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Predictors of Primary Postpartum Hemorrhage among Women who gave birth at Adama Hospital Medical College, Adama, Ethiopia: A Case-Control Study

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Abstract

Background: Early recognition of predictors of primary postpartum hemorrhage (PPH) is critically important to develop an effective preventive strategy. Even though PPH continues to be a leading preventable cause of maternal death in sub-Saharan African countries including Ethiopia, locally generated evidence about predictors of PPH were scarce.

Objective: To identify predictors of primary PPH among women who gave birth at Adama Hospital Medical College from July 01, 2022, to June 30, 2023.

Methods: A hospital-based unmatched case-control study was conducted by taking a sample of 494 women (124 cases and 370 controls). Data were collected through face-to-face interviews and review of women's medical records. Data were entered into Epi info version 7.2 and analyzed with SPSS version 20. Binary logistic regression analysis was used to model the association between independent variables and primary PPH.

Results: The study revealed that the odds of having primary PPH were 3.9-fold higher among women with twin pregnancies. The previous history of PPH is associated with 6 -fold increase in the risk of recurrent PPH. Women with placental abruption had 2.7-fold increased risk of primary PPH compared to their counterparts. Women with instrumental delivery had a 4-fold higher risk of primary PPH compared to spontaneous vaginal delivery. The risk of primary PPH increased by 4-fold among women with stillbirth compared to women with live births.

Conclusions: Twin pregnancy, previous history of PPH, abruptio placentae, operative vaginal delivery, and intrauterine fetal death are independent predictors of primary PPH.

Keywords: adama; predictors of primary postpartum hemorrhage; risk factors for PPH

Introduction

Postpartum hemorrhage (PPH) is defined as a cumulative blood loss ≥ 500ml following a vaginal delivery or ≥ 1000ml following cesarean delivery or blood loss following delivery resulting in signs and symptoms of hypovolemia [1]. Postpartum hemorrhage is considered to be primary or early when it occurs within the first 24 hours after delivery and secondary or late or delayed when it occurs between 24 hours and up to 12 weeks after delivery [2-4]. Primary PPH is the most common type of PPH and its incidence varies from 1.2% to 12.5% [5].

Despite several international initiatives being adopted to reduce maternal mortality, it remains a major public health problem in developing countries. In 2020, an estimated 287,000 women died from pregnancy or childbirth-related complications worldwide, which is equivalent to almost 800 maternal deaths every day, and approximately one woman die every two minutes [6]. The majority of this death occurs in developing countries mainly in sub-Saharan African countries. The probability of dying from complications of pregnancy and childbirth is nearly 20 times higher in women of developing countries than in developed countries [7]. Ethiopia is one of the countries with a high maternal mortality ratio (MMR), according to the 2016 Ethiopian Demographic Health Survey (EDHS), MMR was 412 per 100,000 live births, which is far from the SDG goal of reducing MMR less than 70 per 100,000 live births [8]. PPH continues to be the leading preventable cause of maternal morbidity and mortality worldwide [9, 10]. Most cases of morbidity and mortality due to PPH occur in the first 24 hours

following delivery [11]. Globally, PPH accounts for about 8% of maternal deaths in developed regions of the world and 20% of maternal deaths in developing countries [10].

Risk factors for PPH can be identified during the antepartum period at the time of ANC follow-up, intrapartum period during labor, and postpartum period after delivery which is very important for timely prevention of PPH [12]. Socio-demographic factors that increase the risk of primary PPH include; maternal age ≥ 35 years [13-15], obesity [16, 17], Asian [18], and African women [19], and PPH was more common in rural women [19]. Predictors of primary PPH that present during the antepartum period include: previous history of PPH [13, 14, 20, 21], hypertensive disorder of pregnancy [21-23], multiparity [24, 25], multiple pregnancies [14, 21], maternal anemia [22, 26-28], fetal macrosomia [14, 22, 28], gestational age of 40 weeks and above at the time of delivery [22, 29], placenta praevia [16, 20], Abruptio placentae [30, 31], previous cesarean section [17, 32], gestational diabetes mellitus [15], polyhydramnios [21], and HIV positive [14]. Intrapartum factors that increase the risk of primary PPH include; prolonged labor [13, 22-24], instrumental delivery [13, 26, 28], induction of labor [25], maternal fever [17, 21], episiotomy [17, 21], women receiving pethidine in labor [22], and chorioamnionitis [33].

To reduce the maternal mortality ratio to the desired level, locally generated evidence addressing predictors of the commonest causes of maternal death like PPH is critically important to develop an effective preventive strategy. To improve maternal mortality and morbidities associated with primary PPH, prevention through early recognition of the predictors of primary PPH is much better than the diagnosis and treatment of established cases. Knowledge of primary PPH predictors helps clinicians in the early identification of high-risk women and in undergoing necessary preparations like arranging delivery at facilities where emergency surgical interventions, intensive care, and blood bank services are immediately available. Advanced efforts to identify women at risk of primary PPH as early and accurately as possible are crucial in developing an effective prevention strategy, in this regard several studies were conducted to identify determinants of primary PPH, but most of these studies were from the developed countries. Even though PPH continue to be a leading preventable cause of maternal death in sub-Saharan African countries including Ethiopia, locally generated evidence about predictors of PPH were scarce. Our study aimed to identify determinants of primary PPH among women who gave birth at Adama Hospital Medical College (AHMC) from July 1st, 2022 to June 30th, 2023, which would serve as local evidence for healthcare providers and policymakers to develop a strategy for early identification, prevention, and treatment of a woman at risk of primary PPH.

Methods and Material

Study design, period, and setting

A hospital-based unmatched case-control study was conducted at Adama Hospital Medical College (AHMC) from July 1st, 2022 to June 30th, 2023. AHMC is found in Adama town, which is located 100 kilometers to the southeast of Addis Ababa, the capital of Ethiopia. The hospital provides health care services to an estimated 6 million people coming from its catchment area. Obstetrics and gynecology is one of the major departments in the college, providing training to medical students & OB/GYN residents. The department also provides several maternal health care services including; ANC, labor and delivery, postnatal care, abortion, family planning, and gynecologic surgeries. The total numbers of deliveries were estimated at 800 to 900 per month.

Study Participants

All women who gave birth at AHMC were taken as a source population for both cases and controls. A woman diagnosed to have primary PPH was taken as a case. The diagnosis of primary PPH was made by a physician attending delivery based on; visually estimated blood loss of 500 ml and above after vaginal delivery or 1000 ml and above after cesarean delivery, or delivery-related blood loss associated with signs and symptoms of hypovolemia, or postpartum hemoglobin decrement of 10% and above from the prepartum level that occurs within 24 hours of delivery of the fetus. Women with no primary PPH were taken as a control.

Having a diagnosis of primary PPH was considered as a primary eligibility criterion to include a woman as a case in the current study. However, women who gave birth at AHMC and developed PPH after 24 hours of delivery, women who gave birth outside AHMC and were referred to the hospital for the management of PPH, women who refused to give consent, women who were critically ill and unable to communicate, and women less than 18 years of age were excluded

from the cases. The absence of primary PPH was considered as a primary eligibility criterion to include a woman as a control. However, women who gave birth in another health facility and were referred to AHMC for other reasons, women who refused to give consent, women who were critically ill, and women less than 18 years of age were excluded from the controls.

Sample size determination and Sampling procedure

The sample size for the unmatched case-control study design was calculated using EPI Info version 7.2 by considering the following statistical assumptions; 80% of power, 95% of confidence level, and 3 to 1 control to case ratio. Pregnancy-induced hypertension was taken as a main exposure for primary PPH according to the findings of the previous study; the percentage of women who had pregnancy-induced hypertension among cases (10.64%) and the percentage of women who had pregnancy-induced hypertension among controls (3.58%) (34). Accordingly, the total sample size was 494, among which 124 cases and 370 controls were included in the study.

All women who were diagnosed to have primary PPH during the study period were consecutively enrolled in the study. The case of primary PPH was traced by data collectors from the delivery registration book in the labor ward and operation theater. Three women with no primary PPH who were registered following the case were randomly selected as controls. If a selected woman failed to meet the inclusion criteria, the next woman was chosen as a control.

Operational definitions

Primary PPH is diagnosed when

- A visually estimated blood loss is ≥ 500 ml after vaginal delivery or ≥ 1000 ml after C/D that occurs within the first 24 hours after birth, or
- Excessive bleeding after delivery leading to clinical symptoms and signs of Hypovolemia (dizziness, palpitation, tachycardia, hypotension, or decrease in blood pressure) that occurs within 24 hours after delivery, or
- Postpartum hemoglobin decreased by ≥10% from the prepartum level.

Maternal anemia- maternal hemoglobin less than 11g/dl

Fetal macrosomia - the birth weight of the neonate ≥4000g

Data collection tools, procedures, and Data quality control

Data were collected by 4 trained BSC midwives through face-to-face interviews and medical record review. The questionnaire was designed after reviewing relevant literature and it was first prepared in English and then translated into the Afan Oromo and Amharic languages, which are commonly spoken languages in the study setting. To check for consistency, it was translated back into English. The questionnaire was pretested on 5% of the total sample size to determine their validity at Bishoftu Hospital before embarking on the main study. Supervision was carried out by the investigators throughout the data collection. All filled questionnaires were checked for completeness, accuracy, and consistency by the investigators. Data collection was begun by verbally inviting a woman in the postpartum period who met the inclusion criteria to take part in the study by explaining the objective of the study.

Data Processing and analysis

The collected data was coded and entered into Epi info version 7.2, and then exported to SPSS version 20 for analysis. To make it ready for analysis data were cleaned, categorized, and transformed. Descriptive statistics like frequencies and cross-tabulations were performed to explore the characteristics of the cases and controls across their different socio-demographic and obstetric variables. Binary logistic regression analysis was used to identify determinants of primary PPH. First, a simple logistic regression analysis was performed to screen candidate variables that had a crude association with primary PPH at P- value < 0.25. The selected candidate variables were subjected to a multiple logistic regression model to estimate their adjusted association with primary PPH. The statistical significance of independent variables in the final fitted model of primary PPH was declared at P-value <0.05. Finally, the magnitude of association between the independent variables and primary PPH was estimated using an odds ratio with a 95% confidence interval.

Results

Socio-demographic characteristics of cases and controls

During the study period, we found, a total of 146 women who were diagnosed to have a primary PPH, of which 22 cases were excluded from the study (10 cases refused to participate in the study, 5 cases were

critical and unable to give consent, and the remaining 7 cases gave birth at the nearby health center and referred to our hospital for blood transfusion). Accordingly, 124 women with primary PPH were compared with 370 women without primary PPH.

Per the findings of the current study, the highest proportion of women among cases 47(37.9%) and controls 147 (39.7%) were in the age range of 25 to 29 years. The highest proportions of women were urban residents both among cases 96 (77.4%) and control 262 (70.8%) groups. Almost all women involved in the study were in a marital relationship. Regarding occupational status, the housewife women were highly proportionate among cases 85(68.5%) and controls 214(57.8%) (Table-1).

Table 1: Socio-demographic characteristics of women, who gave birth at Adama Medical College from July 2022 to June 2023 (n=494).

Characteristics	Cases Number (%)	Controls Number (%)	Total Number (%)
Maternal Age in Years			
≤ 19	8(6.5)	15(4.1)	23(4.7)
20 – 24	37(29.8)	127(34.3)	164(33.2)
25 – 29	47(37.9)	147(39.7)	194(39.3)
30 – 34	19(15.3)	55(14.9)	74(15.0)
≥ 35	13(10.5)	26(7.0)	39(7.9)
Place of Residence			
Urban	96(77.4)	262(70.8)	358(72.5)
Rural	28(22.6)	108(29.2)	136(27.5)
Maternal Education			
No Education	18(14.5)	66(17.8)	84(17.0)
Primary	69(55.6)	166(44.9)	235(47.6)
Secondary	22(17.7)	96(25.9)	118(23.9)
College or university	15(12.1)	42(11.4)	57(11.5)
Marital Status			
In a marital relationship	123(99.2)	362(97.8)	485(98.2)
Not in a marital relationship	1(0.8)	8(2.2)	9(1.8)
Occupation			
Housewife	85(68.5)	214(57.8)	299(60.5)
Merchant	16(12.9)	55(14.9)	71(14.4)
Employed	12(9.7)	44(11.9)	56(11.3)
Others	11(8.9)	57(15.4)	68(13.8)

Antepartum characteristics of cases and controls

The study found that; the proportion of multiparous women was 60(48.4%) among cases and 183(49.5%) among controls. About 8.1% of women among the cases and 2.7% of women among controls had twin pregnancies. A previous history of postpartum hemorrhage was reported in 10.5% of cases and 2.4% of controls. Antepartum hemorrhage caused by abruption placentae was more common among cases (15.3%) than controls (6.2%) (Table 2).

Table 2: Antepartal characteristics of women, who gave birth at Adama Hospital Medical College from July 2022 to June 2023 (n=494).

Characteristics	Cases Number (%)	Controls Number (%)	Total Number (%)
Parity			
One	54(43.5)	172(46.5)	226(45.7)
2 to 4	60(48.4)	183(49.5)	243(49.2)
5 and above	10(8.1)	15(4.1)	25(5.1)
ANC follow-up			
Yes	118(95.2)	356(96.2)	474(96.0)
No	6(4.8)	14(3.8)	20(4.0)

Number of ANC follow-up			
< 4 visits	23(19.5)	91(25.6)	114(24.1)
≥ 4 visits	95(80.5)	265(74.4)	360(75.9)
Place of ANC follow-up			
Public health center	72(61.0)	244(68.5)	316(66.7)
Public hospital	33(28.0)	75(21.1)	108(22.8)
Private health facility	13(11.0)	37(10.4)	50(10.5)
Gestational age at delivery			
Unknown date	39(31.5)	126(34.1)	165(33.4)
Preterm pregnancy	10(8.1)	25(6.8)	35(7.1)
Term pregnancy	69(55.6)	207(55.9)	276(55.9)
Post-term pregnancy	6(4.8)	12(3.2)	18(3.6)
Types of gestation			
Singleton	114(91.9)	360(97.3)	474(96.0)
Twins	10(8.1)	10(2.7)	20(4.0)
Previous history of PPH			
Yes	13(10.5)	9(2.4)	22(4.5)
No	111(89.5)	361(97.6)	472(95.5)
Previous C/S scar			
Yes	15(12.1)	43(11.6)	58(11.7)
No	109(87.9)	327(88.4)	436(88.3)
HIV status			
Positive	3(2.4)	6(1.6)	9(1.8)
Negative	121(97.6)	364(98.4)	485(98.2)
Anemia at admission			
Yes	18(14.5)	43(11.6)	61(12.3)
No	106(85.5)	327(88.4)	433(87.7)
Placental Abruption			
Yes	19(15.3)	23(6.2)	42(8.5)
No	105(84.7)	347(93.8)	452(91.5)
Pregnancy-induced hypertension			
Yes	19(15.3)	29(7.8)	48(9.7)
No	105(84.7)	341(92.2)	446(90.3)
Premature rupture of membrane			
Yes	16(12.9)	61(16.5)	77(15.6)
No	108(87.1)	309(83.5)	417(84.4)

Intrapartum characteristics of cases and controls

Nearly two-thirds of women among the cases and controls had spontaneous onset of labor. Vaginal delivery was the commonest mode of delivery in both groups; however, the percentage of instrumental delivery was higher among cases (16.1%) than controls (5.4%). Although an alive neonate was the most common pregnancy outcome among both groups, the proportion of stillbirth was higher among cases (6.5%) than controls (1.6%) (Table 3).

Table 3: Intrapartum characteristics of women, who gave birth at Adama Hospital Medical College from July 2022 to June 2023 (n=494).

Characteristics	Cases Number (%)	Controls Number (%)	Total Number (%)
Onset of labor			
Spontaneous	84(67.7)	264(71.4)	348(70.4)
Induced	31(25.0)	76(20.5)	107(21.7)
Elective C/S	9(7.3)	30(8.1)	39(7.9)
Magnesium sulfate given			
Yes	17(13.7)	26(7.0)	43(8.7)

No	107(86.3)	344(93.0)	451(91.3)
Labor abnormality in the first stage of labor			
Yes	7(10.6)	14(6.9)	21(7.8)
No	59(89.4)	189(93.1)	248(92.2)
Mode of Delivery			
Vaginal delivery	66(53.2)	203(54.9)	269(54.5)
Instrumental delivery	20(16.1)	20(5.4)	40(8.1)
Cesarean delivery	38(30.6)	147(39.7)	185(37.4)
Types of Instrumental Delivery			
Forceps	16(80.0)	13(65.0)	29(72.5)
Vacuum	4(20.0)	7(35.0)	11(27.5)
Types of cesarean section			
Emergency	29(76.3)	119(81.0)	148(80.0)
Elective	9(23.7)	28(19.0)	37(20.0)
Episiotomy			
Yes	24(36.4)	66(32.5)	90(33.5)
No	42(63.6)	137(67.5)	179(66.5)
The Outcome of the pregnancy			
Alive	116(93.5)	364(98.4)	480(97.2)
Stillbirth	8(6.5)	6(1.6)	14(2.8)
Birth weight			
Low birth weight	14(11.3)	36(9.7)	50(10.1)
Normal birth weight	96(77.4)	300(81.1)	396(80.2)
Macrosomia	14(11.3)	34(9.2)	48(9.7)
Sex of the newborn			
Male	68(54.8)	186(50.3)	254(51.4)
Female	56(45.2)	184(49.7)	240(48.6)

Factors associated with primary postpartum hemorrhage

First simple logistic regression was performed; at this level we identified maternal age, place of residency, maternal occupation, parity, types of gestation, previous history of postpartum hemorrhage, placental abruption, pregnancy-induced hypertension, magnesium sulfate administration, mode of delivery, and outcome of the current pregnancy has a crude association with primary postpartum hemorrhage at P-value < 0.25. The goodness of fit of the model was assessed using Hosmer and Lemeshow tests statistics. Accordingly, the corresponding p-value for the Hosmer and Lemeshow tests' statistics indicated that the model was well fitted, with a P-value = 0.605. Multicollinearity statistics were also assessed using the Variance Inflation Factor (VIF) and the calculated mean VIF value was found to be 1.1023, and there was no VIF value above 5 indicating the absence of multi-collinearity. Finally, multiple logistic regression analysis found that; types of gestation, previous history of postpartum hemorrhage, abruption placentae, mode of delivery, and outcome of the current pregnancy were significantly associated with primary postpartum hemorrhage at P- value <0.05 (Table 4).

Table 4: Factors associated with primary postpartum hemorrhage among women who gave birth at Adama Hospital Medical College from July 2022 to June 2023 (n=494).

Characteristics	Cases Number(%)	Controls Number(%)	COR [95%CI]	AOR [95%CI]
Maternal Age in Years				
≤ 19	8(6.5)	15(4.1)	1.00 (Ref.)	1.00 (Ref.)
20 – 24	37(29.8)	127(34.3)	0,55[0.22, 1.39] *	0,46[0.17, 1.26]
25 – 29	47(37.9)	147(39.7)	0.60[0.24, 1.50]	0.42[0.15, 1.18]
30 – 34	19(15.3)	55(14.9)	0.65[0.24, 1.77]	0.55[0.18, 1.71]
≥ 35	13(10.5)	26(7.0)	0.94[0.32, 2.78]	0.71[0.21, 2.41]
Place of Residence				
Urban	96(77.4)	262(70.8)	1.41[0.88, 2.28] *	1.75[0.98, 3.13]

Rural	28(22.6)	108(29.2)	1.00 (Ref.)	1.00 (Ref.)
Occupation				
Housewife	85(68.5)	214(57.8)	2,06[1.03, 4.11] *	1,71[0.80, 3.65]
Merchant	16(12.9)	55(14.9)	1.51[0.64, 3.54]	1.07[0.41, 2.81]
Employed	12(9.7)	44(11.9)	1.41[0.57, 3.50]	1.22[0.45, 3.41]
Others	11(8.9)	57(15.4)	1.00 (Ref.)	1.00 (Ref.)
Parity				
One	54(43.5)	172(46.5)	Ref (1.00).	Ref
2 to 4	60(48.4)	183(49.5)	1.04[0.68, 1.59]	1.06[0.62, 1.81]
5 and above	10(8.1)	15(4.1)	2.12[0.90, 5.00] *	1.90[0.63, 5.73]
Types of gestation				
Singleton	114(91.9)	360(97.3)	1.00 (Ref.)	1.00 (Ref.)
Twins	10(8.1)	10(2.7)	2.73[1.43, 5.21] *	3.97[1.49, 10.60] **
Previous history of PPH				
Yes	13(10.5)	9(2.4)	4.70[1.96, 11.28] *	6.07[2.32, 15.85] **
No	111(89.5)	361(97.6)	1.00 (Ref.)	1.00 (Ref.)
Placental Abruption				
Yes	19(15.3)	23(6.2)	2.73[1.43, 5.21] *	2.66[1.29, 5.49] **
No	105(84.7)	347(93.8)	1.00 (Ref.)	1.00 (Ref.)
Magnesium sulfate given				
Yes	17(13.7)	26(7.0)	2.10[1.10, 4.02] *	2.03[0.98, 4.19]
No	107(86.3)	344(93.0)	1.00 (Ref.)	1.00 (Ref.)
Mode of delivery				
Vaginal delivery	66(53.2)	203(54.9)	1.00 (Ref.)	1.00 (Ref.)
Instrumental delivery	20(16.1)	20(5.4)	3.08[1.56, 6.07] *	4.27[2.04, 8.94] **
Cesarean delivery	38(30.6)	147(39.7)	0.79[0.51, 1.25]	0.88[0.53, 1.44]
The Outcome of the pregnancy				
Alive	116(93.5)	364(98.4)	1.00 (Ref)	1.00 (Ref)
Stillbirth	8(6.5)	6(1.6)	4.18[1.42, 12.31] *	4.08[1.31, 12.76] **

** P < 0.25; ** P < 0.05*

Discussion

The finding of our study revealed that; a woman with twin pregnancies had a nearly 4-fold increased odds of primary PPH compared to those women with singleton pregnancies (AOR = 3.97; 95% CI: 1.49, 10.60). Similarly, the increased risk of primary PPH in a woman with multifetal gestation was reported by other studies conducted in Turkey [35], Rwanda [12], and Uganda [14]. After delivery of the fetus, bleeding from the placental implantation site is arrested mainly through effective uterine contraction around the spiral arterioles. In a woman with multifetal gestation, the ability of the uterine myometrium to contract effectively was decreased because of overstretching of the uterine muscle fiber as a result of uterine over-distension. Increases in the placental implantation surface area as a result of a larger placenta associated with multifetal gestation also had a significant contribution to the increased risk of primary PPH in a twin pregnancy [12]. This finding calls for more vigilance preparation and planning by the health care providers attending labor and delivery of multiple pregnancies for early identification and prevention of primary PPH.

Previous history of PPH is a non-modifiable risk factor that increases the risk of primary PPH. According to the finding of this study; a woman whose previous pregnancy was complicated by PPH had a 6-fold increased risk of recurrent PPH with the current pregnancy (AOR = 6.07; 95% CI: 2.32, 15.85). Similar findings were reported by the study conducted in Australia [36], Rwanda [12], Cameron [20], and Southern Ethiopia [13]. On the other hand, studies done in Thailand [34] and Uganda [14] didn't find a significant association between the previous history of PPH and the current risk of primary PPH, this variation can be explained by the dissimilarity in the study design. The increased risk of recurrent primary PPH in subsequent pregnancy can be explained by inherited genetic predisposition such as a defect in coagulation or defect in tissue elasticity which might lead to a higher risk of PPH [37]. In addition, the increased risk of recurrent PPH is in part related to

the recurrence of antepartum or intrapartum obstetric factors associated with postpartum hemorrhage (38). Women with this risk factor should be counseled about their risk of recurrent bleeding after delivery and their delivery should be planned in a better facility capable of handling their problem. In addition, healthcare providers attending the delivery of this woman should be alerted and should take proactive measures to prevent the development of primary PPH.

In general, antepartum hemorrhage increases the risk of postpartum hemorrhage. The study found that; a woman with abruption placentae had a 2.7-fold increased risk of primary PPH, compared to their counterparts (AOR = 2.66; 95% CI: 1.29, 5.49). A similar finding was reported by a systematic review of 27 studies [30] and a study done in Zimbabwe [23]. The increased risk of primary PPH in a woman with placental abruption can be explained by a high risk of uterine atony and disseminated intravascular coagulation in this woman. Widespread extravasation of blood into the uterine myometrium known as Couvelaire uterus impairs the ability of the myometrium to contract effectively which leads to uterine atony. Abruption is the most common cause of clinically profound consumptive coagulopathy or disseminated intravascular coagulation in obstetrics which manifests as antepartum or postpartum hemorrhage [39]. Healthcare providers should recognize the risk of primary PPH in a woman with abruption placentae and take proactive measures to prevent this deadly obstetric complication.

According to the finding of this study; operative vaginal delivery increases the risk of primary PPH by 4-fold, compared to those women with normal vaginal delivery (AOR = 4.27; 95% CI: 2.04, 8.94). We didn't find a statistically significant difference in the risk of primary PPH among the two instruments (forceps vs vacuum). The association of primary PPH with instrumental delivery was also reported by studies done in Japan [27], Australia [36], Senegal [28], and Southern Ethiopia [13]. One of the maternal complications associated with an operative vaginal delivery was lower genital tract laceration (cervical, vaginal, and perineal laceration), which in turn increases the risk of primary PPH. In addition prolonged second stage of labor as an indication for instrumental delivery was identified as an important risk factor that increases the risk of primary PPH in several studies [22, 24]. This finding alert healthcare providers to anticipate primary PPH in all women having an operative vaginal delivery and take necessary measures to reduce or prevent this complication.

Women whose current pregnancy is complicated by stillbirth had an increased risk of primary PPH. In our study, this woman had 4-fold increased risk of primary PPH (AOR = 4.08; 95% CI: 1.31, 12.76). The finding of our study was in line with the existing evidence which shows; a higher magnitude of PPH in women with intrauterine fetal death (10 -12%) compared to their counterparts according to the study done in the USA [40, 41]. A case-control study done in Rwanda also found a higher prevalence of stillbirth among women who develop primary PPH [12]. A higher prevalence of retained placenta in a woman with stillbirth, which was reported as high as 23% in one retrospective study [40], can be taken as an explanation for the increased risk of primary PPH in a woman with stillbirth. In addition, this association can also be explained by; the higher risk of maternal disseminated intravascular coagulation (DIC) in a woman with stillbirth [41, 42]. Irrespective of the condition leading to stillbirth, it is necessary to give full attention to all women with a stillbirth at the time of delivery to prevent the development of primary PPH.

The source of data we used in this study was reasonably good in quality. The medical records of the women were combined with structured interviews of the study participants during their hospital stay which allowed us to collect all necessary information with minimum missing data. Selection bias was reduced by including established cases of primary PPH and 3 randomly selected women without primary PPH from the same source population. One of the limitations of this study was that blood loss was estimated visually by the health care provider attending the delivery which may have been over or underestimated which leads to overdiagnosis or missing some cases of primary PPH. To minimize this close supervision was made by the investigators and regularly reviewing the diagnosed cases of PPH and cross-checking the diagnosis with the clinical condition of the women was made.

Conclusions

In general, our study found that twin pregnancy, previous history of PPH, abruptio placentae, operative vaginal delivery, and intrauterine fetal death were independent predictors of primary PPH. Although

primary PPH can occur in the absence of risk factors, it is recommended to assess all pregnant women during antepartum, intrapartum, and immediate postpartum periods for their risk of primary PPH, which is critical for early identification and prevention of PPH.

Declarations

Ethical approval and Informed consent

Ethical clearance & permission letters were obtained from the Institutional Review Board (IRB) of Adama Hospital Medical College. Informed written consent was obtained from each study participant after the objectives of the study were explained. At the beginning, the data collector would explain to the participant that their participation is voluntary and would not affect their current and future care in the hospital. The data collector would reassure the participants that their names would not be used and that they would not be identified by any means. Confidentiality would also be maintained during data analysis and interpretation.

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Authors' contributions

The idea or concept of this research was initially developed by the corresponding author. All authors were involved in the development of the proposal including setting the study design. A significant contribution was made by all authors in the process of data collection, execution, analysis, and interpretation. Drafting and writing of the document were made by the contribution of all authors. After the development of the manuscript, the critical revision was made by all authors who gave final approval of the submitted document. All authors have agreed on the manuscript to be published in this journal and agreed to take responsibility and be accountable for the contents of the article.

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