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Research article

Predictors of postpartum hemorrhage at public hospitals in Addis Ababa, Ethiopia: A case-control study

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ABSTRACT

Introduction: Postpartum hemorrhage (PPH) is responsible for half of all maternal deaths during childbirth. Despite being preventable and curable, PPH remains the leading cause of maternal death in Ethiopia. Therefore, the aim of this study was to identify the determinants of PPH among women delivered at public hospitals in Addis Ababa, Ethiopia, in 2022.

Methods: A facility-based, unmatched case control study with 378 study participants was carried out in selected public hospitals in Addis Ababa, Ethiopia. Women who gave birth and developed PPH were considered cases, while women who gave birth in public hospitals in Addis Ababa and did not develop PPH were controls. Binary and multivariable logistic regression analyses were used to identify independent predictors of PPH. Variables was considered statistically significant in the final model if their p-value was less than 0.05.

Results: The result of this study identified that antenatal care follow-up (AOR: 2.58; 95% CI: 1.12, 5.96), history of cesarean delivery (AOR: 3.47; 95% CI: 1.40, 8.58), prolonged labor (AOR: 5.14; CI: 2.07, 12.75), and genital trauma apart from episiotomy (AOR: 4.39; CI: 1.51, 12.81) were determinants of PPH.

Conclusion: According to the finding of this study duration of labor, history of cesarean section, antenatal care follow-up, and genital trauma other than episiotomy were independent determinants of PPH. Therefore, it is crucial to screen and closely monitor high-risk mothers during antepartum care visit, including those who have a history of cesarean delivery.

1. Introduction

Postpartum hemorrhage (PPH) is defined as blood loss higher than 1000 mL after a cesarean delivery or over 500 mL after a vaginal delivery, affecting approximately 5% of women giving birth globally [1]. PPH is the most common but unrecognized cause of maternal mortality in the majority of low-income countries [2]. Most deaths from PPH happen within the first 24 h following delivery due to the uterus' failure to contract after giving birth [3,4].

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PPH is the leading cause of death during pregnancy and delivery, affecting over 8.7 million women annually and leading to 44,000–86,000 deaths [5,6]. Despite being preventable and frequently treatable, PPH is still the primary cause of maternal death in developing countries, contributing to 25–43% of maternal mortality [7]. PPH prevalence varies worldwide, from 7.2% in Oceania to 25.7% in Africa [8]. According to a World Health Organization report, complications associated with pregnancy and delivery are responsible for the deaths of 275,000 women annually [9,10].

Ethiopia exhibits one of the highest rates of maternal mortality, with PPH being the main cause of direct maternal death and nearly all deaths coming from obstetric complications [11]. The incidence of PPH in Ethiopia has been estimated to be 1.4–9.7% [12]. PPH can occur in women who have no risk factors; however, fetal macrosomia, maternal age, polyhydramnios, pregnancy-induced hypertension, uterine myoma, abnormal placentation, uterine rupture, uterine infection, inadequate iron-folate supplementation, antepartum hemorrhage, instrumental births, anemia, and any tear or injury of the genital tract were all identified as determinants of PPH [13–19].

The Ethiopian government has launched national reproductive health measures, including training healthcare workers, promoting safe birth practices, and providing free ambulance services to improve healthcare quality and equity. Despite periodic drops, the maternal mortality rate continues to be as high as 412 per 100,000 live births [11]. To mitigate its impact, particularly in developing countries, more emphasis has to be placed on potential risk factors that contribute to PPH and associated complications. Therefore, this study aimed to identify the predictors of PPH among mothers who gave birth at selected public hospitals in Addis Ababa, Ethiopia, in 2022.

2. Methods

2.1. Study area and population

The study was conducted in Addis Ababa, the capital of Ethiopia. Addis Ababa has an estimated 2,738,248 million population, growing at a 2.1% yearly pace. In the city, there were 99 kebele (the lowest administrative level) and eleven sub-cities. This study focused on 13 public hospitals in Addis Ababa. A facility-based, unmatched case control study was carried out between August 1st and August 30th, 2022. For this study, a random sample of all women who gave birth in the public hospitals in Addis Ababa was chosen.

2.2. Eligibility criteria

Women who gave birth during the study period and developed a postpartum hemorrhage were included as cases, and those who gave birth but did not develop a postpartum hemorrhage were included as controls. However, women who were seriously ill, unable to communicate, or who had a stitch abscess and/or episiotomy site infection were excluded from the study.

2.3. Sample size determination and sampling procedure

The sample size was calculated using the Epi Info 7 statistics software. Multiple pregnancies were thought to be a strong predictor of PPH [20], while a 3:1 controls-to-cases ratio with 80% power and a 95% confidence level was assumed. The optimal sample size with a 1:3 ratio was 378 women (92 cases and 276 controls). Cases (women diagnosed with postpartum hemorrhage) were obtained using a consecutive sampling technique, whereas controls were picked using a simple random sampling strategy. Midwives in each selected hospital identified the study participants using patient cards and hospital admission logbooks.

2.4. Study variables and definition

Postpartum hemorrhage (controls, cases) was considered an outcome variable, and socio-demographic factors such as maternal age, marital status, and educational level; obstetric factors like gestational age, parity, types of pregnancy, ANC follow-up, mode of delivery, genital tract trauma other than episiotomy, onset of labor, birth weight, prior history of PPH, and history of antepartum hemorrhage were evaluated as independent determinants.

Postpartum hemorrhage (PPH): For this study, PPH was determined based on a clinician's diagnosis of the woman who gave birth and was obtained from the woman's records or cards [20].

2.5. Data collection and analysis

For the purpose of gathering data, standardized, pretested checklists and questionnaires were developed after reviewing a variety of literature. The questionnaire had two major sections: socio-demographic factors and obstetric characteristics. Data quality was established by the careful design of data extraction checklists and the required adjustments. The data collectors were given a full day of training on the checklist's contents and how to remain anonymous while collecting data. The principal investigator conducted intense supervision throughout the data collection period.

Epi-data version 3.0.1 was used to enter the data, which was then exported to SPSS version 25 for further analysis. Binary and multivariable logistic regression analyses were conducted to examine the association between PPH and explanatory variables. Independent variables with a p-value of less than 0.25 in binary logistic regression analysis were included in the multivariable logistic regression model. Backward stepwise regression was used to choose potential determinant variables. A p-value of less than 0.05 served

as the cut-off point for statistical significance.

3. Results and discussion

3.1. Socio-demographic characteristics

A total of 92 cases and 276 controls were participated in this study, giving a response rate of 100%. The age of controls ranged from 20 to 36 years, with a mean age of 29.4 ± 5.23 years, while the cases' mean age was 29.8 ± 5.23 years, with a range of 20–37 years. The bulk of cases (56.5%) and controls (61.2%) belong to age groups between 20 and 36 years. The majority of the cases (43.5%) and the controls (41.3%) were married. In terms of maternal education, 57 (20.7%) of the controls and 39 (42.4%) of the cases had a college degree or higher (Table 1).

3.2. Previous and current obstetric related characteristics

More than three-quarters of the controls (212; 76.8%) and half of the cases (46; 50%) have two to four pregnancies. In terms of the mothers' gestational ages, 255 (92.4%) of the controls and 70 (76.1%) of the cases gave birth between 37 and 42 weeks. Antenatal care follow-up was provided for 77 (83.7%) of the cases and 256 (92.8%) of the controls, regardless of the number of ANC visits. Besides, 25 (9.1%) of the controls and 23 (25%) of the cases have a history of cesarean delivery. Moreover, the prevalence of prior abortions was 10.9% in cases and 5.4% in controls (Table 2).

Antepartum hemorrhage was reported by 12 (13%) of the cases and 10 (3.6%) of the controls during the most recent pregnancy. Similarly, polyhydramnios was observed in 6 (2.2%) of the controls and 8 (8.7%) of the cases. The vast majority of the 91 (98.9%) cases and 274 (99.3%) controls gave birth via spontaneous vaginal delivery. Furthermore, more than one-fifth of cases (23.9%) and only 15 (5.4%) of controls had genital tract injuries other than episiotomy.

Regarding maternal anaemia status, 64 (23.2%) of the controls and 36 (39.1%) of the cases had anemia. In terms of neonatal features, 22 (8%) of the controls and 28 (30.4%) of the cases had babies delivered weighing less than 2500 g. In relation to birth outcomes, 91 cases (98.9%) and 275 controls (99.6%) had a live baby (Table 3).

3.3. Determinants of post-partum hemorrhage

The risk of PPH increased by more than twofold in moms who failed to attend antenatal care follow-up (AOR: 2.58; 95% CI: 1.12, 5.96) compared with their counter peers. When compared to mothers who had never had a cesarean delivery, those with a history of CS were more than three times more likely to experience PPH (AOR: 3.47; 95%CI: 1.40, 8.58). In a similar way, PPH was approximately five times more likely to occur in mothers who had prolonged labor than in reference mothers (AOR: 5.14; 95%CI: 2.07, 12.75). Additionally, mothers who had genital trauma other than episiotomy during labor have a higher risk of PPH by more than four times compared to their counter peers (AOR: 4.39; 95%CI: 1.51, 12.81) (Table 4).

3.4. Discussion

In this study, we assessed determinant factors contributing to PPH among women delivered at public hospitals in Addis Ababa, Ethiopia. As a result, PPH risk factors such as not having an ANC follow-up, having a history of cesarean delivery, having prolonged labor, and having genital trauma other than episiotomy were identified.

Table 1
Socio-demographic characteristics of the study participants.

Variables	Category	Cases (%)	Controls (%)
Age (in years)	Below 20	3 (3.3%)	20 (7.2%)
	20–34	52 (56.5%)	169 (61.2%)
	More than 34	37 (40.2%)	87 (31.5%)
Marital status	Single	40 (43.5%)	125 (45.3%)
	Married	40 (43.5%)	114 (41.3%)
	Divorced	11 (12.0%)	34 (12.3%)
	Widowed	1 (1.1%)	3 (1.1%)
Educational status	Unable to read and write	9 (9.8%)	45 (16.3%)
	Only read and write	5 (5.4%)	57 (20.7%)
	Primary	18 (19.6%)	52 (18.8%)
	Secondary	21 (22.8%)	65 (23.6%)
	College and above	39 (42.4%)	57 (20.7%)
Occupational status	Civil servant	11 (12.0%)	30 (10.9%)
	Merchant	52 (56.5%)	168 (6.9%)
	Farmer	11 (12.0%)	38 (13.8%)
	Daily labourer	15 (19.6%)	40 (14.5%)
Residence	Urban	22 (23.9%)	122 (44.2%)
	Rural	70 (76.1%)	154 (55.8%)

Table 2
Previous obstetric history of the respondents.

Variables	Category	Cases n (%)	Controls n (%)
Gravidity	One	18 (19.6%)	64 (23.2%)
	Two to four	46 (50%)	212 (76.8%)
	More than four	28 (30.4%)	0 (0%)
Parity	One	4 (4.3%)	21 (7.6%)
	Two to four	21 (22.8%)	127 (46.0%)
	More than four	67 (72.8%)	128 (46.4%)
Gestational age (in weeks)	37–42	70 (76.1%)	255 (92.4%)
	More than 42	22 (23.9%)	21 (7.6%)
ANC initiation	Yes	77 (83.7%)	256 (92.8%)
	No	15 (16.3%)	20 (7.2%)
Ever history of abortion	Yes	10 (10.9%)	15 (5.4%)
	No	82 (89.1%)	261 (94.6%)
History of cesarean section	Yes	23 (25.0%)	25 (9.1%)
	No	69 (75.0%)	251 (90.9%)
History of previous PPH	Yes	9 (9.8%)	6 (2.2%)
	No	83 (90.2%)	270 (97.8%)
History of still birth	Yes	7 (7.6%)	1 (0.4%)
	No	85 (92.4%)	275 (99.6%)

Table 3
Recent obstetric characteristics of the study participants.

Variables	Category	Cases n (%)	Controls n (%)
APH on the current birth	Yes	12 (13.0%)	10 (3.6%)
	No	80 (87.0%)	266 (96.4%)
Delivery characteristics	Single	86 (93.5%)	276 (100%)
	Twin	6 (6.5%)	0 (0%)
Poly hydraminous	Yes	8 (8.7%)	6 (2.2%)
	No	84 (91.3%)	270 (97.8%)
Pregnancy induced hypertension	Yes	11 (12%)	32 (11.6%)
	No	81 (88)	244 (88.4%)
Obstructed labor	Yes	17 (18.5%)	20 (7.2%)
	No	75 (81.5%)	256 (92.8%)
Prolonged labor	Yes	17 (18.5%)	13 (4.7%)
	No	75 (81.5%)	263 (95.3%)
Mode of delivery	SVD	91 (98.9%)	274 (99.3%)
	Caesarean section	1 (1.1%)	2 (0.7%)
Labor status	Spontaneous	91 (98.9%)	274 (99.3%)
	Induced	1 (1.1%)	2 (0.7%)
Third stage prolonged	Yes	9 (9.8%)	6 (2.2%)
	No	83 (90.2%)	270 (97.8%)
Episiotomy	Yes	20 (21.7%)	12 (4.3%)
	No	72 (78.3%)	264 (95.7%)
Genital tract trauma other than episiotomy	Yes	22 (23.9%)	15 (5.4%)
	No	70 (76.1%)	261 (94.6%)
Uterine atone	Yes	15 (16.3%)	14 (5.1%)
	No	77 (83.7%)	262 (94.9%)
Uterine rupture	Yes	2 (2.2%)	0 (0%)
	No	90 (97.8%)	276 (100%)
Birth weight (in gram)	<2500	28 (30.4%)	22 (8%)
	2500–4000	54 (58.7%)	191 (69.2%)
	>4000	10 (10.9%)	63 (22.8%)

PPH risk was more than twice as high in mothers who did not obtain prenatal care follow-up compared to their counterparts. It was consistent with a research report conducted at Dessie Referral Hospital, northern Ethiopia [21] and at Debre Tabor general hospital, western Ethiopia [22]. The similarity could be explained by the probability that PPH risk factors might be assessed and potentially treated early in women who received ANC follow-up.

Additionally, this study found that having a history of cesarean deliveries tripled the risk of developing PPH. PPH was three times more likely to occur in mothers who have previously undergone a cesarean section than in mothers who have not. This result were consistent with those of a prior investigation carried out at Yirgalem General Hospital, southern Ethiopia [23] and Uganda [24]. However, few studies have found that cesarean sections were protective against PPH when compared to vaginal birth [25,26]. The disparity might be due to the fact that PPH rates were lower in cesarean sections than in vaginal births in studies that involved participants who were not in labor (elective cases). Besides, in this study, most of the cesarean sections were performed on women who were in labor, and some cesarean sections were likely conducted late in the advanced stages of labor. Few studies reported an increased

Table 4
Determinants of PPH.

Variables	Category	COR (95%CI)	AOR (95%CI)	P-value
ANC initiation	Yes	1	1	
	No	2.49 (1.22, 5.10)	**2.58 (1.1, 5.96)**[a]	**0.026**
History of abortion	Yes	2.12 (0.92, 4.90)	1.03 (0.28, 3.73)	0.968
	No	1	1	
History of cesarean section	Yes	3.68 (1.18, 7.64)	**3.47 (1.4, 8.6)** **	**0.007**
	No	1		1
Previous history of PPH	Yes	4.88 (1.68, 14.11)	2.03 (0.42, 9.80)	0.381
	No	1	1	
Current APH	Yes	3.99 (1.66, 9.58)	2.48 (0.91, 6.74)	0.075
	No	1	1	
Current obstructed labour	Yes	2.9 (1.45, 5.82)	0.94 (0.33, 2.63)	0.899
	No	1	1	
Prolonged labor	Yes	4.59 (2.13, 9.87)	5.14 (2.1, 12.7)[a]	**0.0001**
	No	1	1	
Genital trauma other than episiotomy	**Yes**	**5.47 (2.69, 11.09)**	4.39 (1.5, 12.8)[a]	**0.007**
	No	1	1	
Uterine atony	Yes	3.65 (1.69, 7.89)	1.06 (0.32, 3.46)	0.924
	No	1	1	

[a] Indicates variables having P-value <0.05 in multivariable analysis.

risk of severe PPH when cesarean sections were performed when the cervical dilatation was greater than 9 cm or in the second stage of labor, which might lead to avulsion of the blood vessels during the delivery of the affected presenting part [27]. Moreover, a cesarean section may also result in the slicing of an organ, damage to blood vessels, and the tearing of nearby tissue, which could lead to additional bleeding. As a result, there may be a higher chance of developing PPH and its complications. An increase in the risk of uterine atony, a major cause of PPH, has also been connected to cesarean sections [28,29].

Mothers who had prolonged labor were more than five times more likely to have PPH compared to their counterparts. The results of this study were in agreement with earlier research findings carried out at Yirgalem General Hospital, southern Ethiopia [23], Bonassama Hospital in Cameroon [30], and various parts of Ethiopia [31,32]. Furthermore, the risk of developing PPH rises with labor duration, as demonstrated by numerous studies [33–35]. The risk of damage to the pelvic blood vessels and soft tissue is increased by prolonged labor, which may be one explanation. Consequently, there may be a markedly increased chance of blood loss following delivery.

Furthermore, PPH was more than four times higher in women who had a genital trauma other than an episiotomy during labor than in moms who did not have a genital trauma other than an episiotomy. This finding was consistent with the research results of the Rwanda study [36]. The reason behind might be due to the fact that using forceps or vacuum extraction during delivery could increase the risk of uterine injuries and hematoma (collection of blood) from uterine injuries and cause bleeding hours or days after delivery [21].

3.5. Strengths and limitations of the study

As strength of this study, we included a relatively large sample size and a maximum response rate. The use of unmatched case-control study design, on the other hand, might be a significant flaw. The precise cause-and-effect link between risk variables and PPH might be difficult to determine because of the retrospective nature of unmatched-case control studies. The fact that PPH was identified using estimation rather than verified blood loss for diagnosis makes calculating blood loss very difficult. Unfortunately, this is the only choice for nations with limited resources. There may also be differences between observers because the diagnosis was made by different health professionals with various degrees of training and expertise.

4. Conclusion

PPH during labor and delivery remains the leading cause of maternal death, illnesses, and obstetric complications in Ethiopia. PPH was independently determined by the initiation of antenatal care follow-up, a prior history of cesarean delivery, prolonged labor, and genital trauma other than episiotomy. Therefore, to reduce obstetric complications and maternal mortality resulting from PPH, it is crucial to stress adequate prevention measures throughout perinatal care. High-risk mothers, including those who have had cesarean deliveries, need to be identified, screened, and closely monitored during antepartum care.

Ethical considerations

Ethical approval was obtained from Yanet College's research and ethical review board with a protocol unique number of YEC/031/22. A permission letter was secured from the medical director of the hospital's record office and obstetrics and gynecology department. Furthermore, by evaluating and sharing the data in aggregate, confidentiality and anonymity were ensured. Since the study was designed to be retrospective, written informed consent from the patient was not obtained for the publication of this report.

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Data availability statement

Data associated with this study wasn't deposited into any publicly available repository. Besides, data will be made available on reasonable request.

CRediT authorship contribution statement

Genanew Kassie Getahun: Formal analysis, Data curation, Conceptualization. **Daniel Wubishet:** Supervision, Methodology, Formal analysis. **Betselot Yirsaw Wubete:** Writing – review & editing, Data curation, Conceptualization. **Shibabaw Yirsaw Akalu:** Methodology, Formal analysis, Data curation. **Tewodros Shitemaw:** Writing – original draft, Supervision, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: None reports was provided by No institution provided additional support to this research. None reports a relationship with We don't have that includes:. We don't have any patent to disclose has patent pending to No. The author declares that they have no competing conflicts of interest. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Abbreviations

AMTSL	Active Management of the Third Stage of Labor
ANC	Antenatal Care
APH	Antepartum Hemorrhage
CS	Cesarean Section
ICM	International Confederation of Midwives
LICs	Low-Income Countries
MDG	Millennium Development Goals
MMR	Maternal Mortality Ratio
PPH	Postpartum Hemorrhage
SPPH	Sever postpartum hemorrhage
WHO	World Health Organization

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e26762.

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