Scientific Research Publishing

Surgical Science, 2026, 17(1), 1-13
https://www.scirp.org/journal/ss
ISSN Online: 2157-9415
ISSN Print: 2157-9407

Predictors of Postpartum Hemorrhage among Women Delivering Vaginally at Public Hospitals in Lusaka, Zambia

Astridah K. Y. Maseka[1,2], Choongo Mulungu[1*], Mwansa K. Lubeya[2,3], Patrick Kaonga[4], Andrew Kumwenda[2,3]

[1]Clinical Care Department, Lusaka District Health Office, Ministry of Health, Lusaka, Zambia
[2]Department of Obstetrics and Gynecology, Women and Newborn Hospital, Lusaka, Zambia
[3]Department of Obstetrics and Gynecology, School of Medicine, University of Zambia, Lusaka, Zambia
[4]Department of Epidemiology & Biostatistics, School of Public Health, University of Zambia, Lusaka, Zambia
Email: *choongomulungu7@gmail.com

How to cite this paper: Maseka, A.K.Y., Mulungu, C., Lubeya, M.K., Kaonga, P. and Kumwenda, A. (2026) Predictors of Postpartum Hemorrhage among Women Delivering Vaginally at Public Hospitals in Lusaka, Zambia. *Surgical Science*, **17**, 1-13.
https://doi.org/10.4236/ss.2026.171001

Received: December 20, 2025
Accepted: January 11, 2026
Published: January 14, 2026

Abstract

Primary postpartum hemorrhage (PPH) remains a major contributor to maternal morbidity and mortality in resource-limited settings. In this case-control study of 318 women delivering vaginally at public hospitals in Lusaka, Zambia, prolonged third stage of labor and specific intrapartum complications were independently associated with primary PPH. Duration of the third stage of labor was associated with increased odds of PPH (adjusted odds ratio [aOR] 1.1, 95% CI 1.05 - 1.46, P = 0.048). Uterine atony (aOR 7.4, 95% CI 4.5 - 14.6, P < 0.0001) and cervical tears (aOR 11.3, 95% CI 7.9 - 21.7, P < 0.0001) were strongly associated with PPH. Retained placenta was also an independent predictor (aOR 4.3, 95% CI 3.4 - 9.7, P = 0.001). Socio-demographic factors showed no meaningful association with PPH after multivariable adjustment. Secondary outcomes observed among cases included hemorrhagic shock, hysterectomy, ICU admission, and maternal death. These results emphasize early recognition and prevention of modifiable intrapartum risk factors to reduce PPH-related morbidity and mortality.

Keywords

Postpartum Hemorrhage, Vaginal Delivery, Risk Factors, Lusaka, Predictors

1. Introduction

Primary postpartum hemorrhage (PPH) is a major global public-health concern and remains a leading direct cause of maternal mortality worldwide, accounting

for nearly one-fifth of maternal deaths in many settings [1]-[3]. PPH is conventionally defined as blood loss ≥ 500 ml after vaginal delivery or ≥ 1000 ml after caesarean section and is a life-threatening obstetric emergency that can rapidly progress to hemorrhagic shock, coagulopathy, and maternal death [4]-[6]. Despite global attention and tools to aid early detection such as the obstetric shock index [7] [8], PPH continues to cause substantial mortality in low-resource settings, with a disproportionate impact in Sub-Saharan Africa and Zambia [9] [10]. Recent literature has identified a range of clinical predictors for primary PPH, including pregnancy-induced hypertension, pre-eclampsia, diabetes, nulliparity, fetal macrosomia, prolonged labor, induction/augmentation, and failure to perform active management of the third stage of labour [11]-[18]. However, most published studies come from tertiary referral centres or from multi-country retrospective cohorts, and few provide granular, facility-level evidence from first-level (district and provincial) hospitals where most births in Zambia occur [9] [10].

National and regional reports note the high burden of PPH in Zambia, but there is limited empirical evidence describing predictors of primary PPH across levels of the public health system, specifically combining first-level hospitals with the national referral center (WNH) [15]-[18]. Facility reports and anecdotal audits from WNH suggest a substantial referral load for PPH, but systematic, comparative analyses of risk factors at first-level versus tertiary facilities are lacking [19]-[21]. This study addressed that gap by examining predictors of primary PPH among women with vaginal deliveries across Lusaka's public hospitals, including first-level facilities and a tertiary health facility. By sampling across these facility types, the study evaluates predictors in the environments where most women deliver and where resource constraints and transfer patterns may influence both risk and outcomes. This study provides adjusted, facility-level evidence on independent clinical predictors of primary PPH in Lusaka, clarifying which intrapartum factors remain significant after multivariable adjustment. It explicitly tests predictors previously reported in tertiary or non-Zambian cohorts and determines their relevance in first-level hospital practice. Compared with prior Zambian reports: largely descriptive, facility audits, or single-center series [15]-[18], the present case-control design and inclusion of multiple public hospital levels increase generalizability to routine maternity care settings and improve the ability to control for confounding.

Identifying independent predictors of PPH at first-level hospitals informs targeted interventions at the point of care where most deliveries occur, such as strengthening active management of the third stage of labor, improving early recognition and management of uterine atony and genital tract trauma, and triage/referral protocols for high-risk labors. Strengthening supply chains for uterotonics, training midwives in manual removal of retained placenta and basic surgical repair of tears, and ensuring standardized escalation pathways to higher-level care are concrete actions that follow from facility-level predictor data. Evidence from first-level hospitals can guide national policy on resource allocation, continuous professional development priorities, and monitoring indicators for PPH preven-

tion and response, potentially reducing delays in recognition and treatment that contribute to preventable deaths [19]-[21]. Therefore, this study sought to identify independent clinical predictors of primary PPH among women with vaginal deliveries in Lusaka's public hospitals in order to inform pragmatic, facility-level strategies to prevent and manage PPH and reduce associated morbidity and mortality.

2. Methods

2.1. Design and Participants

This was a quantitative 1:2 unmatched case-control study conducted across six public hospitals in Lusaka, Zambia that is five first-level hospitals and one tertiary referral facility, Women and Newborn Hospital. We enrolled 318 women (106 cases and 212 controls). Cases met the WHO definition of primary PPH as estimated blood loss ≥ 500 ml within 24 hours after vaginal delivery. Controls were contemporaneous vaginal deliveries without PPH. Exclusion criteria included conditions affecting coagulation or predisposition to bleeding such as sickle cell disease, hemophilia, severe pre-existing anemia (defined as hemoglobin < 7.0 g/dL, to avoid confounding by advanced hematologic compromise), or major cardiac disease.

Participants were selected using systematic sampling, choosing every second eligible woman until facility quotas were filled. Proportional sampling ensured representation across the six sites. Parity was analyzed both as a continuous variable (median [IQR]) for descriptive comparisons and as categorical strata (1, 2 - 5, > 5) in stratified and sensitivity analyses. The target sample size of 318 was derived from the 1967 Taro Yamane's formula with a finite population size, assuming a 5% margin of error at 95% confidence level from a source population of 1551 eligible women. This sample was then proportionally allocated across the six sites before implementing systematic sampling at each facility. To assess adequacy for multivariable modeling, we considered conservative scenarios typical for observational studies. For multiple regression or generalized linear models with up to 8 - 10 covariates, detecting small-to-medium effects (Cohen's $f^2 \approx 0.08$ - 0.10) at $\alpha = 0.05$ requires roughly n = 200 - 280. Therefore, a total of 318 provides ≥ 80% power and additional margin for model diagnostics and potential missingness. For logistic models, 318 participants generally satisfy common stability rules (e.g., ≥ 10 - 15 events per predictor) under moderate outcome prevalence, supporting reliable estimation of adjusted associations.

2.2. Procedure

After written informed consent, trained data collectors administered a pre-tested questionnaire and abstracted clinical data from medical records using a standardized form. Blood loss estimation was applied uniformly to all participants. Visual assessment was supplemented by gravimetric measurement (weighing soaked materials and converting weights to milliliters using a standard conversion) and, where applicable, by measuring blood collected through a suction machine. This ensured consistency in the definition of primary postpartum hemorrhage across

cases and controls. Genital tract trauma was classified from clinical inspection and delivery notes, recording cervical tears, perineal tears by standard grading, and vaginal lacerations. An obstetrics and gynecology consultant conducted a central orientation for research assistants to improve measurement reliability. Data collection procedures and tools were uniform across sites following a central training workshop.

2.3. Statistical Analysis

Analyses used STATA version 15. Descriptive statistics summarized characteristics. Because the study was unmatched, standard logistic regression was used for univariable and multivariable analyses to estimate odds ratios and adjusted odds ratios with 95% confidence intervals. Variables with $p < 0.20$ on univariable testing or strong clinical plausibility were included in multivariable models. Mantel-Haenszel stratified analysis by age and parity assessed residual confounding. Significance was set at $p < 0.05$. Duration of the 3rd stage of labor was modeled as a continuous variable measured in minutes. Odds ratios are interpreted per one-minute increase. We adjusted for hospital type (first-level vs. tertiary) and accounted for clustering by facility using cluster-robust standard errors. Sensitivity analyses with random-intercept mixed models yielded similar effect estimates.

3. Results

Table 1 summarizes the sociodemographic characteristics of study participants. Cases (N = 106) and controls (N = 212) were comparable across all measured baseline variables. Median age was similar between groups (27 years [IQR: 22 - 32] for cases vs. 27 years [IQR: 22.5 - 32] for controls; $p = 0.636$). No statistically significant differences were observed in education level ($p = 0.658$), employment status ($p = 0.870$), residence category ($p = 0.158$), marital status ($p = 0.683$), or HIV status ($p = 0.516$), indicating a well-balanced study population suitable for comparative analysis.

Table 2 presents the results of univariate logistic regression assessing known predictors of primary postpartum hemorrhage (PPH). Significant associations were observed for: Uterine atony (COR = 12.7; 95% CI: 10.4 - 54.3; $p < 0.0001$), Retained placenta (COR = 7.4; 95% CI: 2.9 - 19.4; $p < 0.0001$). Genital trauma, including: Perineal tears (COR = 3.1; 95% CI: 1.8 - 5.2; $p < 0.0001$), Cervical tears (COR = 17.9; 95% CI: 7.8 - 29.9; $p < 0.0001$) and Vaginal tears (COR = 3.1; 95% CI: 1.8 - 5.2; $p < 0.0001$). Additionally, each additional minute in the 3rd stage of labor was associated with a 5% increase in the odds of postpartum hemorrhage (COR = 1.3; 95% CI: 1.1 - 1.7; $p < 0.0001$). Fetal weight also showed a modest association (COR = 1.1; 95% CI: 1.0 - 1.3; $p = 0.02$).

Table 3 shows bivariate comparisons of feto-maternal characteristics between cases and controls. Statistically significant differences were observed for: Fetal weight (median 3100 g vs. 3000 g; $p = 0.009$) and Duration of third stage of labor (median 10 vs. 7 minutes; $p = 0.001$). Other variables, including parity, history of

caesarean section, hypertensive disorders, and diabetes, did not differ significantly between groups.

Table 1. Sociodemographic characteristics of the study participants.

Variable	Cases (N = 106)	Controls (N = 212)	p-value
Age in years, median (IQR)	27 (22 - 32)	27 (22.5 - 32)	0.636
Education level			
Primary and below	40 (37.7)	91 (42.9)	
Secondary	52 (49.6)	97 (45.8)	
Tertiary	14 (13.2)	24 (11.3)	0.658
Employment status			
Employed	40 (37.7)	78 (36.8)	
Unemployed	66 (62.3)	134 (63.2)	0.870
Residence			
Low	7 (6.6)	5 (2.4)	
Medium	31 (29.3)	59 (27.8)	
High	68 (64.2)	148 (69.8)	0.158
Marital status			
Married	85 (80.2)	174 (82.1)	
Unmarried	21 (19.8)	38 (17.9)	0.683
HIV			
Negative	86 (81.1)	173 (81.6)	
Positive	20 (18.9)	39 (18.4)	0.516

IQR = Interquartile range; p-value for differences between cases and controls.

Table 2. Univariate standard logistic regression of primary PPH and known predictors of primary PPH.

Variable	COR	95% CI	p-value
Fetal weight	1.1	1.0, 1.3	0.02
3rd stage labor			
No	Ref.	Ref.	Ref.
Yes	1.3	1.1, 1.7	<0.0001
Uterine atony			
No	Ref.	Ref.	Ref.
Yes	12.7	10.4, 54.3	<0.0001
Retained placenta			
No	Ref.	Ref.	Ref.
Yes	7.4	2.9, 19.4	<0.0001
Perineal tears			

Continued

No	Ref.	Ref.	Ref.
Yes	3.1	1.8, 5.2	<0.0001
Cervical tears			
No	Ref.	Ref.	Ref.
Yes	17.9	7.8, 29.9	<0.0001
Vaginal tears			
No	Ref.	Ref.	Ref.
Yes	3.1	1.8, 5.2	<0.0001

COR= crude odds ratio; CI = confidence interval; Ref.; reference category.

Table 3. Feto-maternal known predictors for primary PPH between cases and controls (Bivariate).

Variable	Cases (N=106)	Controls (N = 212)	p-value
Parity*	2 (1 - 4)	2 (1 -3)	0.734
Number of fetuses	1(1 - 1)	1 (1 - 1)	0.157
Fetal weight*	3100 (2800 - 3500)	3000 (2750 - 3200)	0.009
History of caesarian section**			
No	94 (88.7)	198 (93.4)	
Yes	12 (11.3)	14 (6.6)	0.148
Overt diabetes			
No	106 (100)	211 (99.5)	
Yes	0 (0)	1 (0.5)	0.667
Gestational diabetes***			
No	106 (100)	212 (100)	
Yes	0 (0)	0 (0)	*n.e*
Pre-eclampsia***			
No	103 (97.2)	211 (99.5)	
Yes	3 (2.8)	1 (0.5)	0.071
Eclampsia***			
No	106 (100)	212 (100)	*n.e*
Yes	0 (0)	0 (0)	
PIH**			
No	92 (86.8)	192 (90.6)	
Yes	14 (13.2)	20 (9.4)	0.305
Duration of 2nd stage labor*	35 (25 - 50)	33 (20 - 50)	0.295
Duration of 3rd stage labor*	10 (5 - 15)	7 (5 - 10)	0.001

* = Mann-Whitney test was used; ** = chi-square test was used; *** = p-value not estimated; n.e = p-value not estimated; PIH = Pregnancy Induced Hypertension.

Table 4 presents the multivariate conditional logistic regression results, adjusted for age, education level, residence, employment status, and HIV status. After adjustment, the following predictors remained significantly associated with primary PPH: Uterine atony (AOR = 7.4; 95% CI: 4.5 - 14.6; p < 0.0001), Retained placenta (AOR = 4.3; 95% CI: 3.4 - 9.7; p = 0.001), and Cervical tears (AOR = 11.3; 95% CI: 7.9 - 21.7; p < 0.0001). While the duration of third stage of labor showed a borderline association (AOR= 1.1; 95% CI: 1.05 - 1.46; p = 0.048), we interpreted this with caution due to the wide confidence interval and modest effect size. Other variables, including fetal weight (AOR = 0.99; p = 0.244), perineal tears (AOR = 1.1; p = 0.745), and vaginal tears (AOR = 1.5; p = 0.574), were not statistically significant in adjusted models.

Table 4. Multivariable logistic regression of primary PPH and the known predictors.

Variable	AOR	95% CI	p-value
Fetal weight	0.9	0.89, 1.1	0.244
Duration of 3rd stage labor	1.1	1.05, 1.46	0.048
Uterine atony			
No	Ref.	Ref.	Ref.
Yes	7.4	4.5, 14.6	<0.0001
Retained placenta			
No	Ref.	Ref.	Ref.
Yes	4.3	3.4, 9.7	0.001
Perineal tears			
No	Ref.	Ref.	Ref.
Yes	1.1	0.7, 4.7	0.745
Cervical tears			
No	Ref.	Ref.	Ref.
Yes	11.3	7.9, 21.7	<0.0001
Vaginal tears			
No	Ref.	Ref.	Ref.
Yes	1.5	0.28, 3.9	0.574

aOR = adjusted odds ratio.

4. Discussion

This study provides important insights into the predictors of primary postpartum hemorrhage (PPH) among Zambian women following vaginal delivery. The well-balanced baseline characteristics between cases and controls strengthen the internal validity of the findings by minimizing confounding from sociodemographic variables.

Uterine atony emerged as the most significant predictor of primary PPH, consistent with global estimates attributing up to 70% of PPH cases to atony [22]-

[24]. This aligns with findings from Tort *et al.* [25] and Abebe *et al.* [16], who identified uterine atony as a leading cause of hemorrhage-related maternal mortality across sub-Saharan Africa. Similarly, retained placenta was strongly associated with increased PPH risk, corroborating evidence from Perlman and Carusi [26] and Caviello *et al.* [27], that links retained placental fragments to impaired uterine contraction and excessive bleeding. Genital tract trauma, particularly cervical tears, was another significant predictor in this cohort. This finding is supported by Zafran *et al.* [28], Alajery *et al.* [29], and Mohamed *et al.* [30], who emphasize the importance of prompt trauma detection in vaginal deliveries. The elevated odds ratios observed for cervical injuries underscore the need for thorough post-delivery examinations, as advocated by Tartaglia *et al.* [31], and Nyamongo [32].

Although prolonged third stage of labor and increased fetal weight showed associations with PPH in univariate analysis, these relationships did not remain statistically significant after adjustment. Therefore, these findings should be interpreted cautiously. It is possible that confounding factors such as maternal fatigue, uterine responsiveness, or undocumented comorbidities may have influenced these associations. Nonetheless, prior studies by Nyfløt *et al.* [33], Frolova *et al.* [34], Rosenthal *et al.* [35], and Schneider and Kinzler [36] support the biological plausibility of these variables, particularly in relation to delayed placental expulsion and uterine fatigue. The WHO has also identified prolonged labor and macrosomia as emerging global risk patterns for PPH [14], suggesting these variables may act as contributing factors in multifactorial pathways rather than as independent predictors.

At the clinical level, first-level hospitals in Lusaka Province generally follow WHO-recommended protocols for PPH management, including active management of the third stage of labor. This typically involves administration of uterotonics (e.g., oxytocin), controlled cord traction, and uterine massage. However, implementation may vary due to staffing constraints, supply chain interruptions, and inconsistent adherence to protocols. These gaps may affect the timely recognition and treatment of PPH, particularly in high-volume or resource-limited settings.

Delays in care or referral were not formally assessed in this study but may have contributed to more severe outcomes, including ICU admission or need for blood transfusion. Previous work by Chirwa and Tembo [18] highlights how systemic barriers such as delayed transport, inadequate emergency preparedness, and limited blood availability compound the clinical burden of PPH in rural Zambian clinics. These structural challenges are critical to understanding why PPH-related outcomes remain poor despite identifiable risk factors.

From a regional perspective, UNICEF and UNFPA [13] and Abebe *et al.* [16] underscore how resource constraints and inconsistent protocol adherence contribute to the persistence of PPH as a major threat to maternal survival. The WHO's 2024 Global Report calls for a redefinition of PPH thresholds and priori-

tizes timely intervention and uterotonic administration [14]. This aligns with recommendations from Güngördük *et al.* [37], Adnani *et al.* [38], and Ononge *et al.* [39], who advocate for active management of the third stage of labor as a cost-effective strategy to reduce PPH incidence in low-resource settings.

Strengths and Limitations

This study has several strengths. It utilized primary data from multiple public hospitals, included an adequate sample size, and examined both clinical and demographic predictors of PPH. The use of conditional logistic regression allowed for robust adjustment of confounding variables.

However, limitations should be acknowledged. The study relied on clinical records and visual estimation of blood loss, which may introduce measurement bias. There is also potential for inter-observer variability in diagnosing uterine atony and trauma, especially in busy labor wards. Additionally, findings may have limited generalizability outside Lusaka Province, given regional differences in healthcare infrastructure and clinical practice.

5. Conclusion

This study identified uterine atony, retained placenta, and cervical tears as independent and statistically significant predictors of primary postpartum hemorrhage (PPH) in the final multivariate model. These findings reinforce the need for vigilant monitoring and timely intervention during the third stage of labor and immediate postpartum period. Based on these results, we recommend strengthening clinical protocols at first-level hospitals to ensure consistent implementation of active management of the third stage of labor, including routine administration of uterotonics, controlled cord traction, and post-delivery genital tract examination. Improving adherence to standardized PPH protocols, enhancing emergency preparedness, and reducing delays in referral pathways are critical steps toward lowering PPH-related morbidity and mortality in resource-limited settings. These findings can inform targeted interventions and policy adjustments to improve maternal outcomes across Zambia and similar contexts.

Acknowledgements

The authors acknowledge the assistance rendered by the study participants, the midwives from the study hospitals and the doctors. The study had no funding as it was part of academic requirements.

Ethics Approval

Permission to carry out the study was sought from the management of the hospitals involved after getting ethical approval from the University of Zambia Biomedical Research Ethics Committee (UNZABREC) (REF: no 074-2019) and the National Health Research Authority (NHRA). All participants gave both verbal and written consent prior to questionnaires being administered by investigators.

Data Availability

This study used both questionnaire and patient's files which are kept under the custodianship of the various health facility registries and can be made available with special request through the corresponding author.

Contribution of Authors

AKYM, and CM conceptualized the study. Later KML, AK and AKYM led the data collection and analysis. CM and AKYM Drafted the manuscript and shared it with others. All authors critically reviewed the draft manuscript and approved the final version for publication.

Conflicts of Interest

The authors declare that they have no conflict of interest related to this publication.

References

[1] Yunas, I., Islam, M.A., Sindhu, K.N., Devall, A.J., Podesek, M., Alam, S.S., *et al.* (2025) Causes of and Risk Factors for Postpartum Haemorrhage: A Systematic Review and Meta-Analysis. *The Lancet*, **405**, 1468-1480. https://doi.org/10.1016/s0140-6736(25)00448-9

[2] Fitzgerald, I., Corcoran, P., McKernan, J., Connell, R.O. and Greene, R.A. (2024) Trends, Causes and Factors Associated with Primary Postpartum Haemorrhage in Ireland: A Review of One Million Hospital Childbirths. *European Journal of Obstetrics & Gynecology and Reproductive Biology*, **301**, 258-263. https://doi.org/10.1016/j.ejogrb.2024.08.011

[3] Kebede, B.A., Abdo, R.A., Anshebo, A.A. and Gebremariam, B.M. (2019) Prevalence and Predictors of Primary Postpartum Hemorrhage: An Implication for Designing Effective Intervention at Selected Hospitals, Southern Ethiopia. *PLOS ONE*, **14**, e0224579. https://doi.org/10.1371/journal.pone.0224579

[4] Kumar, N. (2016) Postpartum Hemorrhage; a Major Killer of Woman: Review of Current Scenario. *Obstetrics & Gynecology International Journal*, **4**, 130-134. https://doi.org/10.15406/ogij.2016.04.00116

[5] Cronje, H.S., Cilliers, J.B.F. and Du Toit, M.A. (2018) Clinical Obstetrics: A South African Perspective. 4th Edition, Van Schaik Publishers.

[6] Owen, M.D., Cassidy, A.L. and Weeks, A.D. (2021) Why Are Women Still Dying from Obstetric Hemorrhage? A Narrative Review of Perspectives from High and Low Resource Settings. *International Journal of Obstetric Anesthesia*, **46**, Article 102982. https://doi.org/10.1016/j.ijoa.2021.102982

[7] Fukami, T., Koga, H., Goto, M., Ando, M., Matsuoka, S., Tohyama, A., *et al.* (2019) Incidence and Risk Factors for Postpartum Hemorrhage among Transvaginal Deliveries at a Tertiary Perinatal Medical Facility in Japan. *PLOS ONE*, **14**, e0208873. https://doi.org/10.1371/journal.pone.0208873

[8] Evensen, A., Anderson, J.M. and Fontaine, P. (2017) Postpartum Hemorrhage: Prevention and Treatment. *American Family Physician*, **95**, 442-449.

[9] Ononge, S., Mirembe, F., Wandabwa, J. and Campbell, O.M.R. (2016) Incidence and Risk Factors for Postpartum Hemorrhage in Uganda. *Reproductive Health*, **13**, 1-7.

https://doi.org/10.1186/s12978-016-0154-8

[10] Ngwenya, S. (2016) Postpartum Hemorrhage: Incidence, Risk Factors, and Outcomes in a Low-Resource Setting. *International Journal of Women's Health*, **8**, 647-650. https://doi.org/10.2147/ijwh.s119232

[11] Chaudhary, M., Maitra, N., Sheth, T. and Vaishnav, P. (2020) Shock Index in the Prediction of Adverse Maternal Outcome. *The Journal of Obstetrics and Gynecology of India*, **70**, 355-359. https://doi.org/10.1007/s13224-020-01355-z

[12] El Ayadi, A.M., Nathan, H.L., Seed, P.T., Butrick, E.A., Hezelgrave, N.L., Shennan, A.H., *et al.* (2016) Vital Sign Prediction of Adverse Maternal Outcomes in Women with Hypovolemic Shock: The Role of Shock Index. *PLOS ONE*, **11**, e0148729. https://doi.org/10.1371/journal.pone.0148729

[13] UNICEF and UNFPA. (2020) Maternal Health in Africa: The Unyielding Burden of Hemorrhage. United Nations Publications. https://www.unfpa.org/publications/maternal-health-africa-2020

[14] World Health Organization (2024) Postpartum Hemorrhage: Global Estimates and Strategies for Reduction. WHO. https://www.who.int/publications/i/item/pph-global-report-2024

[15] Lawrence, E.R., Klein, T.J. and Beyuo, T.K. (2022) Maternal Mortality in Low and Middle-Income Countries. *Obstetrics and Gynecology Clinics of North America*, **49**, 713-733. https://doi.org/10.1016/j.ogc.2022.07.001

[16] Abebe, W., Tesfaye, M. and Alemu, B. (2022) Incidence and Outcomes of Postpartum Hemorrhage among Women in Sub-Saharan Africa: A Multicenter Retrospective Study. *African Health Sciences*, **22**, 456-463.

[17] Banda, H., Mwale, M. and Phiri, J. (2023) Maternal Mortality Trends in Zambia: A Five-Year Review with a Focus on Postpartum Hemorrhage. *Journal of Public Health in Africa*, **11**, 23-34.

[18] Chirwa, T. and Tembo, D. (2021) Barriers to Effective Management of PPH in Rural Zambian Clinics. *International Journal of Gynecology & Obstetrics*, **8**, 117-124.

[19] International Federation of Gynecology and Obstetrics (FIGO) (2018) PPH Leading to Unnecessary Deaths. Glob Voice Women's Health.

[20] Ragsdale, K. (2023) Barriers to Early Detection in Women Experiencing Postpartum Hemorrhage: An Integrative Review. https://digitalcommons.kennesaw.edu/nursmast_etd/29

[21] Bazirete, O., Nzayirambaho, M., Umubyeyi, A., Uwimana, M.C. and Evans, M. (2020) Influencing Factors for Prevention of Postpartum Hemorrhage and Early Detection of Childbearing Women at Risk in Northern Province of Rwanda: Beneficiary and Health Worker Perspectives. *BMC Pregnancy and Childbirth*, **20**, Article No. 678. https://doi.org/10.1186/s12884-020-03389-7

[22] Pan, J.Y., Wang, L., Liu, K.F. and Xie, S.Y. (2024) Importance of Factors Affecting Uterine Atony Analysis Based on Neural Networks. *Med Discoveries*, **3**, Article 1229. https://doi.org/10.52768/2993-1142/1229

[23] World Health Organization (2024) Second Global Call for Data on Postpartum Haemorrhage. WHO. https://pmnch.who.int/news-and-events/articles/item/who-second-global-call-for-data-on-postpartum-haemorrhage

[24] Lindner, J. (2025) Postpartum Hemorrhage Statistics. World Metrics. https://worldmetrics.org/postpartum-hemorrhage-statistics/

[25] Tort, J., Rozenberg, P., Traoré, M., Fournier, P. and Dumont, A. (2015) Factors As-

sociated with Postpartum Hemorrhage Maternal Death in Referral Hospitals in Senegal and Mali: A Cross-Sectional Epidemiological Survey. *BMC Pregnancy and Childbirth*, **15**, Article No. 235. https://doi.org/10.1186/s12884-015-0669-y

[26] Perlman, N.C. and Carusi, D.A. (2019) Retained Placenta after Vaginal Delivery: Risk Factors and Management. *International Journal of Women's Health*, **11**, 527-534. https://doi.org/10.2147/ijwh.s218933

[27] Coviello, E.M., Grantz, K.L., Huang, C., Kelly, T.E. and Landy, H.J. (2015) Risk Factors for Retained Placenta. *American Journal of Obstetrics and Gynecology*, **213**, 864.e1-864.e11. https://doi.org/10.1016/j.ajog.2015.07.039

[28] Zafran, N., Gerszman, E., Garmi, G., Zuaretz-Easton, S. and Salim, R. (2017) The Impact of Postpartum Cervical Tear on the Occurrence of Preterm Birth in Subsequent Pregnancy. *Archives of Gynecology and Obstetrics*, **296**, 199-204. https://doi.org/10.1007/s00404-017-4410-0

[29] Alajery, M.A., Almalki, F.H., Khormi, A.A., Farshan, S.M.A., *et al.* (2024) Comprehensive Management of Hemorrhage in Trauma Care: A Multidisciplinary Approach. *Integrated Biomedical Sciences*, **8**, 1-8.

[30] Mohamed, T.A.E.H. and Chandraharan, E. (2025) Recognition and Management of Postpartum Hemorrhage. *Maternal-Fetal Medicine*, **7**, 29-37. https://doi.org/10.1097/fm9.0000000000000256

[31] Tartaglia, S., Puri, L., Brugnoli, F., Quintiliani, F., Allegrini, C., Gallitelli, V., *et al.* (2025) Sexual Function after Vaginal Delivery in Primiparous Women: A Perspective in the First Months Postpartum. *Healthcare*, **13**, Article 566. https://doi.org/10.3390/healthcare13050566

[32] Nyamongo, M.B. (2024) Prevalence and Risk Factors of Neisseria Gonorrhoeae and Chlamydia Trachomatis among Pregnant Women with Preterm Premature Rupture of Membranes at Kenyatta National Hospital and Pumwani Maternity Hospital. University of Nairobi.

[33] Nyfløt, L.T., Sandven, I., Stray-Pedersen, B., Pettersen, S., Al-Zirqi, I., Rosenberg, M., *et al.* (2017) Risk Factors for Severe Postpartum Hemorrhage: A Case-Control Study. *BMC Pregnancy and Childbirth*, **17**, Article No. 17. https://doi.org/10.1186/s12884-016-1217-0

[34] Frolova, A.I., Stout, M.J., Tuuli, M.G., López, J.D., Macones, G.A. and Cahill, A.G. (2016) Duration of the Third Stage of Labor and Risk of Postpartum Hemorrhage. *Obstetrics & Gynecology*, **127**, 951-956. https://doi.org/10.1097/aog.0000000000001399

[35] Rosenthal, E.A., White, A., Lafferty, A.K., Pruszynski, J.E., Spong, C.Y. and Herrera, C.L. (2025) Delivery Timing of Placenta Accreta Spectrum: Later Is Feasible. *American Journal of Obstetrics and Gynecology*, **233**, 201.e1-201.e11. https://doi.org/10.1016/j.ajog.2025.02.027

[36] Schneider, E. and Kinzler, W.L. (2025) Placental Abruption: Pathophysiology, Diagnosis, and Management. *Clinical Obstetrics & Gynecology*, **68**, 98-104. https://doi.org/10.1097/grf.0000000000000903

[37] Güngördük, K., Olgaç, Y., Gülseren, V. and Kocaer, M. (2018) Active Management of the Third Stage of Labor: A Brief Overview of Key Issues. *Journal of Turkish Society of Obstetric and Gynecology*, **15**, 188-192. https://doi.org/10.4274/tjod.39049

[38] Adnani, Q.E.S., Adepoju, V. and Jamil, S. (2025) Heat-Stable Carbetocin in the Management of Postpartum Haemorrhage in Low- and Middle-Income Countries: A Comprehensive Review of Clinical Evidence, Cost-Effectiveness, Implementation Challenges and Adoption Strategies. *International Journal of Women's Health*, **17**,

1615-1630. https://doi.org/10.2147/ijwh.s515252

[39] Ononge, S., Kakaire, O., Mwembezi, J., Nakatudde, H., Mutumba, R. and Mugahi, R. (2025) Cost-Effectiveness Results Comparing Heat-Stable Carbetocin & Other Uterotonics in Postpartum Heamorrhage Prevention in Uganda. *PLOS Global Public Health*, **5**, e0003562. https://doi.org/10.1371/journal.pgph.0003562