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Predictors of Primary Postpartum Haemorrhage in a Tertiary Teaching Hospital in Ekiti State, Nigeria: A Facility-Based Analytical Study

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ABSTRACT

Background: Postpartum haemorrhage (PPH) is a major contributor to maternal morbidity and mortality, especially in LMICs. Identifying context-specific predictors in tertiary facilities supports targeted prevention, early detection, and timely first-response care bundles consistent with contemporary guidance.
Subjects and Method: This prospective facility-based analytical cohort study evaluated associations between socio-demographic characteristics, antepartum risk factors, and labour events with occurrence of PPH among 308 parturients at Ekiti State University Teaching hospital. Bivariate associations were assessed using chi-square tests, and independent predictors were modelled using binary logistic regression with adjusted odds ratios (aOR), 95% confidence intervals (CI), and p-values interpreted at α=0.05.
Results: Thirty women developed PPH (9.7%) at Ekiti State University Teaching Hospital. Also, ethnicity was the only socio-demographic factor associated with PPH (p=0.047). Obstetric and intrapartum variables showed strong associations. In multivariable analysis, gravidity 3–4 (aOR 8.15; p=0.001), parturients who have been pregnant more than four times (aOR 59.40; p<0.001), grand multiparity (aOR 16.875; p<0.001), fetal macrosomia (aOR 12.63; p<0.001), uterine fibroids (aOR 2.95; p=0.024), antepartum haemorrhage (aOR 22.91; p<0.001), prolonged labour (aOR 13.65; p<0.001), labour duration >12 hours (aOR 15.33; p=0.003), perineal tear (aOR 10.43; p<0.001), birthweight >4.0 kg (aOR 13.02; p<0.001), and accumulation of ≥2 or ≥3 risk factors (aOR 5.00 and 43.81; p=0.010 and <0.001) independently predicted PPH.
Conclusion: In this tertiary hospital cohort, PPH risk was driven primarily by high gravidity/parity, placental-bleeding antecedents, macrosomia, and labour duration/trauma variables. Therefore, risk-factor triggered preparedness and objective early detection with rapid bundled response are warranted for high-risk parturients.

Keywords: postpartum haemorrhage, predictors, risk factors, tertiary hospital, Nigeria

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BACKGROUND

Primary Postpartum haemorrhage (PPH) remains one of the most common, and most consequential complications of childbirth. The most recent consolidated primary PPH guideline from the World Health Organization notes that primary PPH accounts for nearly one fifth of maternal deaths globally and is the dominant cause of maternal mortality in many low-income settings (WHO, 2025). In Nigeria, where maternal mortality remains high, national guidance emphasizes that primary PPH contributes substantially to hospital admissions for obstetric haemorrhage and to maternal deaths, underscoring the urgent need for prevention, early diagnosis, and standardized management pathways across levels of care (Ibrahim et al., 2026; Federal Ministry of Health and Social Welfare [FMH], 2024). Despite longstanding knowledge that many primary PPH deaths are preventable, implementation gaps persist. WHO's consolidated guideline highlights that life-saving interventions are often used inconsistently or too late, and that contradictory or fragmented guidance can impede uptake of evidence-based practice (WHO, 2025).

To address these challenges, recent WHO recommendations have explicitly strengthened the role of routine objective measurement of postpartum blood loss and endorsed treatment bundles for first-response management when primary PPH is detected (WHO, 2023). These normative shifts are echoed in the global Roadmap to Combat PPH (2023–2030), which frames coordinated action across research, norms/standards, implementation, and advocacy as necessary to reduce preventable deaths from PPH, particularly in LMICs where health system constraints are pronounced (FMH, 2024). From a clinical perspective, primary PPH is typically defined by blood loss thresholds in the first 24 hours after birth (commonly ≥500 mL after vaginal birth, with higher thresholds often used to define severe bleeding), but contemporary guidance stresses that rigid cut-offs can underestimate clinically important haemorrhage and that earlier therapeutic action may be warranted in women with anaemia or other comorbid vulnerability (WHO, 2023).

Aetiologically, recent high-quality meta-analytic evidence indicates that uterine atony is the most frequently reported cause, followed by genital tract trauma and retained placenta, and that multiple concurrent causes are not rare. Therefore, supporting bundle-based response approaches rather than single-intervention strategies (Okonofua et al., 2026). Risk factors for primary PPH are multifactorial and span pre-pregnancy, antepartum, and intrapartum domains. Recent studies have identified strong associations of PPH with anaemia, multiple pregnancy, macrosomia, placenta previa/abnormal placentation, caesarean birth, and absence of antenatal care, with moderate associations reported for antepartum haemorrhage and other pregnancy complications (Mansukhani et al., 2023; Genina et al., 2023; Yunas et al., 2025). A complementary systematic review also focused on vaginal birth emphasizes labour-related factors including prolonged labour and genital tract trauma, pregnancy-related factors, and delivery-related contributors (Huang et al., 2023). In Africa, pooled estimates suggest meaningful regional burden variation and highlight macrosomia

and caesarean section among common risk factors in aggregated studies (Ibrahim et al., 2026; Forbes et al., 2023).

Across Nigeria specifically, recent multicentre analysis of over 68,000 births in referral-level hospitals found a primary PPH prevalence of 3.2% (2.7% for vaginal and 4.0% for caesarean deliveries) and identified antepartum haemorrhage and multiple pregnancy as major predictors, particularly for vaginal births (Adebayo et al., 2024). This is complemented by Nigerian implementation evidence demonstrating that multifaceted quality-improvement interventions can reduce primary PPH rates and PPH-related deaths in referral facilities, illustrating that prevention and response are not solely biomedical challenges but also systems problems related to training, supplies, detection, and coordinated emergency action (Okonofua et al., 2026; Bohren et al., 2025).

The need for facility-specific evidence remains strong. Risk profiles may differ by referral case mix, underlying population characteristics, and the quality of detection and documentation systems. The international cluster-randomized E-MOTIVE trial also showed that calibrated blood collection drapes plus a first-response treatment bundle reduced severe PPH and related complications compared with usual care across multiple countries, including Nigeria (Gallos et al., 2023). Yet qualitative and process evaluation work emphasizes that successful implementation depends on local resources, workforce capacity, medication availability, and integration into workflow and emergency systems. Against this background, the present study aimed to determine the prevalence of primary PPH in a tertiary teaching hospital cohort and to identify socio-demographic, obstetric, and intrapartum predictors of primary PPH. The findings are intended to inform risk stratification at admission and strengthen preparedness and first-response pathways aligned with contemporary global and national guidance (WHO, 2023; WHO, 2025; FMH, 2024).

SUBJECTS AND METHOD

1. Study Design

This study was a prospective facility-based analytical cohort study conducted at the Ekiti State University Teaching Hospital, Ado-Ekiti, Ekiti State. EKSUTH is a major tertiary referral centre providing specialized obstetric care to Ekiti State and neighbouring states in southwestern Nigeria. The hospital receives referrals from primary and secondary healthcare facilities and conducts several thousand deliveries annually.

2. Populationand Sample

The study population comprised women who delivered vaginally at term in the labour ward of EKSUTH between January and June 2025. Eligible participants were recruited and followed from the third stage of labour until 24 hours postpartum to assess the occurrence of primary postpartum haemorrhage (PPH).

Therefore, parturients who had caesarean section, or have bleeding disorders/ coagulopathies were excluded from this study. The sample size was determined using the single population proportion formula, assuming a prevalence of postpartum haemorrhage from previous Nigerian studies, a 95% confidence level, and a 5% margin of error.

$$n = \frac{Z^2 \, x \, p \, x \, (1-p)}{d^2}$$

Where n is the sample size, Z is the statistic corresponding to level of confidence and p is the expected prevalence of 9.7% that was obtained from similar study. After adjusting for potential non-response, a minimum sample size of 308

parturients was obtained. Eligible participants were recruited consecutively during the study period until the required sample size was achieved.

3. Study Variables

The dependent variable for this study was the occurrence of primary postpartum haemorrhage (PPH), which is categorised as present or absent. The independent variables included socio-demographic characteristics (age, ethnicity, educational level, occupation and marital status), obstetric factors (gravidity, parity, grand multiparity, fibroids, antepartum haemorrhage, and antenatal care attendance), and intrapartum variables duration of labour, prolonged labour, perineal tear, birthweight, foetal macrosomia, and accumulation of risk factors). These variables were selected based on established evidence linking them to the risk of postpartum haemorrhage and their relevance to the study setting.

4. Operational Definition of Variables

Primary postpartum haemorrhage (PPH). was defined as blood loss of 500 mL or more within 24 hours following vaginal delivery, measured objectively using the gravimetric method, where a 1g increase in weight of soaked materials equals 1 mL of blood loss.

Age. was defined as completed years at last birthday, while ethnicity, education, occupation, and marital status were self-reported.

Gravidity. referred to the total number of pregnancies, and parity to the number of births at ≥28 weeks, with grand multiparity defined as parity of five or more.

Antepartum haemorrhage. was defined as bleeding after 28 weeks of gestation but before delivery, and uterine fibroids as clinically or ultrasonographically diagnosed.

Prolonged labour. was defined as labour lasting more than 12 hours, perineal tear as any genital tract laceration during delivery, and fetal macrosomia as birthweight ≥4.0 kg.

Accumulation of risk factors. referred to the presence of two or more or three or more identified risk factors in a single participant.

5. Study Instruments

Data were collected using a structured data extraction form designed to capture relevant socio-demographic, obstetric, and labour-related variables from patient records and clinical observations. For this study, Postpartum blood loss was objectively measured using the gravimetric method (weighed blood loss technique). the blood loss was derived by weighing a pre-weighed absorbent sheet that was placed underneath the buttock of selected parturients immediately after delivery. Two pre-weighed perineal pads were applied to the perineum after placental delivery and all the perineal pad that were used for episiotomy and laceration repair were pre-weighed.

The perineal pads used for episiorhaphy and laceration repair where indicated were reweighed after the repair. The perineal pads and the absorbent sheath were removed after the first hour and reweighed. New perineal pads and an absorbent sheet of known weight were replaced and removed every four hours as the usual practice in this facility till the first 24 hours after the delivery. These perineal pads were reweighed immediately after removal. The blood loss was calculated by the difference in weight between the dry and soaked perineal pads and absorbent sheets used because 1gram difference is equal to 1ml of blood loss.

The difference in the weight before and after use of the pads and the absorbent sheet were noted and added together 24hours after the delivery. Primary postpartum haemorrhage was defined as blood

loss of 500 mL or more within the first 24 hours following vaginal delivery. Post-partum haemoglobin and haematocrit levels were also assessed within 24 hours after delivery to support the assessment of blood loss

6. Data Analysis

Data obtained were coded and entered using IBM SPSS version 27. Continuous variables were presented as mean ± Standard deviation and median depending on the distribution pattern of the data set, while categorical data such as frequency tables and percentages. Chi-square test was used to evaluate statistical significance. Multicollinearity among independent variables was assessed using variance inflation factors (VIF). Results were considered statistically significant when $P< 0.05$.

7. Research Ethic

Ethical approval for the study was obtained from the Research and Ethics Committee of the Ekiti State University Teaching Hospital, Ado Ekiti, Ekiti state. Participation was voluntary, and confidentiality of participants' information was maintained throughout the study.

RESULTS

1. Relationship between Respondents' Socio-demographics Characteristics and events of PPH

A total of 308 parturients were recruited for this study, and 30 parturients experienced PPH (prevalence 9.74%), and 278 parturients did not experience primary PPH. In Table 1 the results summarize the socio-demographic distribution of the study participants stratified by incidence of primary postpartum haemorrhage (PPH). Among the 30 women who developed PPH, most (86.67%) were aged 20–29 years, while some (13.33%) were aged 30–39 years and none (0.00%) were more than 40 years of age. In the non-PPH group (n=278), the majority (77.34%) were also aged 20–29 years and followed by 30–39 years (21.58%). Regarding marital status, nearly all parturients who experienced PPH cases were married (96.67%), with 1 (3.33%) recorded as separated.

The ethnic distribution showed that Yoruba participants constituted the majority in both the PPH (63.33%) and non-PPH groups (80.58%), while a relatively higher proportion of PPH cases occurred among the "Others" ethnic category (23.33% vs 7.91%). Christianity was the predominant religion in both groups (76.67% in PPH and 79.50% in non-PPH), followed by Islam (23.33%), with traditional religion minimally represented (1.08%). In terms of socio-economic characteristics, most participants had tertiary education in both groups (80.00% in PPH and 83.81% in non-PPH), while occupational distribution showed that business women formed the largest group (36.67% vs 47.12%), with relatively higher proportions of PPH cases observed among professionals (26.67% vs 19.06%) and students (23.33% vs 8.27%) compared with housewives (3.33% vs 7.91%) and artisans (10.00% vs 14.75%).

Table 1. Relationship between Respondents' Socio-demographics Characteristics and events of Postpartum Haemorrhage

Variables	Postpartum Haemorrhage	
	Present N (%)	Absent N (%)
Age (years)		
20 – 29	26 (86.67)	215 (77.34)
30 – 39	4 (13.33)	60 (21.58)

Variables	Postpartum Haemorrhage	
	Present N (%)	Absent N (%)
40 above	0 (0.00)	3 (1.08)
Marital status		
Single	0 (0.0)	5 (1.5)
Married	29 (96.67)	251 (90.27)
Divorced	0 (0.0)	5 (1.80)
Separated	1 (3.33)	17 (6.12)
Ethnicity		
Hausa	1 (3.3)	8 (2.9)
Igbo	3 (10.0)	24 (8.63)
Yoruba	19 (63.33)	224 (80.58)
Others	7 (23.33)	22 (7.91)
Religion		
Islam	7 (23.33)	46 (16.55)
Christianity	23 (76.67)	221 (79.50)
Traditional	0 (0.0)	3 (1.08)
Others	0 (0.0)	8 (2.88)
Education		
None	0 (0.0)	1 (0.36)
Primary	1 (3.33)	4 (1.44)
Secondary	5 (16.67)	24 (8.63)
Tertiary	24 (80.00)	233 (83.81)
Others	0 (0.00)	16 (5.76)
Occupation		
Housewife	1 (3.33)	22 (7.91)
Business	11 (36.67)	131 (47.12)
Professional	8 (26.67)	53 (19.06)
Artisan	3 (10.00)	41 (14.75)
Student	7 (23.33)	23 (8.27)
Others	0 (0.0)	8 (2.88)

2. Relationship between the risk factors of PPH and events of PPH

Multiple obstetric risk variables were significantly associated with primary PPH at bivariate level. Gravidity (OR= 56.79; p<0.001) and parity (OR= 198.13; p<0.001) showed strong gradients of association with primary PPH. Foetal macrosomia (OR= 68.91; p<0.001), fibroid with pregnancy (OR= 22.88; p<0.001), and grand multiparity (OR= 167.87; p<0.001) were also significantly associated with primary PPH. The parturients with more than one risk factors of primary PPH (OR= 87.49; p<0.001) showed increasing PPH incidence. Multiple pregnancy and augmentation were not statistically significant at bivariate level.

Table 2. Relationship between the risk factors of PPH and events of PPH

Variables	PPH		OR	p
	Present N (%)	Absent N (%)		
Multiple pregnancies			0.93	0.291
No	28 (93.33)	269 (96.76)		
Yes	2 (6.67)	9 (3.24)		
Gravidity			56.79	<0.001
1 – 2	3 (10.0)	162 (58.27)		
3 – 4	16 (53.33)	106 (38.13)		

Variables	PPH		OR	p
	Present N (%)	Absent N (%)		
≥ 5	11 (36.67)	10 (3.60)		
Parity			54.91	<0.001
Nulliparous	6 (20.00)	78 (28.06)		
Primiparous	0 (0.00)	95 (34.17)		
Multiparous	14 (46.67)	97 (34.89)		
Grand multiparous	10 (33.33)	8 (2.88)		
Fetal macrosomia			49.76	<0.001
No	10 (33.33)	240 (86.33)		
Yes	20 (66.67)	38 (13.67)		
Polyhydramnios			3.71	0.186
No	29 (96.67)	277 (99.64)		
Yes	1 (3.33)	1 (0.36)		
Uterine fibroids in pregnancy			5.53	0.028
No	23 (76.67)	252 (90.65)		
Yes	7 (23.33)	26 (9.35)		
Previous history of PPH			2.23	0.139
No	24 (80.00)	248 (89.21)		
Yes	6 (20.00)	30 (10.79)		
Anaemia			0.10	0.729
No	27 (90.00)	255 (91.73)		
Yes	3 (10.00)	23 (8.27)		
Induction of labour			0.19	0.702
No	18 (60.00)	155 (55.76)		
Yes	12 (40.00)	123 (44.24)		
Augmentation of labour			0.51	0.475
No	17 (56.67)	176 (63.31)		
Yes	13 (43.33)	102 (36.69)		
Grand-multiparity			45.64	<0.001
No	20 (66.67)	270 (97.12)		
Yes	10 (33.33)	8 (2.88)		
Prolonged labour			26.05	<0.001
No	24 (80.00)	273 (98.20)		
Yes	6 (20.00)	5 (1.80)		
Antepartum haemorrhage			34.17	<0.001
No	24 (80.00)	275 (98.92)		
Yes	6 (20.00)	3 (1.08)		
Precipitate labour			3.87	0.108
No	28 (93.33)	274 (98.56)		
Yes	2 (6.67)	4 (1.44)		
Risk factors			76.21	<0.001
1	4 (13.33)	185 (66.55)		
2	8 (26.67)	74 (26.62)		
3	18 (60.00)	19 (6.83)		

3. Relationship between Respondents' Labour events and PPH

Labour and delivery variables showed important associations as duration of labour greater than 12 hours was significantly associated with PPH compared to those less than 12 hours (OR=14.60; p= 0.007), as was birthweight category (OR= 58.56; p<0.001). Perineal tear was also strongly associated with the incidence of

primary PPH (OR= 123.18; p<0.001). However, the mode of delivery (spontaneous vs instrumental) was not significantly associated with the incidence of primary PPH (p=0.185).

Table 3. Relationship between Respondents' Labour events and PPH

Variable	PPH		OR	p
	Present N (%)	Absent N (%)		
Onset of labour				
Spontaneous	18 (60.00)	155 (55.76)	0.19	0.702
Induction of labour	12 (40.00)	123 (44.24)		
Progress of labour				
Augmented	13 (43.33)	102 (36.69)	0.51	0.552
Non-augmented	17 (56.67)	176 (63.31)		
Duration of labour				
Less than 12 hours	27 (90.00)	276 (99.28)	14.60	0.007
Greater than 12 hours	3 (10.00)	2 (0.72)		
Associated perineal tear				
No	8 (26.67)	220 (79.14)	123.17	<0.001
Yes	12 (40.00)	0 (0.0)		
Episiotomy	10 (33.33)	58 (20.86)		
Method of delivery				
Spontaneous vaginal delivery	29 (96.67)	277 (99.64)	3.71	0.185
Instrumental vaginal delivery	1 (3.33)	1 (0.36)		
Birth weight (kg)				
< 2.5	0 (0.0)	1 (0.36)	58.56	<0.001
2.5 – 3.0	0 (0.0)	105 (37.77)		
3.0 – 3.5	10 (33.33)	50 (18.99)		
> 4.0	20 (66.67)	37 (13.31)		
Method of placenta delivery				
Controlled cord traction	29 (96.67)	274 (98.56)	0.61	0.403
Manual removal of placenta	1 (3.33)	4 (1.44)		
Duration of third phase of labour (minutes)				
Less than 5 minutes	22 (73.33)	216 (77.70)	0.29	0.647
Greater than 5 minutes	8 (26.67)	62 (22.30)		

4. Predictors of Postpartum Haemorrhage

Multivariable logistic regression of the study showed that several predictors remained independently associated with PPH (Table 4). Women who have had 3-4 gravid experiences were strongly predicted to have PPH (aOR 8.15; 95% CI 2.15–30.83; p=0.001), and women who have had more than four times gravid experiences (aOR 59.40; 95% CI 10.54–335.03; p<0.001). Parturients who have had five or more parous experiences (grand multiparity) were strongly predicted to have PPH (aOR 16.25; 95% CI 4.69–56.25; p<0.001) and they were also more likely to have PPH compared to other parturients (aOR 16.87; 95% CI 5.19–54.79; p<0.001).

Antepartum haemorrhage was also strongly predicted to cause PPH (aOR 22.91; 95% CI 6.02–87.18; p<0.001), parturients who had experienced prolonged labour in the past were strongly predicted to have PPH (aOR 13.65; 95% CI 3.59–51.82; p<0.001). Labour duration >12 hours (aOR 15.33; 95% CI 2.52–93.21; p=

0.003), foetal macrosomia (aOR 12.63; 95% CI 4.20–38.00; p<0.001), birthweight >4.0 kg (aOR 13.02; 95% CI 4.26–39.73; p <0.001), and perineal tear (aOR 10.43; 95% CI 4.03–26.98; p<0.001) were also significant predictors of PPH. Fibroid with pregnancy also remained significant (aOR 2.95; 95% CI 1.15–7.54; p=0.024). Higher incidence of multiple risk factors identified were independently associated with the incidence of PPH (risk factors=2: aOR 5.00; p=0.010; risk factors=3: aOR 43.81; p<0.001).

Table 4. Predictors of Postpartum Haemorrhage

Risk factors	aOR	95% CI	p
Gravidity			
1 – 2	Ref.		
3 – 4	8.15	2.32 – 28.65	0.001
≥ 5	59.40	14.25 – 247.57	<0.001
Parity			
Nulliparous	Ref.		
Primiparous	0.01	-	0.996
Multiparous	1.87	0.69 – 5.10	0.218
Grand multiparous	16.25	4.67 – 56.52	<0.001
Fetal macrosomia			
No	Ref.		
Yes	12.63	5.49 – 29.04	<0.001
Uterine fibroids in pregnancy			
No	Ref.		
Yes	2.95	1.15 – 7.53	0.024
Grand-multiparity			
No	Ref.		
Yes	16.87	5.99 – 47.49	0.001
Prolonged labour			
No	Ref.		
Yes	13.65	3.88 – 48.02	0.001
Antepartum haemorrhage			
No	Ref.		
Yes	22.92	5.39 – 97.43	0.001
Risk factors			
1	Ref.		
2	5.00	1.46 – 17.10	0.010
3	43.81	13.44 – 142.85	0.001
Duration of labour			
Less than 12 hours	Ref.		
Greater than 12 hours	15.33	2.45 – 95.81	0.003
Associated perineal tear			
No	Ref.		
Yes	10.43	4.42– 24.63	<0.001
Episiotomy	1.89	0.84 – 4.27	0.123
Birth weight (kg)			
< 2.5	Ref.		
2.5 – 3.0	0.01	-	0.996
3.0 – 3.5	0.01	-	0.997
> 4.0	13.03	5.66 – 30.00	<0.001

DISCUSSION

This study revealed a PPH prevalence of 9.7% among parturients in Ekiti State University Teaching Hospital. This is substantially higher than the 3.2% prevalence reported in a recent multicentre Nigerian referral-hospital analysis also higher than pooled meta-analytic estimates reported across African studies (pooled prevalence ~ 4 – 5% in Western/Central regions in one 2026 synthesis) (Ibrahim et al., 2026; Adebayo et al., 2024). The most plausible inference is that the variation in detection thresholds compared with broader multi-facility studies, this challenge has been consistently noted in contemporary guidance and research on PPH measurement and definition heterogeneity (WHO, 2025; Adebayo et al., 2024).

A notable contribution of this study is the emphasis on risk clustering. The number of concurrent "risk factors" showed strong independent association (aOR 5.0 for two risk factors; aOR 43.8 for three). This aligns with modern syntheses indicating that multiple concurrent causes and risk factors are common and that bundle-based responses may be more appropriate than linear single-cause models (Yunas et al., 2025). It also reflects the direction of contemporary WHO recommendations endorsing treatment bundles and standardized first-response sequences to reduce delays and increase reliability under real-world constraints (WHO, 2023; Gallos et al., 2023).

Antepartum haemorrhage emerged as one of the highest-magnitude predictors in this dataset (aOR= 22.9). This finding is consistent with multicentre Nigerian evidence, where antepartum haemorrhage was a very strong predictor of PPH, especially following vaginal delivery (aOR 11.7 in Adebayo et al.) (Adebayo et al, 2024). It is also supported by major synthesis work classifying placenta-related bleeding antecedents, including placenta praevia and placental disorders as strongly associated with PPH and identifying the need for anticipatory planning such as blood availability, experienced staff, and rapid escalation pathways (Yunas et al., 2025). Given that antepartum haemorrhage frequently signals placental pathology (abruption or previa spectrum) and coagulopathy risk, its strong association in this dataset plausibly reflects both biological propensity to haemorrhage and greater likelihood of operative interventions, uterine atony, or retained placental tissue mechanisms consistently emphasized in contemporary clinical guidance (WHO, 2025, Escobar et al., 2022).

High gravidity and grand multiparity were also strongly associated with PPH (aORs 8.2 to 59.4 for gravidity categories; ~16.9 for grand multiparity). This pattern is widely reported in the literature as a marker for uterine atony, uterine distension history, and increased probability of obstetric complications. Large systematic reviews classify high-parity phenotypes and related obstetric histories among core risk constructs for PPH risk stratification, though effect sizes vary by setting and outcome definition (Yunas et al., 2025; Huang et al., 2023). Macrosomia and birthweight showed consistent associations with the incidence of PPH as foetal macrosomia (aOR= 12.6) and birthweight >4.0 kg (aOR= 13.0) were significant predictors. This aligns with contemporary evidence syntheses identifying macrosomia (particularly >4,500 g) as a strong risk factor and with African pooled analyses that flag macrosomia as a recurring determinant (Ibrahim et al., 2026; Yunas et al., 2025). Mechanistically, foetal macrosomia increases uterine distension and labour dystocia risk, both of which can predispose

to uterine atony and traumatic delivery, reinforcing why prevention and early response pathways frequently prioritize similar underlying aetiologies in pregnancies multiple pregnancy, polyhydramnios, macrosomia (Yunas et al., 2025).

Uterine fibroids in pregnancy remained independently associated (aOR 2.95). This is clinically plausible: fibroids can impair uterine contractility, increase malpresentation and caesarean risk, and contribute to placental abnormalities. Recent large cohort evidence shows fibroids as an independent risk factor for PPH. While effect size in this study is smaller than in some cohorts, directionality is concordant and supports targeted antenatal identification and delivery planning among women with known uterine fibroids, especially in referral-level facilities (Wu and Zhang, 2026).

Labour duration and prolonged labour were significant predictors of (aOR= 15.3 for labour >12 hours; aOR= 13.7 for prolonged labour). Large population-based work demonstrates increased PPH risk with prolonged active labour stages, and systematic reviews identify prolonged labour/ dystocia as central labour-related risks for PPH, though thresholds vary by study and outcome definition.9,19 A related contributor is oxytocin augmentation; evidence is mixed depending on dose, duration, and confounding by dystocia. A 2024 meta-analysis suggests oxytocin augmentation is associated with increased odds of PPH (pooled OR 1.27), and detailed cohort analyses show higher PPH risk with higher maximum oxytocin doses independent of labour duration in some settings (Jafarabady et al., 2024; Bernitz et al., 2023). In the present study, augmentation and induction were not statistically significant in the bivariate tables, which could reflect (i) limited power, (ii) misclassification of exposure intensity/dose, or (iii) clinical practice patterns where augmentation is nearly universal in this cohort, limiting discriminatory ability.

Perineal tear was a strong independent predictor (aOR= 10.4). This is consistent with the established aetiologic architecture of PPH in which genital tract trauma is among the most common causes after uterine atony (Aimagambetova et al., 2024). Recent meta-analysis estimates genital tract trauma contributes meaningfully to PPH burden, and contemporary cohort and case-control evidence identifies cervical/perineal tears as key predictors, supporting protocols emphasizing routine birth canal examination and timely repair when bleeding persists despite a firm uterus (Yunas et al., 2025; Al Khatri et al., 2025). The finding that episiotomy was not independently significant in this cohort (aOR 1.90; p=0.123) should be interpreted alongside guidance discouraging routine episiotomy and encouraging perineal-protection techniques to reduce trauma.1

The study's findings have practical implications for both preparedness and response reliability. E-MOTIVE evidence shows that improving early detection (using calibrated drapes) plus a first-response treatment bundle reduces severe PPH and related complications across multiple countries including Nigeria, and WHO now recommends objective blood loss measurement to improve detection and prompt treatment (WHO et al., 2025). Process and qualitative work further indicate that successful implementation depends on resources (drug/staff availability), training, role clarity, adoption into workflow, and emergency "kits/trolleys"—critical considerations in tertiary Nigerian contexts (Forbes et al., 2023; Bohren et al., 2025). In addition, Nigeria's national guideline explicitly frames PPH as a major contributor to

maternal death and directs attention to evidence-based standardized management and preparedness, reinforcing that local implementation frameworks are both necessary and timely (FMH, 2024).

Although several limitations should be considered when interpreting the findings of this study. The study was conducted in a single tertiary referral hospital, which may limit the generalizability of the findings to primary and secondary healthcare settings. Tertiary hospitals often manage more complicated pregnancies and referrals, which may influence the observed prevalence and risk profile of postpartum haemorrhage. Also, blood loss was measured using the gravimetric method, some degree of measurement error may still occur due to contamination of absorbent materials with other body fluids such as amniotic fluid. However, the use of pre-weighed absorbent materials and standardized weighing procedures helped to minimize this potential error, and the observational design of the study limits the ability to establish causal relationships between identified risk factors and postpartum haemorrhage.

The findings therefore reflect associations rather than causation. Future multicentre studies with larger sample sizes and broader clinical variables may provide more comprehensive insights into the determinants of postpartum haemorrhage in Nigerian healthcare settings. The results support a facility policy of structured risk stratification at admission and heightened preparedness (uterotonics, blood availability, senior staffing readiness) for high-risk women, paired with early objective blood loss measurement and rapid first-response bundles consistent with updated WHO guidance and the evidence base on the E-MOTIVE trial.

AUTHOR CONTRIBUTION

Gbenga Damilola Akinlua and Richard Akindele Akinyoade, and Oluwayomi Samson Gbenga conceptualized and designed the study, supervised data collection, managed the project, performed data analysis and interpretation, and led manuscript writing and revision. Omolola Ajayi Alao, Olaogun Oluwole Dominic, Olufunke Temiloluwa Oso, Olusola Peter Aduloju, and Temitope Omoladun Okunola contributed to data curation, analysis, interpretation, and critical intellectual input in drafting and revising the manuscript. All authors reviewed and approved the final manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest regarding the publication of this study.

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