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Risk Factors for Prolonged Postpartum Length of Stay Following Cesarean Delivery

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Abstract

Objective—This study aims to identify risk factors for prolonged postpartum length of stays (LOS) after cesarean delivery (CD).

Study Design—Patients undergoing CD were sourced from a multicenter registry of 19 academic centers between 1999 and 2002 (n = 57,067). Prolonged postpartum LOS was defined as a hospitalization duration ≥ 90th centile. Maternal, antepartum, perioperative, and neonatal variables were compared between women with and without prolonged postpartum LOS.

Results—The 90th centile for postpartum LOS was 4 days, with 14,954 women experiencing prolonged postpartum LOS. Women with perioperative complications had the highest independent risk for a prolonged postpartum LOS: ileus (adjusted odds ratio [aOR] = 12.28; 95% confidence interval CI = 8.98–16.8); endometritis (aOR = 10.45; 95% CI = 9.51–11.5), and wound complications (aOR = 5.49; 95% CI = 4.54–6.63). Several antepartum, perioperative, and neonatal variables were associated with a prolonged postpartum LOS.

Conclusion—Perioperative complications had the highest risk for prolonged LOS after CD. Strategies to reduce perioperative complications are needed to decrease the health care burden of prolonged post-CD LOS.

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Conflict of Interest

The authors report no conflict of interest.

Note

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Contribution to Authorship

Y. B., D. L., Y. E. S., and A. J. B. assisted with conception of the study, study design, data analysis, and article writing. L. M. N. assisted with data analysis and article writing.

This study was given a waiver of exemption from the Stanford University Institutional Review Board approval as the Caesarean registry dataset contains deidentified data.

Keywords

cesarean; postpartum length of stay; prolonged

Cesarean delivery is one of the most common surgeries performed in the United States. In 2012, over 1.2 million cesarean deliveries were performed, accounting for 32.8% of all deliveries.[1] Cesarean delivery has been implicated as an important explanatory factor for increasing rates of maternal morbidity, which includes venous thromboembolism, shock, and hemorrhage.[2] As a consequence, multiple large-scale initiatives have been promoted by leading obstetric figures and organizations to reduce rates of maternal morbidity.[3–5]

Postoperative length of stay (LOS) after nonobstetric surgery has been identified as an important quality indicator of inpatient care.[6–8] LOS after cesarean delivery may also be an important metric for evaluating the quality of peripartum and postpartum obstetric care. Unfortunately, studies investigating risk factors associated with prolonged LOS after a cesarean delivery are lacking. Such data could assist ongoing efforts aimed at reducing maternal morbidity after cesarean delivery and could be useful for evaluating postcesarean LOS as a quality measure related to obstetric practice.

The primary aim of this study was to identify risk factors for prolonged postpartum LOS after cesarean delivery. Moreover, we sought to analyze the contribution of potentially modifiable risk factors on prolonged LOS to highlight areas where improvements in perioperative care could be made. We also performed a secondary analysis to identify risk factors for prolonged LOS for the entire delivery hospitalization period including the intrapartum period.

Patients and Methods

The study cohort was identified using a dataset (the Cesarean registry) sourced from a previous multicenter study by the National Institute of Child Health and Human Development Maternal-Fetal Medicine Units (MFMU) Network.[9] Briefly, between 1999 and 2002, data were collected in women who underwent primary cesarean delivery, repeat cesarean delivery, or trial of labor after cesarean, and who delivered infants ≥ 20 weeks or ≥ 500 g at 19 academic centers. The final 2 years of the study included only women who underwent repeat cesarean delivery or vaginal birth after cesarean. Data were collected through detailed chart review at delivery, and information regarding perioperative morbidity was collected from discharge summaries. Patients and hospitals were deidentified by the MFMU.

For the current study, we included only women from the Cesarean registry who had undergone a primary or repeat cesarean delivery. Based on a definition described by Kuklina et al,[2] we defined a prolonged postpartum LOS as a postpartum hospitalization (number of hospital days between cesarean delivery to hospital discharge) with a postpartum LOS ≥ 90th centile. In the Cesarean registry dataset, all dates were expressed as day numbers. Maternal demographic, antepartum, perioperative, and neonatal variables were compared between women with and without prolonged LOS. Maternal characteristics included: age,

race/ethnicity, body mass index (BMI) at delivery, diabetes, chronic hypertension, and number of prior cesarean deliveries. Obstetric variables included: gestational age at delivery, pregnancy-associated hypertension, labor, or induction before the cesarean delivery, and chorioamnionitis. Perioperative variables included: type of uterine incision, mode of anesthesia, intraoperative red blood cell transfusion, hysterectomy, and postpartum complications, such as endometritis and wound complications. We also compared birth weights of neonates of women with versus without prolonged LOS.

We performed bivariate analyses to compare maternal, obstetric, and neonatal characteristics between women with and without prolonged LOS after cesarean delivery. Categorical variables were compared using the chi-square test; bivariate analyses did not account for missing data. Based on bivariate analyses, unadjusted odds ratios (ORs) and accompanying 95% confidence intervals (CIs) were calculated. Candidate variables that were associated with prolonged LOS on bivariate analyses ($p \leq 0.1$) were included as covariates in an unconditional multivariable logistic regression model. The final model was determined using a traditional backward elimination, with all variables initially included and then selectively removed if not significant ($p < 0.05$). To determine the presence of collinearity between independent variables, variance inflation factor (VIF) testing was performed. Collinearity was determined to be insignificant as VIF scores ranged from 1.01 to 1.49 with a mean VIF score of 1.18. Population attributable fractions (PAFs) were used to calculate the proportional reduction in risk of prolonged LOS that would occur by eliminating the exposure of interest from the population while the distribution of other risk factors remained unchanged. PAFs were calculated for selected risk factors that were considered modifiable by using adjusted ORs (aORs) from the final multivariate model.[10] We calculated the area under the receiver-operating characteristic curve (AUROC) using standard methodology to assess the predictive performance of the final model.

Based on data for the date of hospital admission and discharge, we performed a secondary analysis to assess risk factors for prolonged total length of hospital stay, defined as the interval from admission to discharge. For the total period of hospital stay we defined a prolonged delivery hospitalization as a total hospital LOS ≥ 90th centile. We did not count the day of admission in the calculation for the total hospital LOS.

Data analyses were performed using SAS 9.2 (SAS Inc., Cary, NC) and STATA version 12 (Statacorp, College Station, TX). As the Cesarean registry contains deidentified data, our study was deemed institutional review board exempt by the Stanford Institutional Review Board.

Results

A total of 57,812 women underwent primary or repeat cesarean delivery in the MFMU Cesarean registry. We excluded 79 women with missing LOS data, and 36 women who died during their hospitalization. The median (interquartile range [IQR]) postpartum LOS after cesarean delivery was 3 days (3–4 days). The 90th centile for the postpartum LOS was 4 days and 14,954 women were identified with a prolonged postpartum LOS.

Maternal sociodemographic and antepartum characteristics were compared between women with and without prolonged LOS (Table 1). Compared with women with a postpartum LOS < 4 days, women with prolonged postpartum LOS were more likely to have the following characteristics: aged < 20 years or > 34 years, non-Hispanic race/ethnicity, private or government-assisted insurance, BMI ≤ 24.9 or ≥ 40, medical comorbidity (preexisting diabetes; chronic hypertension; asthma), obstetric comorbidity (pregnancy-related hypertension, placenta previa, preterm delivery), and multiple pregnancy (Table 1). On bivariate analyses, compared with women with no prior cesarean deliveries, women with one cesarean or two or more prior cesareans were less likely to have prolonged postpartum LOS (Table 1).

We then compared perioperative and postpartum risk factors between those with and without a prolonged postpartum LOS (Table 2). Perioperative morbidities, including intraoperative transfusion, postpartum transfusion, hysterectomy, wound complications, maternal ileus, and endometritis, were more common among women with prolonged postpartum LOS. Women who delivered neonates with low birth weight (< 2,500 g) also had significantly higher rates of prolonged postpartum LOS compared with women who delivered infants between 2,500 and 3,499 g or neonates ≥ 3,500 g.

Table 3 summarizes the crude and aORs of risk factors for prolonged postpartum LOS. Patients who experienced perioperative complications had the highest aOR for prolonged LOS: ileus (aOR = 12.28); endometritis (aOR = 10.45), wound complications (aOR = 5.49), hysterectomy during cesarean delivery (aOR = 3.16), and postpartum red blood cell (RBC) transfusion (aOR = 3.04). Among the obstetric morbidities included in our model, eclampsia/hemolysis, elevated liver enzymes, low platelets (HELLP) syndrome had the highest risk of prolonged postpartum LOS (aOR = 2.65). For prolonged postpartum LOS, the PAFs for surgical complications were high (endometritis = 9.8% [95% CI = 9.4–10.2%]; ileus = 10.3% [95% CI = 9.5–11.3%]; and wound complications = 15.1% [95% CI = 13.5–16.7%].

Women whose insurance status was self-pay or other, who were Hispanic, or who had an infant with a birth weight ≥ 3,500 g were independently associated with a reduced risk of prolonged postpartum LOS. The final model yielded an AUROC of 0.72, which indicates moderate model discrimination.

In our secondary analysis, the median (IQR) period for total LOS was 3 days (3–4 days), and the 90th centile for the total LOS was 6 days. A total of 6,122 (10.6%) women were identified with a prolonged total LOS. Data for sociodemographic, antepartum, peripartum, and postpartum characteristics for women with and without prolonged total LOS are presented in Tables 1 and 2. Data from our logistic models for prolonged total LOS are presented in Table 3. Consistent with the findings of our primary analysis, perioperative complications were independently associated with the highest risk for prolonged total LOS: endometritis (aOR = 9.81), ileus (aOR = 9.28), wound complications (aOR = 5.0), postpartum RBC transfusion (aOR = 2.67), and hysterectomy during cesarean (aOR = 2.02). However, these point estimates were all lower than those observed for prolonged postpartum LOS. The PAF for endometritis for prolonged total LOS was 16.2% (95% CI = 15.3–

17.1%). The PAFs for prolonged total LOS were lower for ileus 1.9% (95% CI = 1.6–2.2%) and wound complications 2.3% (95% CI = 1.9–2.7%).

Discussion

Among 57,812 women who underwent cesarean delivery in the MFMU network between 1999 and 2002, 14,954 women incurred a prolonged postpartum LOS. We identified several maternal, medical, and obstetric characteristics linked to prolonged postpartum LOS: African American race, BMI ≥ 40, diabetes, asthma, chronic hypertension, multiple pregnancy, ≥ 1 prior cesarean, and pregnancy-associated hypertensive disorders. In addition, specific perioperative morbidities (general anesthesia, uterine atony, transfusion, hysterectomy, endometritis, ileus, wound complications), and perinatal factors (preterm delivery, neonatal birth weight) were also independently associated with prolonged postpartum LOS. Of these, ileus, endometritis, and wound complications conferred the highest risk for prolonged postpartum LOS. These surgery-related complications also conferred the highest risk for a prolonged total LOS. Based on our findings, attention should be focused on developing new approaches for managing high-risk patients and improving surgical practices to decrease the risk of prolonged LOS after cesarean delivery.

In our cohort, patient, perioperative, and perinatal-related factors were associated with prolonged postpartum and prolonged total LOS. Although the etiologies for prolonged LOS could not be ascertained, many of the risk factors for prolonged LOS identified in our study have also been linked to obstetric morbidity. African American women have been reported to have the highest rates of morbidity compared with women of other races or ethncities.[11,12] Furthermore, obese women are known to be at increased risk of intrapartum morbidity, prolonged hospital stay, and wound complications related to cesarean delivery.[13,14] We found that women with indicators for severe obstetric hemorrhage (transfusion, hysterectomy) had at least a 1.8-fold increased odds of prolonged postpartum LOS. Our findings are in keeping with those from other population wide studies that have identified hemorrhage-related morbidities, notably transfusion and hysterectomy, as important indicators of obstetric morbidity.[2,15] Women who had undergone ≥ 1 prior cesarean delivery were observed to be at an increased risk of prolonged postpartum LOS compared with women who had no prior cesareans.

Among the independent variables examined, patients who developed endometritis, ileus, or wound complications had the highest risk of prolonged postpartum and total LOS. The morbidity associated with endometritis may be underappreciated, especially as rates of postcesarean endometritis reported in other studies are high, ranging from 16.9% to 32%.[16,17] While the Cesarean registry did not contain detailed data on antibiotic protocols or operative techniques, the high rate of endometritis among women with prolonged LOS deserves attention. Ileus, a potentially modifiable perioperative complication, had the highest odds for prolonged postpartum LOS. It is possible that early feeding after cesarean delivery may reduce the risk of ileus and secondarily prolonged postpartum LOS. In a recent meta-analysis, early oral intake after cesarean delivery was associated with the earlier return of gastrointestinal function and did not increase the occurrence of gastrointestinal complications.[18] Though not all studies included in this meta-analysis reported LOS, one

randomized controlled trial found early feeding to be associated with a significantly shorter hospital stay (4.8 vs. 6.7 days).[19]

Although postoperative LOS may be a useful outcome for analyzing obstetric morbidity, the Agency for Healthcare Research and Quality and the National Quality Forum have not identified LOS as an indicator of maternal quality of care.[20,21] Renewed efforts are needed to improve the perioperative and postoperative care of low- and high-risk patients undergoing cesarean delivery to reduce the health care and cost burden of prolonged hospitalization. In nonobstetric surgical settings, multidisciplinary pathways have been adopted which have successfully reduced LOS after surgery.[22–24]

The major strength of this study is that the Cesarean registry comprises clinical data on more than 57,000 women who underwent cesarean delivery at the 19 U.S. obstetric centers. Due to the large sample size and quality of the clinical data available in the registry, we were able to investigate the influence of several candidate variables on prolonged LOS.

We acknowledge that our study has several limitations. Hospitals within the MFMU network were academic and university affiliated, therefore, our findings may not be generalizable to all hospital settings. However, the median total and postpartum LOS found in our cohort was 3 days, respectively. This finding is consistent with the mean LOS (3.5 days) for cesarean delivery at a national level (from the 2006 National Hospital Discharge Survey).[25] We could not account for other unmeasured clinical factors that may have influenced postpartum LOS, such as intraoperative adhesions and severity of postoperative pain[26,27] along with total hospital LOS (such as obstetric and fetal conditions that warrant early antenatal admission). In addition, other hospital-level or patient-level factors may have influenced LOS after cesarean delivery, such as institution-specific criteria for patient discharge, individual obstetrician's years of experience, physician and nursing efficiencies of postpartum care, and patient preferences for the day of hospital discharge. These nuanced data were not available in the Cesarean registry. Further studies are needed to validate these findings and to elucidate etiologies for prolonged LOS after the cesarean delivery.

Based on our findings, preexisting obstetric disease and potentially modifiable perioperative complications such as endometritis, ileus, wound complications, and hemorrhage-related morbidities were identified as risk factors for prolonged LOS after cesarean delivery. These data highlight the need to optimize the preoperative and perioperative care of women undergoing cesarean delivery. By adopting strategies to improve the care of high-risk women undergoing cesarean delivery and decreasing rates of perioperative morbidity, the health care burden of prolonged LOS may be reduced.

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Table 1

Maternal demographic and antepartum data by postpartum and total hospital length of stay

	Postpartum LOS < 4 d (*n* = 42,113)	**Postpartum LOS ≥ 4 d (*n* = 14,954)**	***p*-Value**	**Total hospital LOS < 6 d (*n* = 50,945)**	**Total hospital LOS ≥ 6 d (*n* = 6,122)**	***p*-Value**
Maternal demographics						
Maternal age (y)			< 0.001			< 0.001
< 20	2,925 (6.9%)	1,242 (8.3%)		3,470 (6.8%)	697 (11.4%)	
20–34	30,107 (71.5%)	9,665 (64.6%)		35,783 (70.3%)	3,989 (65.2%)	
> 34	8,890 (21.1%)	3,894 (26.1%)		11,423 (22.4%)	1,361 (22.2%)	
Missing	191 (0.5%)	153 (1.0%)		269 (0.5%)	75 (1.2%)	
Insurance status			< 0.001			< 0.001
Government-assisted	16,632 (39.5%)	6,145 (41.1%)		19,906 (39.1%)	2,871 (46.9%)	
Private insurance	16,938 (40.2%)	6,860 (45.9%)		21,680 (42.6%)	2,118 (34.6%)	
Self-pay/other	6,260 (14.9%)	1,362 (9.1%)		6,887 (13.5%)	735 (12.0%)	
Missing	2,283 (5.4%)	587 (3.9%)		2,472 (4.8%)	398 (6.5%)	
Race			< 0.001			< 0.001
Caucasian	16,666 (39.6%)	6,227 (41.6%)		20,790 (40.8%)	2,103 (34.4%)	
African American	10,756 (25.5%)	5,142 (34.4%)		13,404 (26.3%)	2,494 (40.7%)	
Hispanic	12,688 (30.1%)	2,710 (18.1%)		14,180 (27.8%)	1,218 (19.9%)	
Other	2,003 (4.8%)	875 (5.9%)		2,571 (5.1%)	307 (5%)	
BMI at delivery (kg/m^2)			< 0.001			< 0.001
≤ 24.9	3,526 (8.4%)	1,380 (9.2%)		4,182 (8.2%)	724 (11.8%)	
25–29.9	11,597 (27.5%)	3,988 (26.7%)		14,141 (27.8%)	1,444 (23.6%)	
30–34.9	11,982 (28.4%)	3,945 (26.4%)		14,502 (28.5%)	1,425 (23.3%)	
35–39.9	6,822 (16.2%)	2,368 (15.8%)		8,204 (16.1%)	986 (16.1%)	
≥ 40	5,627 (13.4%)	2,445 (16.4%)		6,993 (13.7%)	1,079 (17.6%)	
Missing	2,559 (6.1%)	828 (5.5%)		2,923 (5.7%)	464 (7.6%)	
Preexisting maternal comorbidities						
Preexisting diabetes	3,815 (9.1%)	1,749 (11.7%)	< 0.001	4,602 (8.1%)	962 (15.7%)	< 0.001
Chronic hypertension	863 (2.1%)	715 (4.8%)	< 0.001	1,109 (2.2%)	469 (7.7%)	< 0.001

	Postpartum LOS < 4 d (*n* = 42,113)	Postpartum LOS ≥ 4 d (*n* = 14,954)	*p*-Value	Total hospital LOS < 6 d (*n* = 50,945)	Total hospital LOS ≥ 6 d (*n* = 6,122)	*p*-Value
Asthma	2,854 (6.8%)	1,347 (9.0%)	< 0.001	3,634 (7.1%)	567 (9.3%)	< 0.001
Antepartum variables						
Gestational age at delivery (wks)			< 0.001			< 0.001
< 37	6,648 (15.8%)	4,983 (33.3%)		7,754 (15.2%)	3,877 (63.3%)	
37–41	31,924 (75.8%)	8,963 (59.9%)		38,955 (76.5%)	1,932 (31.6%)	
> 41	3,477 (8.3%)	985 (6.6%)		4,162 (8.2%)	300 (4.9%)	
Missing	64 (0.1%)	23 (0.2%)		74 (0.1%)	13 (0.2%)	
Number of gestations			< 0.001			< 0.001
Singleton pregnancy	40,375 (96.7%)	13,852 (92.6%)		49,128 (96.4%)	5,459 (89.2%)	
Multiple pregnancy	1,378 (3.3%)	1,102 (7.4%)		1,817 (3.6%)	663 (10.8%)	
Number of prior CD			< 0.001			< 0.001
None	16,333 (38.8%)	6,870 (45.9%)		19,512 (38.3%)	3,691 (60.3%)	
1 prior CD	17,917 (42.5%)	5,637 (37.7%)		21,869 (42.9%)	1,685 (27.5%)	
2 or more prior CD	7,698 (18.3%)	2,380 (15.9%)		9,372 (18.4%)	706 (11.5%)	
Missing	165 (0.4%)	67 (0.5%)		192 (0.4%)	40 (0.7%)	
Pregnancy-associated hypertension[a]			< 0.001			< 0.001
None	37,810 (89.8%)	11,794 (78.9%)		45,763 (89.8%)	3,841 (62.8%)	
Gestational hypertension	1,366 (3.3%)	588 (3.9%)		1,649 (3.2%)	305 (15.6%)	
Preeclampsia	2,752 (6.5%)	2,241 (15.0%)		3,244 (6.4%)	1,749 (28.6%)	
Eclampsia/HELLP syndrome	181 (0.4%)	329 (2.2%)		284 (0.6%)	226 (3.7%)	
Placenta previa	557 (1.3%)	340 (2.3%)	< 0.001	541 (1.1%)	356 (5.8%)	< 0.001

Abbreviations: BMI, body mass index; CD, cesarean delivery; HELLP, hemolysis, elevated liver enzymes, low platelets; LOS, length of stay.

[a]Six patients missing data for pregnancy-associated hypertension.

Table 2

Perioperative, postpartum, and neonatal characteristics by postpartum and total hospital length of stay

	Postpartum LOS < 4 d (*n* = 42,113)	**Postpartum LOS ≥ 4 d (*n* = 14,954)**	***p*-Value**	**Total hospital LOS < 6 d (*n* = 50,945)**	**Total hospital LOS ≥ 6 d (*n* = 6,122)**	***p*-Value**
Intrapartum factors						
Labor or attempted induction	19,771 (46.9%)	7,413 (49.6%)	< 0.001	23,862 (46.8%)	3,322 (5.8%)	< 0.001
Placental abruption	760 (1.8%)	549 (3.7%)	<0.001	914 (1.8%)	395 (6.4%)	<0.001
Perioperative factors						
Mode of anesthesia			< 0.001			< 0.001
Neuraxial anesthesia	39,467 (93.7%)	13,054 (87.3%)		47,538 (93.3%)	4,983 (81.4%)	
General anesthesia	2,579 (6.1%)	1,877 (12.6%)		3,333 (6.5%)	1,123 (18.3%)	
Missing	67 (0.2%)	23 (0.1%)		74 (0.2%)	16 (0.3%)	
Uterine atony	1,517 (3.6%)	944 (6.3%)	< 0.001	1,998 (3.9%)	463 (7.6%)	< 0.001
Hysterectomy at cesarean	79 (0.2%)	205 (1.4%)	< 0.001	160 (0.3%)	124 (2%)	< 0.001
Intraoperative RBC transfusion	157 (0.4%)	337 (2.3%)	< 0.001	274 (0.5%)	220 (3.6%)	< 0.001
Postpartum complications						
Postpartum RBC transfusion	409 (0.7%)	779 (5.2%)	< 0.001	704 (1.4%)	484 (7.9%)	< 0.001
Wound complication[a]	195 (0.5%)	540 (3.6%)	< 0.001	418 (0.82%)	317 (5.2%)	< 0.001
Ileus	60 (0.1%)	333 (2.2%)	< 0.001	189 (0.4%)	204 (3.3%)	< 0.001
Endometritis	890 (2.1%)	2,476 (16.6%)	< 0.001	1,921 (3.8%)	1,445 (23.6%)	< 0.001
Neonatal factors						
Birth weight			<0.001			<0.001
< 2,500 g	5,193 (12.3%)	4,068 (27.2%)		5,845 (11.5%)	3,416 (55.8%)	
2,500–3,499 g	31,799 (75.5%)	9,356 (62.6%)		38,779 (76.1%)	2,376 (38.8%)	
≥ 3,500 g	5,101 (12.1%)	1,518 (10.1%)		6,296 (12.3%)	323 (5.3%)	
Missing	20 (0.1%)	12 (0.1%)		25 (0.1%)	7 (0.1%)	

Abbreviations: LOS, length of stay; RBC, red blood cells.

[a]Wound complications include: infection, seroma, and hematoma.

Table 3

Risk factors for prolonged postpartum and prolonged total length of stay

	Prolonged postpartum LOS		Prolonged total hospital LOS	
	Unadjusted OR (95% CI)	**Adjusted OR (95% CI)**	**Unadjusted OR (95% CI)**	**Adjusted OR (95% CI)**
Demographic factors				
Maternal age (y)				
< 20	1.32 (1.23–1.42)	1.03 (0.94–1.12)	1.80 (1.65–1.97)	–
20–34	Referent	Referent	Referent	–
> 34	1.36 (1.31–1.43)	1.31 (1.25–1.39)	1.07 (1.00–1.14)	–
Insurance class				
Government-assisted	Referent	Referent	Referent	Referent
Private insurance	1.10 (1.05–1.14)	1.17 (1.11–1.23)	0.68 (0.64–0.72)	0.83 (0.77–0.90)
Self-pay/other	0.59 (0.55–0.63)	0.72 (0.66–0.78)	0.74 (0.68–0.81)	0.90 (0.80–1.01)
Race				
Caucasian	Referent	Referent	Referent	Referent
African American	1.28 (1.22–1.34)	1.08 (1.02–1.14)	1.84 (1.73–19.6)	1.33 (1.21–1.45)
Hispanic	0.57 (0.54–0.60)	0.64 (0.59–0.68)	0.85 (0.79–0.91)	1.03 (0.92–1.15)
Other	1.17 (1.07–1.27)	1.07 (0.97–1.19)	1.18 (1.04–1.34)	1.06 (0.89–1.25)
BMI at delivery (kg/m^2)				
≤ 24.9	Referent	Referent	Referent	Referent
25–29.9	0.88 (0.82–0.94)	1.03 (0.95–1.13)	0.59 (0.54–0.65)	0.93 (0.82–1.05)
30–34.9	0.84 (0.78–0.90)	1.02 (0.93–1.10)	0.57 (0.51–0.63)	0.98 (0.86–1.10)
35–39.9	0.89 (082–0.96)	0.97 (0.88–1.06)	0.69 (0.63–0.77)	1.08 (0.95–1.24)
≥ 40	1.11 (1.02–1.20)	1.14 (1.04–1.25)	0.89 (0.81–0.99)	1.35 (1.18–1.55)
Preexisting maternal complications				
Preexisting diabetes	1.33 (1.25–1.41)	1.22 (1.13–1.31)	1.88 (1.74–2.02)	2.04 (1.85–2.27)
Chronic hypertension	2.40 (2.17–2.66)	1.28 (1.14–1.45)	3.73 (3.34–4.17)	1.21 (1.04–1.41)
Asthma	1.36 (1.27–1.46)	1.24 (1.15–1.34)	1.33 (1.21–1.46)	–
Prenatal factors				
Gestational age at delivery (wk)				
< 37	2.67 (2.56–2.79)	1.71 (1.59–1.84)	10.08 (9.50–10.70)	4.18 (3.77–4.63)
37–41	Referent	Referent	Referent	Referent
> 41	1.01 (0.94–1.09)	0.96 (0.88–1.05)	1.45 (1.28–1.65)	1.19 (1.02–1.41)
Type of pregnancy				
Singleton pregnancy	Referent	Referent	Referent	–
Multiple pregnancy	3.29 (2.99–3.61)	1.49 (1.34–1.64)	3.29 (2.99–3.61)	–
Number of prior CD				
None	Referent	Referent	Referent	Referent
1 prior CD	0.75 (0.72–0.78)	1.08 (1.03–1.14)	0.41 (0.38–0.43)	0.67 (0.62–0.73)

	Prolonged postpartum LOS		Prolonged total hospital LOS	
	Unadjusted OR (95% CI)	**Adjusted OR (95% CI)**	**Unadjusted OR (95% CI)**	**Adjusted OR (95% CI)**
2 or more prior CD	0.74 (0.70–0.78)	1.09 (1.02–1.16)	0.40 (0.37–0.43)	0.62 (0.55–0.69)
Pregnancy-associated hypertension				
None	Referent	Referent	Referent	Referent
Gestational hypertension	1.38 (1.25–1.52)	1.29 (1.07–1.35)	2.20 (1.94–2.50)	1.98 (1.68–2.32)
Preeclampsia	2.61 (2.46–2.77)	1.82 (1.69–1.96)	6.42 (6.00–6.87)	2.99 (2.73–3.28)
Eclampsia/HELLP syndrome	5.83 (4.85–6.99)	2.65 (2.12–3.30)	9.48 (7.94–11.33)	2.05 (1.63–2.57)
Placenta Previa	1.74 (1.51–1.99)	–	5.75 (5.02–6.59)	3.32 (2.74–3.28)
Intrapartum factors				
Labor or attempted induction	1.11 (1.078–1.15)	–	1.35 (1.28–1.42)	1.12 (1.03–1.21)
Placental abruption	2.08 (1.86–2.32)	–	3.78 (3.35–4.26)	–
Perioperative factors				
Mode of anesthesia				
Neuraxial anesthesia	Referent	Referent	Referent	Referent
General anesthesia	2.20 (2.07–2.34)	1.30 (1.20–1.42)	3.22 (2.99–3.46)	1.12 (1.00–1.24)
Uterine atony	1.80 (1.66–1.96)	1.32 (1.19–1.46)	2.01 (1.81–2.23)	1.41 (1.21–1.63)
Hysterectomy at CD	6.57 (5.19–8.31)	3.16 (2.20–4.52)	6.57 (5.19–8.31)	2.02 (1.36–3.02)
Intraoperative RBC transfusion	6.16 (5.09–7.45)	1.76 (1.33–2.33)	6.90 (5.76–8.25)	1.57 (1.14–2.16)
Postpartum RBC transfusion	5.60 (4.96–6.33)	3.04 (2.59–3.57)	6.13 (5.44–6.90)	2.67 (2.22–3.21)
Wound complication[a]	8.05 (6.83–9.49)	5.49 (4.54–6.63)	6.60 (5.69–7.66)	5.00 (4.02–6.21)
Ileus	15.96 (12.11–21.02)	12.28 (8.98–16.80)	9.26 (7.58–11.30)	9.28 (7.03–12.2)
Endometritis	9.19 (8.49–9.95)	10.45 (9.51–11.50)	7.89 (7.32–8.50)	9.81 (8.84–10.89)
Neonatal factors				
Birth weight				
Less than 2,500 g	2.66 (2.54–2.79)	1.22 (1.10–1.35)	9.54 (8.99–10.12)	3.57 (3.01–4.23)
2,500–3,499 g	Referent	Referent	Referent	Referent
3,500 g or more	1.01 (0.95–1.07)	0.92 (0.86–0.99)	0.84 (0.74–0.94)	1.14 (0.99–1.32)

Abbreviations: BMI, body mass index; CD, cesarean delivery; CI, confidence interval; LOS, length of stay; OR, odds ratio; RBC, red blood cells.

[a]Wound complications include: infection/seroma/hematoma.