately 10%–15% of maternal deaths [2]. The World Health Organization (WHO) defines hypertension as a systolic blood pressure (SBP) ≥140 mmHg and/or a diastolic blood pressure (DBP) ≥90 mmHg [3]. While HDP are a global public health concern, the risk of death from associated complications is much higher in developing countries like Cameroon, where the prevalence continues to increase [4].

HDP are sub-classified into several disorders, including chronic hypertension, gestational hypertension, preeclampsia (PE), superimposed preeclampsia, and eclampsia [5]. PE, a complex multi-organ disease, affects about 2–8% of pregnancies globally [6]. According to the 2018 European Society of Cardiology guidelines, PE is defined as new-onset hypertension after 20 weeks' gestation, with significant proteinuria (>0.3 g/24h) [7]. It can be further categorized by gestational age of onset: early-onset (<34 weeks' gestation) or late-onset (≥34 weeks' gestation) [8]. Sentence below in red.

In the United States, PE complicates about 6%–10% of pregnancies [9], while a Thai study reported a

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9.6% prevalence, with increased risks of neonatal complications like low birthweight, asphyxia, and stillbirth [10]. PE is more common in Africa, affecting about 10% of pregnancies [11]. A study in Nigeria's Jos University Teaching Hospital reported a prevalence of 8.8%, and identified risk factors like a history of PE or eclampsia, a body mass index >25 kg/m^2 and nulliparity [12].

The reported prevalence of PE in Cameroon ranges from 4.9% to 7.7% [13]. Severe features, including SBP ≥160 mmHg or DBP ≥110 mmHg on two occasions at least 4 hours apart, impaired liver or renal function, thrombocytopenia, pulmonary oedema, and new cerebral or visual symptoms, signal critical disease [14]. A study in Yaoundé found that 44.4% of participants developed complications, including eclampsia (31.8%), HELLP syndrome (8.4%), placental abruption (5.6%), and maternal death (3.3%) [15,16]. Consequently, PE with complications is seen as a leading cause of foetal and maternal morbidity and mortality. As such, understanding factors predisposing to these complications is crucial for early risk identification, and rational implementation of control measures. Unfortunately, no studies from our setting have identified factors associated with PE complications. The primary objective of this study, therefore, was to identify factors associated with maternal complications of PE in our setting.

MATERIALS AND METHODS

Study Design and Setting

We conducted a case-control study at the obstetrics and gynaecology departments of the Gynaeco-Obstetric and Paediatric Hospital of Yaoundé (GOPHY), the University Teaching Hospital of Yaoundé (UTHY), and the Central Hospital of Yaoundé (CHY). The study spanned five months, from January through June 2023. The study population consisted of the medical records of all delivery cases admitted to these hospitals from January 2022 to December 2023. We considered women who had confirmed preeclampsia and an associated maternal complication as cases. As controls, we considered women diagnosed with preeclampsia without any complications at the same hospitals during the same period. Cases and controls were matched based on maternal age. All incomplete files were excluded from the study.

The variables collected included maternal age, marital status, occupation, religion, level of education, gravidity, parity, gestational age at delivery, history of PE, gestational age of onset of PE, family history of PE , presence of comorbidities (diabetes and obesity), number of antenatal contacts, qualification of antenatal care provider, PE prophylaxis received, symptoms and blood pressure on admission, management, haemoglobin level, platelet count, renal and liver function tests results, documented maternal complications, and foetal sex, birth weight, and complications. The minimum required sample size, using the Schlesseman's formula, was 79 cases and 158 controls (ratio 1:2).

Prior to data collection, we obtained ethical clearance from the institutional Ethics Review Board of the Faculty of Medicine and Biomedical Sciences of the University of Yaoundé 1 and administrative authorisation from the management of each study site.

Data Collection and Statistical Analysis

We collected data using a pretested questionnaire and subsequently transferred it to Microsoft Excel spreadsheets for cleaning. The cleaned data were then analysed using R software version 4.3.3. Categorical variables were expressed as frequencies and proportions, and comparisons done using the Pearson's chi-squared test or Fisher's exact test, as appropriate. Quantitative normally distributed variables were summarized as means and standard deviations (SD), and comparisons were done using the Student's t-test or ANOVA, as appropriate. Multiple logistic regression analysis was used to determine the (adjusted) odds ratios (ORs) for factors independently associated with PE complications. All P-values less than 0.05 were deemed statistically significant, with a 95% confidence interval. To ensure the privacy and confidentiality, all personal information was coded and data kept on a password protected device.

RESULTS

Data collection covered the period spanning from January 2022 to December 2023. We reviewed a total of 344 medical records of women with PE, but 53 of them failed to meet the eligibility criteria (20 control and 33 case files for incompleteness). Consequently, we retained a total of 291 files (97 cases and 194 controls).

Sociodemographic Profile of Study Participants

The mean age of participants was 28.4, and 209 (71.8%) of these women were single. Regarding education, 266 participants (91.4%) had attained at least a secondary level of formal education. Additionally, the most represented occupation was home-maker (94, 32.3%), closely followed by workers of the informal sector (89, 30.6%). (Table I).

Table I: Distribution of study participants according to sociodemographic characteristics (N=291)

Variables	Categories	Number (n)	Proportion (%)
Age	16-20	48	16.5
	21-30	127	43.6
	31-40	108	37.1
	>40	8	2.7

Variables	Categories	Number (n)	Proportion (%)
Level of education	Primary	25	8.6
	Secondary	174	59.8
	University	92	31.6
Marital status	Single	209	71.8
	Married	81	27.8
	Widow	1	0.3
Profession	Civil servant	29	10.0
	Housewife	94	32.3
	Informal sector	89	30.6
	Student	79	27.1
Ethnic group	Bamileke	62	21.3
	Ewondo	44	15.1
	Eton	32	11.0
	Ewondo	33	11.3
	Mbam	23	7.9
	Other*	97	33.3
*Hausa, Bulu, Bassa, Bamoun, Maka'a			

Sociodemographic Factors Associated with Complications of Preeclampsia

Maternal age, marital status, and profession showed no statistically significant relationship with PE complications. However, level of education was significantly associated with complications, with higher odds (OR = 2.35; 95% CI: 1.40–3.95) for university-level education (p = 0.002). Christians were about 2.53 times more exposed to complications of PE (Table II)

Table II: Sociodemographic characteristics associated with PE complications

Variables	Categories	Cases N=97; n (%)	Controls N=194; n (%)	OR [95% CI]	p-value
Maternal age	≤20 years	21 (21.6)	27 (13.9)	Ref.	0.132
	>20 years	76 (78.4)	167 (86.1)	0.59 [0.31-1.11]	
Education level	Secondary and below	54 (55.7)	145 (74.7)	Ref.	**0.002**
	University level	43 (44.3)	49 (25.3)	**2.35 [1.40-3.95]**	
Marital status	Married	23 (23.7)	58 (29.9)	Ref.	0.331
	Single/Widow	74 (76.3)	136 (70.1)	1.37 [0.79-2.43]	
Profession	Housewife	32 (33.0)	62 (32.0)	Ref.	0.965
	Other profession	65 (67.0)	132 (68.0)	0.95 [0.57-1.62]	
Religion	Christian	89 (91.8)	158 (81.4)	Ref. [2.53]	**0.032**
	Other	8 (8.3)	36 (18.6)	**0.40 [0.17-0.86]**	

Proportion of Complications in Preeclampsia

Regarding complications of preeclampsia in our study, the most frequent complication was eclampsia (77, 59.2%), representing the major cause of morbidity in this group. HELLP syndrome was the second most common, occurring in 24 women (18.5%). Other complications observed included placenta abruptio (9, 6.9%), acute kidney injury (8, 6.2%) and pulmonary oedema (5, 3.8%). Maternal death was reported in 3 cases (2.3%). (Table III)

Table III: Distribution of preeclampsia complications

Variable	Category	Number (n) N = 130	Proportion (%)
Maternal complications	Eclampsia	77	59.2
	HELLP syndrome	24	18.5
	Placenta abruptio	9	6.9
	Acute kidney injury	8	6.2
	Pulmonary oedema	5	3.8
	Maternal death	3	2.3
	Retinal detachment	2	1.5
	Pulmonary embolism	1	0.8
	Stroke	1	0.8

Obstetric Factors Associated with Complications of PE

Women who had fewer than five antenatal care (ANC) contacts were significantly more likely to experience complications compared to those with five or more contacts (OR = 0.26; 95% CI: 0.14–0.48; p < 0.001). Similarly, odds of receiving ANC from non-physician providers was higher for women who had complications compared to those who did not have. (OR = 3.34; 95% CI: 1.63–7.63; p = 0.002). Regarding parity, odds of being primigravida were more than double among cases compared to same odds in those with no complications (OR = 2.28; 95% CI: 1.36–3.85; p = 0.003). The same was observed with primiparity (OR = 1.73; 95% CI: 1.05–2.87; p = 0.042).

Other factors like gestational age at onset, number of foetuses, history of pre-eclampsia, alcohol use, calcium or aspirin intake during pregnancy, and baby sex, showed no statistically significant association with complications (p > 0.05). Additionally, women with an old partner were less likely to have complications compared to those with a new partner (OR = 0.19; 95% CI: 0.06–0.50; p = 0.001). (Table IV)

Table IV: Distribution of participants according to obstetric characteristics

Variables	Categories	Cases N=97; n (%)	Controls N=194; n (%)	OR [95% CI]	p-value
Gestational age at PE onset (N=291)	≤34 weeks	46 (47.4)	73 (37.6)	Ref.	0.140
	>34 weeks	51 (52.6)	121 (62.4)	0.67 [0.41-1.10]	
Type of pregnancy (N=291)	Singleton	91 (93.8)	183 (94.3)	Ref.	1.000
	Multiple	6 (6.2)	11 (5.7)	1.11 [0.36-3.05]	
Type of partner* (N=203)	New Partner	12 (21.4)	7 (4.8)	Ref.	0.001
	Old Partner	44 (78.6)	140 (95.2)	0.19 [0.06-0.50]	
Past PE* (N=203)	No	38 (67.9)	95 (64.6)	Ref.	0.789
	Yes	18 (32.1)	52 (35.4)	0.87 [0.44-1.66]	
Consumption of alcohol (N=291)	No	67 (69.1)	152 (78.4)	Ref.	0.113
	Yes	30 (30.9)	42 (21.6)	1.62 [0.93-2.81]	
Number of ANC contacts (N=291)	<5 visits	82 (84.5)	114 (58.8)	Ref.	<0.001
	≥5 visits	15 (15.5)	80 (41.2)	0.26 [0.14-0.48]	
ANC provider** (N=278)	Doctor	9 (10.2)	53 (27.9)	Ref.	0.002
	Other[1]	79 (89.8)	137 (72.1)	3.34 [1.63-7.63]	
Baby sex (N=291)	Boy	56 (57.7)	108 (55.7)	Ref.	0.834
	Girl	41 (42.3)	86 (44.3)	0.92 [0.56-1.51]	
Primigravida (N=291)	No	56 (57.7)	147 (75.8)	Ref.	0.003
	Yes	41 (42.3)	47 (24.2)	2.28 [1.36-3.85]	
Primipara (N=291)	No	54 (55.7)	133 (68.6)	Ref.	0.042
	Yes	43 (44.3)	61 (31.4)	1.73 [1.05-2.87]	
Supplemental Calcium (N=291)	No	69 (71.1)	126 (64.9)	Ref.	0.355
	Yes	28 (28.9)	68 (35.1)	0.75 [0.44-1.27]	
Prophylactic aspirin (N=291)	No	96 (99.0)	186 (95.9)	Ref.	0.280
	Yes	1 (1.03)	8 (4.12)	0.27 [0.01-1.55]	

Risk Factors for Complications in Women with PE

On multivariable analysis, age above 20 years was significantly protective (aOR = 0.87; 95% CI: 0.80–0.94; p<0.001). Higher ANC attendance (>5 visits) also reduced the odds of complications (aOR = 0.71; 95% CI: 0.58–0.88; p=0.001). In contrast, alcohol consumption during pregnancy (aOR = 2.53; 95% CI: 1.19–5.40; p=0.016) and having a new partner (aOR = 3.63; 95% CI: 1.14–11.57; p=0.029) were significantly associated with increased odds. (Table V)

Table V: Multiple logistic regression model for risk factors of complications in PE

Model* covariates	Categories	aOR (95% CI)	P-value
Age	**>20years**	**0.865 (0.800 – 0.936)**	**<0.001**
Education level	Primary	Ref.	
	Secondary	1.094 (0.360 – 3.324)	0.875
	University	3.276 (0.973 – 11.029)	0.055
Profession	Civil Servant	Ref.	
	Student	0.297 (0.086 – 1.033)	0.056
	Housewife	0.817 (0.265 – 2.521)	0.726
	Informal sector	0.462 (0.144 – 1.480)	0.193
Gravidity	Primigravida	0.495 (0.116 – 2.103)	0.340

Model* covariates	Categories	aOR (95% CI)	P-value
Parity	Primiparous	0.539 (0.171 – 1.700)	0.291
Preeclampsia onset	after 34 weeks	0.632 (0.327 – 1.220)	0.172
Previous preeclampsia	Yes	0.724 (0.365 – 1.435)	0.354
Supplemental calcium	Yes	0.872 (0.454 – 1.674)	0.680
Aspirin prophylaxis	Yes	0.246 (0.023 – 2.608)	0.244
ANC contacts number	**>5**	**0.711 (0.575 – 0.877)**	**0.001**
ANC provider qualification	No ANC done	Ref.	
	Nurse assistant	0.165 (0.025 – 1.091)	0.062
	Nurse	0.674 (0.142 – 3.201)	0.620
	Doctor	0.312 (0.045 – 2.181)	0.240
Alcohol consumption	**Yes**	**2.532 (1.188 – 5.396)**	**0.016**
New partner	**Yes**	**3.634 (1.141 – 11.574)**	**0.029**
Sex of baby	Female	1.235 (0.670 – 2.278)	0.499
**n=291, Pseudo-R^2 (Cragg-Uhler) = 38.8%, AIC = 316.6*			

DISCUSSION

Factors Associated with Complications in Pre-Eclampsia

Level of Education

In this study, we observed that participants who had attained a university level of education had significantly higher odds (OR=2.35; 95% CI: [1.40-3.95]) for developing complications compared to those with lower educational levels. This matches results reported by Logan *et al*., [17], in a 2020 study in Nairobi, Kenya and could be explained by the fact that both studies were carried out in urban settings, with higher proportions of educated women. Another possible explanation could be that some educated women may feel self-sufficient and only seek specialized care when complications set in.

Parity and Gravidity

Our findings show that primigravida (OR=2.28; p=0.003) and primiparous status (OR=1.73; p=0.042) are both significantly associated with an increased risk of developing preeclampsia complications. This finding supports the existing evidence that first pregnancies carry a higher risk of PE because the mother's immune system is encountering foreign foetal cells for the first time [2-17]. Additionally, this increased susceptibility is often attributed to maternal immune maladaptation that occurs after early trophoblastic invasion. This supports the immunological theory of preeclampsia. Specifically, nulliparity is believed to increase the risk because of the initial conflict between maternal immune response and paternal genes during the first pregnancy [18].

Partner Change

Our study further showed a strong association between having a new partner and an increased odd of developing preeclampsia complications (p=0.001). This finding is consistent with results from a 2021 study by Sitterich *et al*., in Sierra Leone, and is coherent with the immunological theory, where a change in the source of paternal antigens (a new partner) is often linked to an increased risk of preeclampsia in subsequent pregnancies [18,19].

Antenatal Care Quality and Frequency

We observed that women who attended fewer than five ANC visits had higher odds of developing complications (p<0.001). Similarly, having ANC conducted by personnel other than a physician (e.g., a nurse or other hospital staff) resulted in a significant 3.34-fold increased risk of complications (95% CI: 1.63-7.63; p=0.002). These results align with prior studies by Logan *et al*., [17], in Kenya and Fouedjio *et al*., in Cameroon [20]. In the Cameroonian setting, the elevated risk associated with non-physician providers may stem from inadequate training in preeclampsia risk assessment and management. Furthermore, other factors such as low socioeconomic status of the mother, which often result in poor ANC attendance and reliance on lower-level care providers, may also contribute to these findings.

Maternal Complications and Proportion of Complications

In our study, the most frequent complications were eclampsia (59.2%), followed by HELLP syndrome (18.5%), placenta abruptio (6.9%), acute kidney injury (6.2%), and pulmonary oedema (3.8%). Similar findings have been reported in previous studies. Prior study in Yaoundé by Henry-Leonard *et al*., reported the same group of complications, with eclampsia (39%) being the most frequent, followed by HELLP syndrome (14%) [21], while Ngbale *et al*., in Bangui reported eclampsia (29.3%) and renal failure (19.5%) as their most frequent complications [22]. Although these values are lower than those in our study, the trend consistently demonstrates that eclampsia remains the most prevalent and life-threatening complication of severe preeclampsia. The higher rates observed in our population may be attributed to differences in population size and delayed referral.

In terms of maternal mortality, three maternal deaths (2.3%) were recorded in our study. This figure is slightly lower than the 4.4% mortality reported by Halle-Ekane in a prior study in Douala, Cameroon [23]. The overall proportion of complications (37.8%) in our study was equally lower than the 42.3% reported by Fouedjio *et al*., in 2022 in a similar setting in Yaoundé [16]. This

improvement may be due to increased awareness of the adverse outcomes of preeclampsia and the implementation of preventive measures such as low-dose aspirin and calcium supplementation, which, although not statistically significant in our study, were associated with reduced odds of preeclampsia complications.

Risk Factors of Complications in Women with PE

After multivariable analysis, complications in PE were associated with maternal age >20 years and attending more than five ANC visits, both of which were protective. In contrast, alcohol consumption and having a new partner significantly increased the odds of complications. These findings are consistent with those reported by Hortence *et al*., [16], and Benjelloun *et al*., [24].

Several mechanisms may explain these associations. Younger maternal age may reflect biological and social vulnerability, including poorer health-seeking behaviour and limited awareness of PE warning signs. Higher ANC attendance increases opportunities for early detection and timely management, thereby reducing complications. Alcohol consumption has been linked to endothelial dysfunction and poorer adherence to medical advice, which may exacerbate PE severity. The association with a new partner may relate to immunologic maladaptation to unfamiliar paternal antigens, a hypothesis supported in previous literature on PE risk. Additionally, limited provider competence during ANC—particularly when delivered by less-qualified staff—may lead to missed diagnoses, inadequate blood pressure monitoring, and delayed referrals, contributing to worse outcomes.

Several mechanisms may explain these associations. Younger maternal age may show biological and social vulnerability, including poorer health-seeking behaviour and limited awareness of warning signs in pregnancy. On the other hand, higher ANC attendance increases early detection and timely management, reducing complications. Additionally, alcohol consumption can worsen PE endothelial dysfunction. Likewise, the association with a new partner can be explained by immunologic maladaptation to unfamiliar paternal antigens, supported by previous literature on PE risk.

Limitations

Although we achieved our objectives and determined sample size, a potential limitation of our study is its retrospective nature. Access to complete data was challenging due to the presence of numerous incomplete files. Many of these files lacked important variables, such as BMI, which is hypothesized to influence the outcome of preeclampsia. Consequently, these variables could not be evaluated in our study.

CONCLUSION

Preeclampsia remains a major public health concern in our setting, significantly affecting maternal and perinatal outcomes. The main objective of this work was to study the risk factors of complications of preeclampsia in three hospitals in Yaoundé. The results showed that the mean age of women who developed complications was 28.4 ± 6.7 years, with most participants having had university education, single and housewives. The overall proportion of preeclampsia-related complications was 37.8%, with eclampsia, HELLP syndrome, and placental abruption as the leading maternal morbidities.

Key risk factors identified included primigravida and primipara status, attendance of fewer than five antenatal care visits and a new male partner. Additionally, receiving care from non-physician healthcare providers was also significantly associated with the development of complications.

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