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Risk Factors for Postpartum Hemorrhage in Vaginal Deliveries in a Latin-American Population

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Abstract

OBJECTIVE—To identify risk factors for immediate postpartum hemorrhage after vaginal delivery in a South-American population.

METHODS—This was a prospective cohort study including all vaginal births (n=11,323) between October-December 2003 and October-December 2005 from 24 maternity units in two South-American countries: Argentina and Uruguay. Blood loss was measured in all births using a calibrated receptacle. Moderate postpartum hemorrhage and severe postpartum hemorrhage were defined as blood loss of at least 500 ml and at least 1,000 ml, respectively.

RESULTS—Moderate and severe postpartum hemorrhage occurred in 10.8% and 1.9% of deliveries, respectively. The risk factors more strongly associated and the incidence of moderate postpartum hemorrhage in women with each of these factors were: retained placenta (33.3%) (adjusted odds ratio – aOR: 6.02; 95% confidence interval [CI]: 3.50–10.36); multiple pregnancy (20.9%) (aOR:4.67; CI 2.41–9.05); macrosomia (18.6%) (aOR:2.36; CI 1.93–2.88), episiotomy (16.2%) (aOR:1.70; CI 1.15–2.50); and need for perineal suture (15.0%) (aOR:1.66; CI 1.11–2.49). Active management of third stage of labor, multiparity and a low birth weight baby, were found to be protective factors. Severe postpartum hemorrhage was associated with retained placenta (17.1%) (aOR:16.04; CI 7.15–35.99), multiple pregnancy (4.7%)(aOR:4.34; CI 1.46–12.87), macrosomia (4.9%)(aOR:3.48; CI 2.27–5.36), induced labor (3.5%)(aOR:2.00; CI 1.30–3.09), and need for perineal suture (2.5%) (aOR:2.50; CI 1.87–3.36).

CONCLUSION—Many of the risk factors for immediate postpartum hemorrhage in this South-American population are related to complications of the second and third stage of labor.

INTRODUCTION

In economically developed and developing countries, post partum hemorrhage is a leading cause of severe maternal morbidity and mortality. Approximately, 14 million women suffer postpartum hemorrhage annually. Worldwide, 529,000 pregnancy-related deaths occur every

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year. Postpartum hemorrhage contributes to 25–30% of these deaths in the developing world. Thus, severe bleeding is the single most important cause of maternal mortality worldwide (1, 2). Determinants of, and risk factors for, postpartum hemorrhage have been studied to identify pregnant women with increased risk. Obstetric textbooks list many different predisposing factors, with no indication of their relative importance or frequency. Several articles have cited determinants of postpartum hemorrhage (3–9). According to these studies, postpartum hemorrhage in vaginal deliveries is more common in: 1) nulliparas; 2) multiparas; 3) prolonged and augmented labor; 4) preeclampsia; 5) after episiotomy; 6) multiple pregnancy; 7) forceps or vacuum delivery; 8) Asian or Hispanic ethnicity; and 9) retained placenta.

An important drawback of the majority of the published studies is the reliance on visual estimation of blood loss registered in the clinical records to identify postpartum hemorrhage, a method that has proved to have considerable inaccuracy. Finally, as far as we know, there is only one observational study that has approached this topic in Latin America and the Caribbean (10). The Trial for Improving Perinatal Care in Latin America was a multi-center international cluster randomized trial in which one of the secondary outcomes was blood loss during the third stage of labor. The measurement technique of blood loss for all vaginal deliveries used in this trial was the direct method with a calibrate receptacle. Using data collected as part of this study, we identified risk factors for immediate post-partum hemorrhage in a Latin American population.

MATERIALS AND METHODS

The Trial for Improving Perinatal Care in Latin America was a multi-center cluster randomized trial in 24 public maternity hospitals in Argentina and Uruguay. The main aim of the trial was to increase the use of two evidence-based birth practices, the use of oxytocin during the third stage of labor and selective episiotomy (11). For that purpose, the trial evaluated a behavioral intervention to facilitate the development and implementation of evidence-based clinical guidelines regarding the prevention of postpartum hemorrhage and the use of episiotomy, compared to usual training activities. A complete description of the trial has been previously reported (11,12). In brief, the study design was a cluster randomized controlled trial with hospitals as units of randomization. Hospitals were invited to participate in the study if they had an Institutional Review Board or existing committee which could serve as such, at least 1,000 vaginal deliveries per year and they did not have an explicit policy for selective episiotomy and for active management of the third stage of labor – defined as gentle umbilical cord traction, uterine massage, and use of uterotonics. Data were collected from eligible patients at three points in time, at baseline before randomization (period I), at the end of the main intervention (period II), and one year after the end of the intervention (period III). We used data from the baseline and post-intervention periods for the current analyses (period I: October–December 2003 and period III: October–December 2005) from both intervention and control clusters. Initially a total of 24 hospitals were invited to participate, and baseline data were collected for all vaginal deliveries for a period of three months. Out of these 24 hospitals, only 19 were randomized because the analysis of their baseline data showed that they did not fulfill the inclusion criteria. Although the main outcomes of the trial were the frequencies of oxytocin use and use of selective episiotomy; blood loss was a secondary outcome and it was measured for all vaginal deliveries during the data collection period. Of the 15,263 deliveries recorded in the database, 3,940 were excluded 3,690, leaving 11,323 deliveries available for analysis (Figure 1). Data were collected on patients onto a standard perinatal clinical history form designed for the study. This form registers data on obstetric history, prenatal care, labor, delivery, and neonatal outcomes. Additional information was recorded in specific instruments developed for the study. Risk factors that were considered in the current study included: maternal age, parity, gestational age, birthweight, onset of labor (spontaneous or induced), augmentation or induction with oxytocin, single or multiple pregnancy, fetal death,

instrumental delivery, episiotomy, tear and need of vaginal or perineal suture, placental retention, active management of third stage of labor, type of attendant (nurse/midwife or physician) and period of time (baseline or after intervention). These data were collected directly from the clinical records and the delivery log book from each hospital. The database incorporated routines for data validation (range and rules). This system was designed in such a way that data entry and validation were performed simultaneously, while the clinical record remained available to check for inconsistencies detected by the program routines. All data and validation reports were sent from hospitals to a research unit data center on a daily basis. Finally, after being reviewed, validated and stored in backup files, the final data set was sent to the Research Triangle Institute (RTI) in North Carolina, where the main study database is kept. The primary outcome for the current study was standard postpartum hemorrhage based on the definition by the World Health Organization (WHO) of blood loss ≥ 500 ml. In addition, severe postpartum haemorrhage (≥ 1000 ml of blood loss) and the need of blood transfusion were used as secondary outcomes. Nurses, midwives and physicians who were part of the teams attending deliveries at participating hospitals were trained in post-partum blood loss measurement. A plastic bag designed to collect blood (drape) was used to collect post-partum blood loss. This method has shown to be highly correlated ($r = 0.928$) with the photospectrometry method (the established gold standard for blood loss) (13). The drape was made of transparent plastic and was not calibrated. As soon as the baby was delivered, the drape was placed under the buttock. The blood was allowed to flow into the drape as long as the woman stayed in the delivery bed or chair. The time of delivery and the time when the blood collection started and finished were recorded. The blood loss was measured until the practitioner considered that it was not significant anymore. At the end of the blood collection period, the blood was poured in a calibrated jar and measured. The blood and collection drape was properly disposed of and the amount of blood loss was recorded on the study form by the birth attendant or the nurse. All analyses were conducted in STATA, version 9.0. Delivery characteristics were calculated as means and proportions for continuous and categorical variables, respectively. Potential risk factors that were collected as continuous variables were analyzed first as they were registered and after being categorized using standard clinical definitions. Age was categorized as adolescent (less than 19 years old), ideal reproductive health (19–34 years old) and older reproductive health (35 years old or more). Parity was categorized in nullipara (no previous deliveries), previous parity from 1 to 3, and multipara (more than 3 previous parities). Birthweight was categorized as low birth weight (less than 2500 grams), normal weight (between 2500 and 3999 grams) and macrosomia (4000 grams or more). Gestational age was categorized as pre-term birth (less than 37 weeks), term birth (between 37 and 41 weeks) and post-term birth (more than 41 weeks of gestational age). Multiple pregnancy, induced/augmented labor, episiotomy, termination, active management of third stage of labor and retained placenta were transformed in dummy variables. Tears were analyzed as a dichotomous variable and as an ordinal variable (no tear, first degree tear, second degree tear and third/fourth degree tear). Polynomial coding was used in the model to test linear trend in this variable. Need of suture was considered when a vaginal or perineal suture was performed regardless of its cause—including episiotomy. Collinearity tests (variance inflation factor and tolerance) showed that since episiotomy, tear and suture were independently associated with the outcome, they were considered in the analyses (14).

The percentages of deliveries with standard postpartum hemorrhage, severe postpartum hemorrhage and requiring a blood transfusion were calculated overall, and by pregnancy characteristics. Chi-square statistics and unadjusted odds ratios with their corresponding 95% confidence intervals were used to determine whether these independent variables were significantly associated with post partum haemorrhage or blood transfusion. Because risk factors may be interrelated, we performed logistic regression modeling on these data. Adjustment was also made for the variable period of data collection. The variables included in the final model were based on the following findings: a) initially bivariate analyses between

the outcome and the potential risk factor; and b) model selection (forward and backward stepwise). Due to the fact the included population was originally from 24 clusters—hospitals—, we performed cluster regression analyses (14). The final model was the one that included all the clinical effects of interest and with the best fit for the data. Based on the following considerations: i) an expected sample size of 11,000 vaginal deliveries; ii) an estimated prevalence of postpartum hemorrhage of 11% (defined as a blood loss equal or more than 500 ml); and iii) a relative risk of 2.0 between exposed and non-exposed for the studied factors, we estimated in advance that the power of the study would be over 80% for all studied variables.

RESULTS

The mean blood loss was 215 ml (standard deviation of 216 ml), the median was 150 ml with a range of from 40 ml and 2400 ml. Overall, 1,221 (10.8%) vaginal deliveries had standard postpartum hemorrhage and 209 (1.86%) severe postpartum hemorrhage. Among all 11,323 vaginal deliveries, 40 (0.35%) received a blood transfusion. The study population characteristics and the prevalence of moderate postpartum hemorrhage by risk factor levels are given in Tables 1 and 2. The risk factors more strongly associated and the incidence of moderate postpartum hemorrhage in women with each of these factors were: retained placenta (33.3%), multiple pregnancy (20.9%), macrosomia (18.6%), episiotomy (16.2%), and need for perineal suture (15.0%). All these factors remained statistically significantly associated after adjustments. On the other hand, active management of third stage of labor, multiparity and low birth weight showed a protective effect. In the bivariate analyses, severe postpartum hemorrhage was associated with retained placenta (incidence of severe postpartum hemorrhage in women with this factor was 17.1%), macrosomia (4.9%), induced labor (3.5%), first degree perineal tear (2.8%), episiotomy (2.7%), need for perineal suture (2.5%) and nulliparity (2.3%) (Table 3). After adjustment, retained placenta, multiple pregnancy, macrosomia and perineal or vaginal suture remained statistically significantly associated (Table 3).

Only fetal death, tear and retained placenta were associated with blood transfusion. Frequency of blood transfusions in women presenting these events was 4.3%, 3.6% and 0.5%, respectively. After accounting for the most important factors, these associations were still observed. Due to the fact that blood transfusion may be caused, or at least may be strongly associated with the presence of severe postpartum hemorrhage, we account for blood loss/severe postpartum hemorrhage in some of the analyses in order to estimate the effect brought about through these variables. Again, fetal death (aOR:7.98; 95%CI 1.79–36.00), placental retention (aOR:9.74; 95%CI 3.30–28.76) and tears (aOR:2.84; 95%CI 1.10–7.35) were associated with this medical intervention after accounting for the effect of blood loss or severe postpartum hemorrhage. Finally, we performed the analyses for moderate postpartum hemorrhage and severe postpartum hemorrhage in data from the two different periods of time (baseline and post-intervention) and the findings were similar, except for the loss of power due to sample size reduction.

DISCUSSION

The purpose of this report was to analyze risk factors for post-partum hemorrhage in a Latin American population. A major strength of this study is the accurate way in which blood loss was measured. The majority of previously reported studies had the measurement of blood loss through visual estimation without any objective measurement. The degree of inaccuracy of this method varies greatly, with many studies demonstrating that visual estimates range from 30 to 50% of actual losses (3–5,13). Furthermore, this inaccuracy increases with increasing blood loss (5). Thus, it is very likely that misclassification of the outcome may have occurred since visual estimation of blood loss may be biased by the attendant's previous knowledge of

potential risk factors. To further ensure data accuracy, all records in this study were collected following rigorous methods with quality control processes within each hospital, and among the main data centre and each hospital in the original trial. These processes achieved a final dataset with a very low rate of missing data. The main limitation of this study is the absence of some variables in the dataset that could be considered important risk factors (such as previous postpartum hemorrhage, prolonged labor and/or previous caesarean section). Although some of the collected variables (e.g., augmentation with oxytocin instead of prolonged labor) have allowed us to adjust indirectly for variables not collected, residual confounding may be present in our results. A further limitation is that the observed number of events for severe postpartum hemorrhage and blood transfusion was low; therefore, statistical power to detect significant associations with some specific variables was also low. Finally, it is pertinent to discuss two important considerations related to selection bias. Due to the fact that both countries -Argentina and Uruguay- have institutional deliveries in almost 98% of the population (15), we believe that for these two countries there is no selection bias in the selected population. Nevertheless, this situation does not necessarily apply to other Latin American countries; therefore, we are prevented from generalizing the results to the rest of the region. On the other hand, we cannot assure that there is no selection bias within the population, since we have only considered vaginal deliveries for the analysis, and cesarean section deliveries were not included (because there was not data collection for blood loss). The distribution of the potential risk factors, as well as the presence of blood loss, may be very different from the ones from vaginal deliveries.

Our findings show that retained placenta, multiple pregnancy, macrosomia (defined as a birth weight of 4,000 grams or more) episiotomy and suture are all risk factors for this Latin-American population. In previously published studies, these risk factors have been reported to be associated with postpartum hemorrhage (6–9,16). However, other risk factors such as maternal age, nulliparity, augmentation and/or induction with oxytocin during first or second stage of labor and preterm birth were not associated with increased risk of postpartum hemorrhage in the current study. Our findings show that active management of third stage of labor, low birth weight and multiparity (more than three deliveries) are protective factors against developing moderate post-partum hemorrhage. Multiparity has been cited in many previous studies as an important risk factor (9,17,18), and it has been used as an important clinical marker for postpartum hemorrhage by practitioners. Nevertheless, not only the deleterious effect of this variable could not be confirmed in our dataset but also we found an important protective effect of multiparity for postpartum hemorrhage. Nevertheless, the difference may be due to the cut off level for parity or grand multiparity. In the same way, maternal age as a risk factor has been controversial in previous reports (6,7,18–20). Again, in our population, the apparent association during initial analyses between maternal age and postpartum hemorrhage virtually disappeared after including other risk factors.

In sum, risk factors for postpartum hemorrhage in the current study included retained placenta, multiple pregnancy, macrosomia, episiotomy, suture, as well as non-use of active management of third stage of labor. The majority of these factors are related to the second and third stage of labor. Therefore, an effort should be made, during the time of delivery, to apply prevention techniques such as restrictive episiotomy and active management of labor to prevent postpartum hemorrhage in vaginal deliveries.

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References

1. World Health Organization. World Health Report. Geneva: 2005.
2. Donnay F. Maternal survival in developing countries: what has been done, what can be achieved in the next decade. *Int J Gynaecol Obstet* 2000;70:89–97. [PubMed: 10884537]
3. Chua S, Ho LM, Vanaja K, Nordstrom L, Roy AC, Arulkumaran S. Validation of a laboratory method of measuring postpartum blood loss. *Gynecol Obstet Invest* 1998;46:31–33. [PubMed: 9692338]
4. Razvi K, Chua S, Arulkumaran S, Ratnam SS. A comparison between visual estimation and laboratory determination of blood loss during the third stage of labour. *AustNZ J Obstet Gynaecol* 1996;36:152–54.
5. Duthie SJ, Ven D, Yung GL, Guang DZ, Chan SY, Ma HK. Discrepancy between laboratory determination and visual estimation of blood loss during normal delivery. *EurJ Obstet Gynecol Reprod Biol* 1991;38:119–24.
6. Bais JM, Eskes M, Pel M, Bonsel GJ, Bleker OP. Postpartum haemorrhage in nulliparous women: incidence and risk factors in low and high risk women. A Dutch population-based cohort study on moderate ($> \text{or} = 500 \text{ ml}$) and severe ($> \text{or} = 1000 \text{ ml}$) postpartum haemorrhage. *EurJ Obstet Gynecol Reprod Biol* 2004;115:166–72.
7. Stones RW, Paterson CM, Saunders NJ. Risk factors for major obstetric haemorrhage. *EurJ Obstet Gynecol Reprod Biol* 1993;48:15–18. [PubMed: 8449256]
8. Combs CA, Murphy EL, Laros RK Jr. Factors associated with postpartum hemorrhage with vaginal birth. *Obstet Gynecol* 1991;77:69–76. [PubMed: 1984230]
9. Xiong Q, Zhang GY, Chen HC. Analysis of risk factors of postpartum hemorrhage in rural women. *Zhonghua Fu Chan KeZa Zhi* 1994;29:582–5. 635.
10. Roopnarinesingh SS. The young Negro primigravida in Jamaica. *J Obstet Gynaecol Br Commonw* 1970;77:424–26.
11. Althabe F, Buekens P, Bergel E, Belizan JM, Campbell MK, Moss N, et al. A behavioral intervention to improve obstetrical care. *N Engl J Med* 2008;358:1929–40.
12. Althabe F, Buekens P, Bergel E, Belizan JM, Kropp N, Wright L, et al. A cluster randomized controlled trial of a behavioral intervention to facilitate the development and implementation of clinical practice guidelines in Latin American maternity hospitals: the Guidelines Trial: Study protocol [ISRCTN82417627]. *BMC Womens Health* 2005;5:4.
13. Patel A, Goudar SS, Geller SE, Kodkany BS, Edlavitch SA, Wagh K, et al. Drape estimation vs. visual assessment for estimating postpartum hemorrhage. *Int J Gynaecol Obstet* 2006 Jun;93(3):220–4. [PubMed: 16626718]
14. Long, JS.; Freese, J. Revised Edition. Stata Press; 2003. Regression Models for Categorical Dependent Variables Using Stata.
15. Pan American Health Organization. Health Analysis and Information Systems. 2008. At: <http://www.paho.org/english/dd/ais/coredata.htm>
16. Ohkuchi A, Onagawa T, Usui R, Koike T, Hiratsuka M, Izumi A, et al. Effect of maternal age on blood loss during parturition: a retrospective multivariate analysis of 10,053 cases. *J Perinat Med* 2003;31:209–15. [PubMed: 12825476]
17. Babinszki A, Kerenyi T, Torok O, Grazi V, Lapinski RH, Berkowitz RL. Perinatal outcome in grand and great-grand multiparity: effects of parity on obstetric risk factors. *Am J Obstet Gynecol* 1999;181:669–74. [PubMed: 10486482]
18. Tsu VD. Postpartum haemorrhage in Zimbabwe: a risk factor analysis. *Br J Obstet Gynaecol* 1993;100:327–33. [PubMed: 8494833]
19. Selo-Ojeme DO, Okonofua FE. Risk factors for primary postpartum haemorrhage. A case control study. *Arch Gynecol Obstet* 1997;259:179–87. [PubMed: 9271837]
20. Du S, Liu X, Hu Q. Epidemiologic study on the risk factors of postpartum hemorrhage. *Zhonghua Liu XingBingXue Za Zhi* 1994;15:206–08.

Figure 1.
Study population

Table 1

Characteristics of the study population

	No Postpartum Hemorrhage N = 10,102 Number (%)	Postpartum Hemorrhage $\geq$ 500 ml N = 1,221 Number (%)	Postpartum Hemorrhage $\geq$ 1,000 ml N = 209 Number (%)
Maternal Age			
Less than 19 years old	1,605 (15.9)	248 (20.3)	41 (19.6)
Between 19 and 34	7,544 (74.7)	892 (73.1)	152 (72.7)
35 years old or more	953 (9.4)	81 (6.6)	16 (7.6)
Parity			
Nullipara	3,487 (34.5)	560 (45.9)	93 (44.5)
1–3 previous para	5,058 (50.1)	564 (46.2)	97 (46.4)
More than 3 previous para	1,157 (15.4)	97 (7.9)	19 (9.1)
Birthweight			
Low birth weight (< 2,500 g)	727 (7.2)	49 (4.0)	11 (5.3)
Normal weight	8,796 (87.1)	1040 (85.2)	163 (78.0)
Macrosomy (> 4,000 g)	579 (5.7)	132 (10.8)	35 (16.7)
Gestational age*			
Preterm birth (less than 37 weeks)	617 (6.1)	52 (4.3)	14 (6.7)
Term pregnancy (37–41 weeks)	9,400 (93.1)	1,157 (94.8)	190 (91.4)
Post-term pregnancy (> 41 weeks)	81 (0.8)	11 (0.9)	4 (1.9)
Multiple pregnancy			
No	10,068 (99.7)	1,212 (99.3)	207 (99.0)
Yes	34 (0.3)	9 (0.7)	2 (1.0)
Onset of labor**			
Spontaneous	9,413 (93.2)	1,117 (91.5)	181 (88.6)
Induction	689 (6.8)	104 (8.5)	28 (13.4)
Induced/augmented labor			
No	3,855 (38.2)	477 (39.1)	75 (35.9)
Yes	6,247 (61.8)	743 (60.9)	134 (64.1)
Fetal death			
No	10,042 (99.4)	1,211 (99.2)	207 (99.0)
Yes	60 (0.6)	10 (0.8)	2 (1.0)
Termination			
Spontaneous	9,813 (97.1)	1,147 (93.9)	198 (94.7)
Operative deliveries	289 (2.9)	74 (6.1)	11 (5.3)
Episiotomy			
No	6,328 (62.6)	490 (40.1)	89 (42.6)
Yes	3,774 (37.4)	731 (59.9)	120 (57.4)
Tears			
No	8,364 (82.8)	948 (77.7)	157 (75.1)
First degree	1,256 (12.4)	198 (16.2)	41 (19.6)
Second degree	438 (4.3)	61 (5.0)	9 (4.3)

	No Postpartum Hemorrhage N = 10,102 Number (%)	Postpartum Hemorrhage $\geq$ 500 ml N = 1,221 Number (%)	Postpartum Hemorrhage $\geq$ 1,000 ml N = 209 Number (%)
Third and fourth degree	44 (0.5)	14 (1.1)	2 (1.0)
Suture			
No	4,947 (49.0)	307 (25.1)	56 (26.8)
Yes	5,155 (51.0)	914 (74.9)	153 (73.2)
Active management of labor ***			
No	6,289 (62.3)	946 (77.5)	159 (76.1)
Yes	3,810 (37.7)	274 (22.5)	50 (23.9)
Retained placenta ****			
No	10,006 (99.3)	1,168 (96.9)	184 (90.6)
Yes	74 (0.7)	37 (3.1)	19 (9.4)

* 5 missing data

** 2 missing data

*** 4 missing data

**** 38 missing data

Table 2
Bivariate analyses between risk factors and moderate and severe postpartum hemorrhage (N = 11,323)

	Postpartum Hemorrhage ≥ 500 ml			Postpartum Hemorrhage $\geq 1,000$ ml		
	% PPH	Odds Ratio	95% Confidence Interval	% PPH	Odds Ratio	95% Confidence Interval
Maternal Age						
Less than 19 years old	13.4	1.31	1.12–1.52	2.2	1.23	0.87–1.75
Between 19 and 34	10.6	1.00	Reference	1.8	1.00	Reference
35 years old or more	7.8	0.72	0.57–0.91	1.6	0.86	0.51–1.44
Parity						
Nullipara	13.8	1.44	1.27–1.63	2.3	1.33	1.01–1.79
1–3 previous para	10.0	1.00	Reference	1.7	1.00	Reference
More than 3 previous para	5.9	0.56	0.45–0.70	1.2	0.66	0.40–1.09
Birthweight						
Low birth weight ($< 2,500$ g)	6.3	0.57	0.42–0.77	1.4	0.85	0.46–1.58
Normal weight	10.6	1.00	Reference	1.7	1.00	Reference
Macrosomia ($> 4,000$ g)	18.6	1.93	1.58–2.36	4.9	3.07	2.11–4.47
Gestational age *						
Preterm birth (< 37 weeks)	7.8	0.68	0.51–0.91	2.1	1.16	0.67–2.02
Term pregnancy (37–41 weeks)	10.9	1.00	Reference	1.8	1.00	Reference
Post-term pregnancy (> 41 weeks)	11.9	1.10	0.59–2.08	4.4	2.48	0.90–6.83
Multiple pregnancy						
No	10.7	1.00	Reference	1.8	1.00	Reference
Yes	20.9	2.20	1.05–4.60	4.7	2.61	0.63–10.7
Onset of labor						
Spontaneous	10.6	1.00	Reference	1.7	1.00	Reference
Induction	13.1	1.27	1.03–1.58	3.5	2.09	1.40–3.14
Induced/augmented labor **						
No	11.0	1.00	Reference	1.7	1.00	Reference
Yes	10.6	0.96	0.85–1.09	1.9	1.11	0.83–1.48
Fetal death						
No	10.8	1.00	Reference	1.8	1.00	Reference
Yes	14.3	1.38	0.71–2.71	2.8	1.57	0.38–6.45

	Postpartum Hemorrhage ≥ 500 ml			Postpartum Hemorrhage $\geq 1,000$ ml		
	% PPH	Odds Ratio	95% Confidence Interval	% PPH	Odds Ratio	95% Confidence Interval
Termination						
Spontaneous	10.5	1.00	Reference	1.8	1.00	Reference
Operative deliveries	20.4	2.19	1.68–2.85	3.0	1.70	0.92–3.15
Episiotomy						
No	7.2	1.00	Reference	1.3	1.00	Reference
Yes	16.2	2.21	2.21–2.83	2.7	2.07	1.57–2.73
Tears						
No	10.2	1.00	Reference	1.7	1.00	Reference
First degree	13.6	1.39	1.18–1.64	2.8	1.70	1.19–2.40
Second degree	12.2	1.23	0.93–1.62	1.9	1.07	0.54–2.11
Third and fourth degree	24.1	2.80	1.53–5.14	3.5	2.08	0.50–8.61
Suture						
No	5.8	1.00	Reference	1.0	1.00	Reference
Yes	15.0	2.86	2.49–3.28	2.5	2.40	1.76–3.27
Active management of 3rd stage of labor						
No	13.1	1.00	Reference	2.2	1.00	Reference
Yes	6.7	0.48	0.42–0.55	1.2	0.55	0.40–0.76
Retained placenta						
No	10.6	1.00	Reference	1.6	1.00	Reference
Yes	33.3	4.28	2.87–6.39	17.1	12.34	7.35–20.71

* 5 missing data

**

2 missing data

4 missing data

38 missing data

Table 3
Multivariate analyses for moderate and severe postpartum hemorrhage

	Postpartum hemorrhage ≥ 500 ml		Postpartum hemorrhage $\geq 1,000$ ml	
	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval
Retained placenta	6.02	3.50–10.36		
Multiple pregnancy	4.67	2.41–9.05	16.04	7.15–35.99
Macrosomia	2.36	1.93–2.88	4.34	1.46–12.87
Episiotomy	1.70	1.15–2.50	3.48	2.27–5.36
Suture	1.66	1.11–2.49	1.39	0.85–2.31
Operative deliveries	1.43	1.09–2.49	2.50	1.87–3.36
Tear (by degree) *	1.23	1.00–1.51	1.17	0.45–2.85
Onset of labor	1.25	1.04–1.50	1.12	0.80–1.56
Multipara	0.75	0.60–0.93	2.00	1.30–3.09
Active management of 3 rd stage of labor	0.54	0.39–0.75	0.81	0.50–1.32
Low Birth Weight	0.48	0.36–0.64	0.60	0.35–1.00
			0.65	0.36–1.17

Adjusted for all variables included in the table and period of data collection.

* Non-statistically significant