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Investigation of Haematological Parameters and Clinical Factors Predisposing Postnatal Women to Postpartum Haemorrhage in Rivers State

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Abstract

Postpartum haemorrhage (PPH) remains a leading cause of maternal morbidity and mortality worldwide, particularly in low-resource settings such as Nigeria. This study assessed haematological parameters and clinical factors predisposing postnatal women to PPH in selected health facilities across Rivers State, Nigeria, and evaluated the effectiveness of Active Management of the Third Stage of Labour (AMTSL) in its prevention. A cross-sectional design was employed, recruiting 200 postpartum women from the University of Port Harcourt Teaching Hospital (UPTH), Rivers State University Teaching Hospital (RSUTH), and selected primary health care centres. Complete Blood Count (CBC) parameters were analysed using the Sysmex XP-300 haematology analyser. Statistical analyses were conducted using SPSS version 27, employing Chi-square tests and independent t-tests ($p < 0.05$). PPH occurred in 13.5% ($n = 27$) of participants. Parity was significantly associated with PPH ($\chi^2 = 10.663$, $p = 0.031$), with higher parity (≥3) women at risk from uterine atony and nulliparous women at risk from prolonged labour. Age showed no significant association ($p = 0.070$). Mean platelet volume (MPV: 13.14 ± 1.21 vs. 10.66 ± 1.65 fL, $p = 0.001$) and red cell distribution width-coefficient of variation (RDW-CV: 23.08 ± 21.87% vs. 10.65 ± 9.51%, $p = 0.006$) were significantly elevated in PPH cases. Basophil count was significantly higher ($p = 0.013$) and lymphocyte count reduced ($p = 0.011$). Eighty percent of healthcare providers adhered to AMTSL standards. Parity, MPV, and RDW-CV are significant predictors of PPH. Routine haematological screening, targeted antenatal care, and consistent AMTSL practice are essential to reducing PPH-related maternal morbidity and mortality in Rivers State.

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Keywords

AMTSL, complete blood count, haematological, postpartum haemorrhage, parity.

Introduction

Postpartum hemorrhage (PPH) is defined as blood loss exceeding 500 ml following vaginal delivery or 1000 ml after cesarean section and remains one of the leading causes of maternal mortality worldwide, particularly in low-resource settings (Say *et al.,* 2014). Globally, PPH accounts for nearly 25% of all maternal deaths, with the majority occurring in sub-Saharan Africa and South Asia, where access to healthcare infrastructure and obstetric services are limited (Knight *et al.,* 2022; Sheldon *et al.,* 2014). The condition is often sudden and unpredictable, with common causes including uterine atony, retained placental tissue, and trauma to the birth canal (Sheldon *et al.,* 2014). The condition is frequently sudden and unpredictable, arising from uterine atony, retained placental tissue, birth canal trauma, or maternal coagulopathies, collectively framed under the mnemonic of the 'four Ts' (Tone, Tissue, Trauma, and Thrombin) by the World Health Organization (WHO, 2025).

In Nigeria, the maternal mortality ratio stands at approximately 576 deaths per 100,000 live births, with PPH accounting for about 27% of these deaths (NPC Nigeria, 2019; UNFPA, 2020). Rivers State bears a disproportionate burden, with an estimated 745 maternal deaths per 100,000 live births, attributable to poor healthcare infrastructure, insufficient provider training, and inadequate access to essential medicines and equipment (NPC Nigeria, 2019). These figures reveal a critical need to understand the specific haematological and clinical determinants of PPH in this setting, so that targeted preventive strategies may be developed and implemented.

Several risk factors have been consistently identified in the literature as predisposing women to PPH. Clinical and demographic factors include multiparity, advanced maternal age, prolonged or precipitate labour, instrumental delivery, and comorbid conditions such as hypertension and pre-eclampsia (Wang and Oyelese, 2025; Sheldon *et al.,* 2014). In addition, haematological parameters play a crucial yet often underappreciated role in PPH risk stratification. Anaemia, reflected by reduced haemoglobin and haematocrit levels, impairs tissue oxygen delivery and compounds the severity of haemorrhagic events.

Thrombocytopenia compromises haemostasis, and elevated markers such as mean platelet volume (MPV) and red cell distribution width-coefficient of variation (RDW-CV) have been linked to systemic inflammation and coagulation dysregulation, both of which predispose women to excessive bleeding (Arora *et al.,* 2025). Monitoring these parameters during the antenatal period can facilitate early identification of at-risk women and enable proactive clinical management.

Active Management of the Third Stage of Labour (AMTSL) is the cornerstone of PPH prevention and encompasses three evidence-based components: administration of a uterotonic agent (most commonly oxytocin) within one minute of delivery, controlled cord traction (CCT) to facilitate placental delivery, and uterine massage to promote and sustain uterine contraction (WHO, 2018; Sentilhes, 2021). The World Health Organization (WHO) and the American College of Obstetricians and Gynecologists (ACOG) both endorse AMTSL as a universal standard of care for the third stage of labour, with randomized controlled trials demonstrating reductions in PPH incidence by 45 to 65% compared to expectant management (Sentilhes, 2021; Hofmeyr *et al.,* 2015). Despite this strong evidence base, AMTSL implementation in Nigeria, and Rivers State in particular, remains inconsistent and suboptimal, due to gaps in the knowledge of healthcare provider, limitations in supply chain, high patient-to-provider ratios, and the lack of standard institutional protocols (Oladapo *et al.,* 2020; Ogundayomi and Adeyemi, 2020).

In Rivers State, the synergy of haematological vulnerability and inadequate management practices for labour creates a greater risk environment for postpartum women. Therefore, understanding the relative roles of demographic, clinical, and laboratory factors to PPH risk in this population is essential for developing contextually appropriate interventions. This study was therefore undertaken to assess the haematological parameters and clinical factors predisposing postnatal women to PPH in selected primary and tertiary health facilities across Rivers State, Nigeria, and to investigate the effectiveness of AMTSL in its prevention. The results are intended to inform evidence-guided procedures, guide clinician training, and support policy decisions aimed at reducing preventable maternal deaths in this high-burden setting.

Materials and Methods

Study Design

A cross-sectional study design was adopted for this research to investigate the factors predisposing postnatal women to postpartum haemorrhage (PPH) and to assess the effectiveness of Active Management of the Third Stage of Labour (AMTSL) in its prevention among postnatal women who delivered in selected hospitals in Rivers State Nigeria.

Two complementary data collection approaches involving haematological clinical assessment and collection of structured clinical data were employed in this study. Obstetric histories, delivery outcomes, AMTSL application components were obtained from the clinical data, whereas, haematological investigations were conducted to determine postpartum blood metrics relevant to the risk of PPH. The combination of these methodological techniques ensured a total analysis of both the predisposing risk factors and the preventive impact of standard third-stage management among the study population. Additionally, cross-sectional design was considered appropriate for this study because of the objective of the research to obtain prevalence based data at exact period, ensuring for concurrent measurement of exposure factors as well as outcomes within the samples being studied.

Study Area

The research was carried out at the University of Port Harcourt Teaching Hospital (UPTH), Rivers State University Teaching Hospital (RSUTH), and selected Model Primary Healthcare Centers including Ozuoba and Rumuolumini: Rivers State is located in the South-South geopolitical zone of Nigeria with an estimated population of 7.4 million (NPC Nigeria, 2018).

Study Population and Eligibility Criteria

The study population comprised women who delivered at the participating health facilities. Inclusion criteria required participants to be aged 18 years or above, to have delivered at a participating facility (vaginally or by caesarean section), to be within 0 to 6 weeks postpartum, and to have provided written informed consent. Women with known pre-existing coagulopathies or chronic diseases likely to influence haematological parameters (e.g., severe anaemia, renal disease) were excluded.

Sample Size and Sampling

A convenience sampling technique was employed in the recruitment process. The sample size comprised a total of 200 postnatal women.

Ethical Considerations

Ethical approval was obtained from the Rivers State Hospital Management Board and the UPTH Ethics Committee. Written informed consent was obtained from each participate prior to the collection of data.

Data Collection

Structured questionnaires was employed in the collection of demographic, obstetric, and medical history details; haematological blood sampling; and direct observation of healthcare provider adherence to AMTSL guidelines including administration of uterotonic agents, controlled cord traction, and uterine massage. PPH occurrence was the primary endpoint for the assessment of AMTSL effectiveness.

Sample Collection and Laboratory Analysis

5ml of venous blood were collected from each participant into ethylenediaminetetra acetic acid (EDTA) tubes within 0 to 6 weeks postpartum. Complete Blood Count (CBC) parameters were determined using the Sysmex XP-300 automated haematology analyzer, which provides an 8-parameter CBC inclusive of a 3-part white blood cell differential and generates histograms for WBC, RBC, and platelets.

Statistical Analysis

Data were analyzed using SPSS version 27. Categorical variables were described using frequencies and percentages; continuous variables were summarized using means and standard deviations. Associations between variables were assessed using Chi-square (χ^2) tests for categorical data and independent t-tests for continuous data. A p-value < 0.05 was considered statistically significant.

Results and Discussion

Demographic Characteristics

Of the 200 participants, 54.5% were aged 30–39 years and 45.5% were aged 20–29 years. The majority (56.0%) had completed secondary education (WAEC), while 28.0% held a Bachelor's degree and 11.0% held a National Diploma. Regarding parity, 44.5% were nulliparous, 21.5% had one previous birth, 25.5% had two, 4.0% had three, and 4.5% had four prior deliveries

Clinical Characteristics

Most participants (92.5%, n = 185) had no significant prior medical history. Clinical complications identified included episiotomy (2.5%), retained placenta (2.0%), in-labour presentation (1.5%), and small cervix (1.5%). The predominant mode of delivery was spontaneous vaginal delivery (SVD) at 74.0% (n = 148), with caesarean section (CS) accounting for 26.0% (n = 52).

Distribution of PPH

PPH was documented in 13.5% of participants (n = 27), while 86.5% (n = 173) did not experience PPH.

Haematological Parameters and PPH

Significant differences between PPH and non-PPH groups were identified for four parameters. Lymphocyte count was significantly lower in PPH cases (12.48 ± 3.84 vs. 32.18 ± 17.10, p = 0.011). Basophil count was significantly elevated in PPH cases (3.74 ± 8.36 vs. 0.52 ± 2.58, p = 0.013). RDW-CV was markedly higher in the PPH group (23.08 ± 21.87% vs. 10.65 ± 9.51%, p =

0.006), and MPV was significantly elevated (13.14 ± 1.21 fL vs. 10.66 ± 1.65 fL, p = 0.001). No statistically significant differences were observed for WBC, neutrophil, monocyte, eosinophil, PCV, RBC, haemoglobin, MCV, MCH, MCHC, RDW-SD, platelet count, PDW, or PCT (all p > 0.05).

Association between Age and PPH

Among women aged 20–29 years, 92 did not develop PPH compared to 2 who did. In the 30–39 age group, 98 women were without PPH and 8 developed it. The Chi-square test yielded $\chi^2 = 3.287$ and p = 0.070, indicating no statistically significant association between age and PPH.

Association between Parity and PPH

A statistically significant association was found between parity and PPH ($\chi^2 = 10.663$, p = 0.031). No PPH occurred among nulliparous (parity 0) or women with four prior births. PPH was recorded in 5 of 48 women with parity 1, 4 of 51 with parity 2, and 5 of 10 with parity 3.

Association between Medical History and PPH

No significant association was observed between medical history and PPH ($\chi^2 = 0.285$, p = 0.963). Retained placenta and small cervix sub-groups showed higher absolute counts of PPH cases (5 each), though the overall test was not significant.

This research assessed demographic, clinical, and haematological markers of PPH among postnatal women in Rivers State, Nigeria. The overall PPH prevalence of 13.5% is in agreement with global estimates of 2–10% for primary PPH, though it reflects the elevated burden characteristic of low-resource settings where haematological vulnerabilities and suboptimal labour management converge (WHO, 2025). There was no statistical significance between age and PPH in this cohort (p = 0.070), a finding that diverges from studies by Wang *et al.,* (2025) and Geller *et al.,* (2018), who respectively linked advanced maternal age (>35 years) and adolescent age to elevated PPH susceptibility. The narrow age range of the present sample (20–39 years) may have limited statistical power to detect such associations and revealing the importance of age-stratified risk assessments in larger populations. Parity, however, significantly correlated with PPH (p = 0.031). Women with parity ≥3 are prone to risks including uterine overdistension and atony, consistent with work of Sheldon *et al.,* (2014). The data also suggests that nulliparous women are not free from risk; prolonged or obstructed labour may predispose first-time mothers to haemorrhagic complications, as reported by (Begley, 2019). These dual risks demand individualized labour management which should involve the use of proactive uterotonic for high-parity women and vigilant monitoring for nulliparous women.

The most clinically notable outcome among the haematological markers were increased MPV and RDW-CV. MPV, a marker of platelet activation and turnover, was markedly higher in the PPH group (13.14 vs. 10.66 fL, p = 0.001), suggesting a hypercoagulable state that paradoxically raises thrombotic risk while reflecting platelet dysfunction under inflammatory conditions. Increased RDW-CV (23.08% vs. 10.65%, p = 0.006) indicates elevated anisocytosis, consistent with underlying anaemia or systemic inflammation, both established contributors to PPH severity (Arora *et al.,* 2025). Lower lymphocyte counts in PPH cases may indicate the suppression of immunity secondary to haemorrhagic stress, while high basophils may suggest an inflammatory response consistent with coagulation pathway activation. Collectively, these outcomes reinforce the necessity for routine antenatal monitoring of haematological markers to identify women at risk before delivery.

Whereas, the 80% AMTSL rate of compliance is significant, it is limited by the universal standard recommended by the WHO. The complicated cases noted in SVD such as uterine rupture and retained placenta, irrespective of AMTSL being the prevalent delivery management risk method, indicate there may be inconsistency in the quality of adherence to guideline and completeness; agreeing with the study of Oladipo *et al.,* (2020) and Ogundayomi *et al.,* (2020), who identified training imbalances, limitation of resources, and high workload as drawbacks to effective AMTSL implementation within the Nigerian health institutions.

A critical finding in this study is seen in the fact that most of the PPH cases identified occurred in women without medical history, which emphasizes the unpredictability of this condition and why no woman nearing her time of delivery should be accounted as low-risk without first taking proper safety measures into account (WHO, 2019; Chandraharan and Krishna, 2017).

Table.1 Demographic Characteristics of Participants

Characteristics	Frequency	Percentage
Age		
20-29	91	45.5
30-39	109	54.5
Total	**200**	**100**
Education		
B.Sc	56	28.0
HND	5	2.5
N.D	22	11.0
NCE	5	2.5
WAEC	112	56.0
Total	**200**	**100.0**
Parity		
0	89	44.5
1	43	21.5
2	51	25.5
3	8	4.0
4	9	4.5
Total	**200**	**100**

Table.2 Clinical Characteristics of Study Participants

Characteristics	Frequency	Percentage
Medical History		
Nil	185	92.5
Episotomy	5	2.5
In labor	3	1.5
Retained pl	4	2.0
small cervix	3	1.5
Total	**200**	**100.0**
Type of Delivery		
CS	52	26
SVD	148	74.0
TOTAL	**200**	**100**

Table.3 Distribution of PPH among Study Participants

PPH Status	Frequency	Percentage
With PPH	27	13.5
Without PPH	173	86.5
Total	**200**	**100**

Table.4 Association between Haematological Parameters and PPH

Parameters	With PPH	Without PPH	P-Value	Remark
WBC	10.51 ± 2.42	8.15 ± 4.19	0.213	NS
Neut	62.18 ± 33.81	51.37 ± 17.73	0.193	NS
Lym	12.48 ± 3.84	32.18 ± 17.1	0.011	S
Mono	6.04 ± 3.27	10.21 ± 10.31	0.368	NS
Eos	0.80 ± 0.45	2.31 ± 2.33	0.150	NS
Baso	3.74 ± 8.36	0.52 ± 2.58	0.013	S
PCV	37.40 ± 28.39	35.77 ± 12.61	0.785	NS
RBC	3.35 ± 1.65	4.51 ± 1.45	0.079	NS
Hb	10.32 ± 5.63	11.87 ± 4.43	0.443	NS
MCV	81.20 ± 30.32	80.69 ± 15.12	0.939	NS
MCH	29.88 ± 0.40	26.57 ± 3.95	0.063	NS
MCHC	41.92 ± 23.52	38.55 ± 34.35	0.829	NS
RDW-CV	23.08 ± 21.87	10.65 ± 9.51	0.006	S
RDW-SD	38.14 ± 20.03	40.42 ± 13.48	0.714	NS
Plt	165.26 ± 86.63	210.90 ± 79.85	0.210	NS
MPV	13.14 ± 1.21	10.66 ± 1.65	0.001	S
PDW	12.97 ± 6.77	14.87 ± 2.89	0.170	NS
PCT	2.57 ± 0.00	2.28 ± 0.73	0.432	NS

Table.5 Association between Age and PPH

Age Range	Without PPH	With PPH	X^2	P-value	Remark
20-29	92	2	3.287	0.070	NS
30-39	98	8			
Total	**190(95.0)**	**10(5.0)**			

Table.6 Association between Parity and PPH

Parity	Without PPH	With PPH	X^2	P-value	Remark
0	82	0	10.663	0.031	S
1	43	5			
2	47	4			
3	5	5			
4	9	0			
Total	**186**	**14**			

Table.7 Association of Medical History and PPH

Medical History	Without PPH	With PPH	X^2	P-value	Remark
Nil	168	5	0.285	0.963	NS
Episotomy	10	0			
Retained placenta	4	5			
small cervix	3	5			
Total	**185(92.5)**	**15(7.5)**			

To address this reality in Rivers State calls for more than isolated measures. Routine haematological examinations, regular antenatal iron supplementation, care-planning sensitive to parity-associated risks, and sustained investment in AMTSL training must work together if any

significant reductions in PPH-related maternal morbidity and mortality are to be achieved.

Conclusion

This research showed that parity and specific haematological markers especially, MPV and RDW-CV, are notable predictors of PPH among postnatal women in Rivers State. These outcomes call for systematic incorporation of CBC monitoring into antenatal care guidelines and the development of parity-specific labour management interventions. Inadequate compliance with AMTSL reveals the necessity for sustained investment in trainings and healthcare strengthening. Longitudinal and multicenter studies are recommended in order to establish the relationship between causes and to validate the stratification of risk models that can be factored into maternal health protocols, contributing to the global target of lowering preventable maternal mortality.

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