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Risk Factors for Maternal Readmission with Sepsis

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Abstract

Objective—Our primary objective was to identify risk factors for maternal readmission with sepsis. Our secondary objectives were to (1) assess diagnoses and infecting organisms at readmission and (2) compare early (<6 weeks) and late (6 weeks to 9 months postpartum) maternal readmission with sepsis.

Study Design—We identified our cohort using linked hospital discharge data and birth certificates for California deliveries from 2008 to 2011. Consistent with the 2016 sepsis classification, we defined sepsis as septicemia plus acute organ dysfunction. We compared women with early or late readmission with sepsis to women without readmission with sepsis.

Results—Among 1,880,264 women, 494 (0.03%) were readmitted with sepsis, 61% after 6 weeks. Risk factors for readmission with sepsis included preterm birth, hemorrhage, obesity, government-provided insurance, and primary cesarean. For both early and late sepsis readmissions, the most common diagnoses were urinary tract infection and pyelonephritis, and the most frequently identified infecting organism was gram-negative bacteria. Women with early compared with late readmission with sepsis shared similar obstetric characteristics.

Conclusion—Maternal risk factors for both early and late readmission with sepsis included demographic characteristics, cesarean, hemorrhage, and preterm birth. Risks for sepsis after delivery persist beyond the traditional postpartum period of 6 weeks.

Keywords

pregnancy; postpartum; risk factors; sepsis; infection; readmission

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Conflict of Interest

None declared.

Infection is the third leading cause of pregnancy-related death in the United States, and the rate of infection-related maternal mortality has remained nearly constant since 1990. Sepsis is identified in the majority of infection-related maternal deaths.¹

In 2016, an international consensus group redefined sepsis as a life-threatening state of organ dysfunction stemming from an infectious etiology.² The World Health Organization supported the revised definition by reclassifying maternal sepsis as “organ-dysfunction resulting from infection during pregnancy, childbirth, postabortion, or postpartum period.”³ Sepsis in the postpartum period is a critically-important and life-threatening condition which requires better characterization to improve early recognition and decrease preventable maternal deaths.

In this study, we aimed to identify risk factors for readmission with sepsis through 9 months of delivery hospitalization and to identify associated diagnoses and infecting organisms. We also aimed to compare characteristics, diagnoses, and infecting organisms of early (less than 6 weeks postpartum) to late (greater than 6 weeks to 9 months postpartum) maternal readmission with sepsis.

Materials and Methods

We performed this study using a linked dataset, provided by the State of California Office of State-Wide Planning and Development from the California Department of Public Health. This dataset contained information from birth certificates and maternal and infant hospital discharge records, including maternal demographics, delivery information, *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM) diagnosis codes, and hospital readmissions through 9 months after discharge from delivery hospitalization. Details on the dataset⁴ and the linkage methodology^{5,6} have been previously described. The Institutional Review Board at Stanford University approved this study.

For our study and control groups, we included deliveries at or beyond 20 weeks' gestation for live births and stillbirths. Ectopic pregnancies and spontaneous abortions were not included in the database; therefore, these pregnancies were not investigated in our study. Data were analyzed for births that occurred from 2008 to 2011 (Fig. 1). Our outcome variable of interest was readmission with sepsis through 9 months after discharge from delivery hospitalization. We chose our end point as through 9 months because we wanted to be inclusive and investigate potential risks beyond the traditional postpartum period of 6 weeks. Further, the database limited readmission information through 9 months following delivery hospitalization. We followed the example of pregnancy-related mortality studies in which cases were included beyond 6 weeks.⁷ Early readmission included readmission within 6 weeks of delivery hospitalization (corresponding to the standard postpartum period) and late readmission as readmission after 6 weeks through 9 months after delivery hospitalization.

To be consistent with the 2016 sepsis classification² and the 2017 World Health Organization definition of maternal sepsis,³ we required that organ dysfunction be present for making a diagnosis of sepsis. Therefore, we identified our cases using ICD-9-CM and

Current procedural terminology (CPT) codes specifying septicemia plus a concomitant diagnosis of acute organ dysfunction (Appendix A). The approach of using ICD-9-CM and CPT codes to diagnose sepsis has been previously validated by chart review analysis in the adult population.⁸ We identified infecting organisms as specified within the ICD-9-CM codes for sepsis (e.g., streptococcal septicemia) (Appendix A).

We defined our comparison group as women who were not readmitted with sepsis through 9 months of discharge from delivery hospitalization. Severe maternal morbidity was defined by the criteria from the Centers of Disease Control and Prevention.^{9,10} To avoid bias, we included only the first readmission with sepsis for women who were readmitted more than once within 9 months following delivery. For women who had more than one delivery during the study interval, we included only the first birth.

We investigated sociodemographic and clinical variables at the time of delivery hospitalization, such as maternal age, race/ethnicity, body mass index (BMI), co-morbidities, gestational age, and mode of delivery. We analyzed additional risk factors including specific pregnancy-related complications (such as infection and/or sepsis during delivery admission), as well as intrapartum and/or postpartum events (such as unplanned cesarean and hemorrhage). We performed univariate analysis to compare women with and without readmission for sepsis on clinical and demographic factors that were deemed as potential confounders. *p*-Values were calculated using the Student's *t*-test for continuous variables and Chi-square test or Fisher's exact test for categorical variables. Multivariable logistic regression was performed to calculate the adjusted odds ratio and 95% confidence interval (95% CI) for readmission with sepsis within 6 weeks of delivery and separately through 9 months after delivery. We adjusted for potential confounding factors including maternal age, race/ethnicity, maternal education, parity, prepregnancy BMI, insurance type, gestational age at delivery, prenatal care initiation, mode of delivery, and number of prior cesarean deliveries.

Women readmitted early versus late with sepsis were compared with regard to the risk factors, associated diagnoses, and infecting organisms. If data were missing for covariates, they were excluded from the corresponding logistic regression. Statistical analyses were performed using SAS 9.4 (SAS Institute, Cary, NC).

Results

Among 1,880,758 women having births in California, we identified 494 (0.03%) women readmitted for sepsis through 9 months of the delivery hospitalization (Fig. 1). Three women were readmitted with sepsis more than once through 9 months after delivery hospitalization.

Compared with women not readmitted with sepsis after delivery, women who were readmitted had higher prepregnancy BMI and were more likely to have government-provided insurance, lower educational attainment, and non-Hispanic Black race/ethnicity. Women readmitted with sepsis also initiated prenatal care later, delivered at earlier gestational ages, had increased parity, and had higher rates of cesarean deliveries (Table 1).

Multivariable regression models controlling for potential confounders revealed an increased odds of readmission with sepsis through 9 months of delivery among women with preterm birth, BMI ≥ 35 kg/m², delivery mode (primary cesarean delivery or failed trial of labor after cesarean resulting in cesarean delivery), and government-provided insurance. Women who experienced hemorrhage, urinary tract infection, pyelonephritis, and pneumonia at delivery hospitalization were also more likely to be readmitted with sepsis. Hispanic ethnicity had the lowest adjusted odds of readmission with sepsis among different race/ethnicities. Among women with preterm birth, odds for readmission were highest in earlier deliveries (aOR 5.2, 95% CI 3.2–8.6 for ≤ 28 weeks; aOR 3.9, 95% CI 2.4–6.3 for 29–32 weeks, aOR 2.2, 95% CI 1.6–2.9 for 33–36 weeks) (Table 2).

At the time of readmission with sepsis, the three leading associated diagnoses were urinary tract infection, pyelonephritis, and pneumonia. In 68% of readmissions, the infecting organism was not specified. Among women with sepsis readmissions in which the infecting organism was identified, gram-negative sepsis was the most common (21%) with the predominant gram-negative organism being *Escherichia coli* (10%). The next most commonly identified organisms were *Staphylococcus* (8%) and *Streptococcus* (5%).

In regards to the timing of readmission, 39% of the total readmissions with sepsis within 9 months following delivery hospitalization occurred by 6-weeks postdelivery, and 50% of readmissions occurred by 10-weeks postdelivery (Fig. 2).

As seen in Fig. 3 after adjustment, several factors remained significantly associated with sepsis readmission at both the late and early time periods, including pneumonia at delivery hospitalization, primary cesarean, and maternal hemorrhage. Pneumonia during delivery hospitalization, for example, had an aOR of 5.7 (95% CI 1.2–26.5) for early and 9.9 (95% CI 3.5–27.6) for late readmissions. Similarly, hemorrhage at delivery had an aOR of 3.6 (95% CI 2.2–5.9) for early and 2.7 (95% CI 1.7–4.4) for late readmissions. Primary CS had an aOR of 1.9 (95% CI 1.2–2.8) for early and 2.4 (95% CI 1.7–3.2) for late readmissions.

As demonstrated in Fig. 4, preterm birth was independently associated with both early and late maternal readmission with sepsis. The adjusted odds for readmission with sepsis were higher for women who had earlier deliveries. Women who delivered prior to 28 weeks had up to a 7.3-fold increased risk for early maternal readmission with sepsis (95% CI 3.8–14.1).

At the time of readmission for women with early compared with late readmission with sepsis, we found that rank orders of associated diagnoses were similar among the two time periods for both ICD-9-CM codes (namely, urinary tract infection/pyelonephritis followed by pneumonia) and identified organisms (namely, gram-negative bacteria followed by *Staphylococcus* species).

Discussion

Sepsis and infection are the leading causes of pregnancy-related morbidity and mortality. To understand the totality of maternal sepsis, we focused on maternal readmission with sepsis and used the 2016 classification of sepsis which included end-organ dysfunction. In older papers, such women would have been classified as having severe sepsis.

With this unique approach, we studied over 1.8 million women having births in California from 2008 to 2011 and identified 494 (0.03%) women who were readmitted with this life-threatening complication. Although these patients accounted for a small number, they are among the sickest arising from an obstetric service, and therefore it is important to characterize them. Not surprisingly, we identified selected demographic and obstetric risk factors for readmission, such as high BMI and primary cesarean. Further, we found that obstetric risk factors, including preterm birth, primary cesarean, and hemorrhage persisted even among late readmissions with sepsis. Interestingly, among women with preterm birth, the risk of maternal readmission with sepsis was increased with the degree of prematurity and persisted as a risk factor even among women with late readmission with sepsis.

In our cohort, postpartum maternal readmission with sepsis within 9 months of delivery occurred in 26 per 100,000 deliveries (95% CI 24–29). Epidemiologic studies from the United States, United Kingdom, and the Netherlands estimated the rate of pregnancy-related sepsis to occur in 9 to 49 per 100,000 deliveries^{11–13}; however, these studies did not specifically investigate the postpartum period. Prior studies have investigated risk factors for maternal sepsis at or before delivery admission^{11,12,14} but did not include postpartum hospital readmission. We found that demographic and obstetric risk factors for postpartum readmission with sepsis were similar to those previously reported for sepsis at or prior to delivery, including obesity,¹⁵ preterm birth,¹¹ postpartum hemorrhage,¹¹ government provided insurance^{11,12} and labored cesarean delivery.^{11,12,14,15}

As previously reported,^{11,14–17} we found that gram-negative organisms were among the most frequently identified organisms in sepsis, in both the early and late time periods. Consistent with the prior studies,^{11,14–17} 68% of the sepsis cases lacked microbiologic identification.

The top concurrent infectious diagnoses in women readmitted with sepsis within 9 months were urinary tract infection and/or pyelonephritis and pneumonia, identified in 78% of readmissions. When comparing early versus late maternal readmission, the rank order of infecting organisms remained similar. Bauer et al found that genitourinary infections and pneumonia were similarly identified as the top concurrent infections associated with sepsis at the time of delivery.¹¹ Further, they noted that uterine infections (chorioamnionitis and endometritis) were associated with 27% of sepsis cases during delivery hospitalization.¹¹ We did not identify uterine infection as a major cause of postpartum readmission with sepsis. We speculate that uterine infections may remain more localized or be diagnosed and treated promptly (most likely during delivery admission); therefore, these are less likely the cause of maternal readmission with sepsis compared with pneumonia or pyelonephritis.

We noted a strong association between preterm birth and risk for subsequent development of maternal sepsis, either within 42 days or through 9 months. In our population of women readmitted with sepsis, 25% experienced preterm birth and women who experienced preterm birth prior to 28 weeks had over a sevenfold increased risk of maternal readmission with sepsis within 6 weeks of delivery. Given that acute or chronic infection is thought to underlie 25 to 40% of the preterm births,¹⁸ our findings may suggest that pre-existing subclinical or clinical uterine infection is associated with both preterm birth and subsequent maternal

sepsis. However, since we did not identify uterine infection as a common concurrent diagnosis among women readmitted with sepsis, and since many of the cases of sepsis occurred weeks to months after delivery, we postulate an alternative explanation; namely, that these women may have underlying maternal immune dysregulation placing them at risk for both preterm birth and maternal readmission with sepsis.^{19–21} For example, studies have demonstrated that women with certain allelic variants of tumor necrosis factor α may be at increased risk for preterm premature rupture of membranes²² and women with variants of IL-1²³ may be at increased risk for preterm birth. Similarly, these allelic variants have also been associated with increased risk for sepsis in nonpregnant adults.²⁴ However, we are not aware of the studies investigating genetic susceptibility to both infection and prematurity.

Pregnancy-related readmissions in the postpartum period is an increasing area of interest, but there is a gap in our knowledge on the role of sepsis in these readmissions.^{25–29} We found that the majority of readmissions with maternal sepsis were late readmissions, but these readmissions remained associated with events occurring at the delivery hospitalization.

Strengths of our study included our use of a California database that allowed for a large, diverse cohort and the unique ability to link delivery hospitalizations with postpartum readmissions. To identify our population with sepsis, we used ICD-9-CM codes that have been previously validated with nested case–control analysis and shown to have high sensitivity, specificity, and negative predictive value in identifying sepsis.⁷ Using a large database, we were able to study the rare but critically important condition of maternal readmission with sepsis, a potentially life threatening and preventable cause of maternal death. Further, we designed our study to adhere to the revised 2016 and 2017 definitions of maternal sepsis, supported by the Surviving Sepsis Campaign² and the World Health Organization.²¹ By investigating risks for readmission with sepsis within 6 weeks and through 9 months postpartum, we were able to better detect short- and long-term risk factors for sepsis as they relate to pregnancy.

Our study had several limitations. We acknowledge that ICD-9-CM codes were primarily designed for billing purposes and there may be some incomplete clinical information and potential for misclassification bias or underestimation due to under coding. Despite these limitations, we still identified strong associations between events at delivery hospitalization and odds for maternal readmission with sepsis. Despite our study population being large and diverse, our results are limited to the population demographics of the state of California and may not be generalizable to the United States.

Although the absolute risk of maternal readmission with sepsis is low, maternal sepsis remains a major contributor to maternal morbidity and mortality and understanding risks and clinical characteristics may lead to prevention and improved care. We found that women with early compared with late readmission with sepsis shared similar demographic and obstetric characteristics, particularly preterm birth and hemorrhage, which persisted beyond the traditional postpartum period.

Appendix A

ICD-9-CM Codes Used to Define Acute Organ Dysfunction (Martin et al (7)^a)

Respiratory

1. Acute respiratory failure: 518.81
2. Acute respiratory distress syndrome: 518.82
3. Acute respiratory distress syndrome after shock or trauma: 518.85
4. Respiratory insufficiency: 786.09
5. Respiratory arrest: 799.1
6. Ventilator management: 96.7

Cardiovascular

1. Hypotension, postural 458.0
2. Shock 785.5
3. Shock, cardiogenic 785.51
4. Shock, circulatory or septic 785.59
5. Hypotension, specified type, not elsewhere classified 458.8
6. Hypotension, arterial, constitutional 458.9
7. Hypotension, transient 796.3

Renal

1. Acute renal failure 584
2. Acute glomerulonephritis 580
3. Renal shutdown, unspecified 585
4. Hemodialysis 39.95

Hepatic

1. Acute hepatic failure or necrosis 570
2. Hepatic encephalopathy 572.2
3. Hepatitis, septic or unspecified 573.3

Hematologic

1. Disseminated intravascular coagulation 286.2

^aAll codes used were previously validated by a prior report (7). Electroencephalography (code 89.14) was also included in the same prior report but was removed in the current study because it was deemed by study authors to not be directly associated with end organ damage.

2. Purpura fulminans 286.6
3. Coagulopathy 286.9
4. Thrombocytopenia, primary, secondary, or unspecified 287.3, 287.4, 287.5

Metabolic

1. Acidosis, metabolic, or lactic 276.2

Neurologic

1. Transient organic psychosis 293
2. Anoxic brain injury 348.1
3. Encephalopathy acute 348.3
4. Coma 780.01
5. Altered consciousness, unspecified 780.09

ICD-9-CM Codes Used to Define Sepsis

038 Septicemia

038.0 Streptococcal septicemia

038.1 Staphylococcal septicemia

038.2 Pneumococcal septicemia (*Streptococcus pneumoniae* septicemia)

038.3 Septicemia due to anaerobes

Septicemia due to bacteroides. Excludes gas gangrene (040.0) that is due to anaerobic streptococci (038.0)

038.4 Septicemia due to other gram-negative organisms

038.40 Gram-negative organism, unspecified

Gram-negative septicemia not otherwise specified (NOS)

- 038.41 Hemophilus influenza
- 038.42 Escherichia coli
- 038.43 Pseudomonas
- 038.44 Serratia
- 038.49 Other

038.8 Other specified septicemias

038.9 Unspecified septicemia

- Septicemia NOS

995.92 Severe sepsis

995.91 Inflammatory response due to infection without organ dysfunction

- 003.1 *Salmonella* septicemia
- 020.2 Septicemic plague
- 022.3 Anthrax septicemia
- 036.2 Meningococcal septicemia
- 036.3 Waterhouse–Friderichsen syndrome
- 054.5 Herpetic septicemia
- 098.89 Gonococcemia
- 112.5 Systemic candidiasis
- 785.52 Septic shock

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Fig.1.
Flow diagram.

Fig. 2.
Timing of readmission with sepsis after delivery hospitalization.

Fig.3.

Events at time of delivery and risk for early versus late readmission with sepsis.

Fig. 4.
Gestational age at delivery and risk for early versus late readmission with sepsis.

Table 1

Characteristics among women who were or were not readmitted with sepsis through 9 months after delivery

Characteristic	Readmission with sepsis (<i>n</i> = 494)	No readmission with sepsis (<i>n</i> = 1,880,264)	<i>p</i> -Value
Age (y)	28.2 ± 6.6	28.3 ± 6.4	0.74
BMI (prepregnancy) (kg/m ²)	28.1 ± 7.9	25.9 ± 6.1	<0.001
Race/Ethnicity			<0.001
White, non-Hispanic	146 (30)	558,701 (30)	
Black, non-Hispanic	56 (12)	107,312 (6)	
Asia/Pacific Islander	63 (13)	208,339 (11)	
Hispanic	211 (43)	918,668 (50)	
Other	9 (2)	54,085 (3)	
Gestational age at delivery (wk)	37.3 ± 3.5	38.6 ± 2.1	<0.001
Parity	2.4 ± 2.6	2.1 ± 1.3	<0.001
Nulliparous	200 (40.8)	784,340 (42)	0.38
Multiparous/	290 (59)	1,091,701 (58)	
Delivery mode			<0.001
Spontaneous vaginal delivery	221 (45)	1,185,289 (63)	
Failed TOLAC, cesarean	28 (6)	79,350 (4)	
Primary cesarean	134 (27)	286,972 (15)	
Repeat cesarean	96 (19)	259,332 (14)	
Prenatal care initiation			<0.001
1st trimester	362 (73)	1,525,735 (81)	
2nd trimester	81 (16)	251,942 (13)	
3rd trimester	20 (4)	50,123 (3)	
No prenatal care/missing	31 (6)	52,464 (3)	
Insurance			<0.001
Private	169 (35)	865,100 (47)	
Government program	304 (62)	944,307 (51)	
Other	17 (4)	34,675 (2)	
Education			<0.001
No high school diploma	126 (26)	465,884 (26)	
High school graduate	152 (32)	479,619 (26)	
Some college/associate degree	129 (27)	429,881 (24)	
College graduate	72 (15)	441,517 (24)	
Conditions and events at delivery hospitalization			
Chorioamnionitis	15 (3)	56,945 (3)	0.471
Pre-eclampsia	69 (14)	126,452 (7)	<0.001
Severe maternal morbidity	5 (12)	29,866 (2)	<0.001
Sepsis	5 (1)	979 (0.1)	<0.001
Pneumonia	5 (1)	1,227 (0.1)	<0.001

Characteristic	Readmission with sepsis (<i>n</i> = 494)	No readmission with sepsis (<i>n</i> = 1,880,264)	<i>p</i> -Value
Urinary tract infection	12 (2)	9,383 (0.5)	<0.001
Pyelonephritis	2 (0.4)	1,805 (0.1)	<0.001
Hemorrhage	37 (7)	1,891 (0.1)	0.038

Abbreviations: BMI, body mass index; TOLAC, trial of labor after cesarean.

Table 2

Odds ratios for maternal characteristics and hospital readmission with sepsis through 9 months after delivery

Characteristic		Readmission with sepsis (vs. no readmission with sepsis) (<i>n</i> = 494)	
	<i>n</i> (%)	OR (95% CI)	aOR ^a (95% CI)
Race and ethnicity			
White, non-Hispanic	146 (30)	Reference	Reference
Hispanic	211 (43)	0.9 (0.7–1.1)	0.6 (0.5–0.8)
Black, non-Hispanic	56 (11)	2.0 (1.5–2.7)	1.2 (0.9–1.7)
Asian/Pacific Islander	64 (13)	1.2 (0.9–1.6)	1.3 (0.9–1.7)
Other	9 (2)	0.6 (0.3–1.3)	0.5 (0.2–1.1)
Pregestational DM	28 (6)	7.1 (4.9–10.4)	3.4 (2.2–5.3)
Autoimmune disease	16 (3)	13.5 (8.2–22.2)	9.6 (5.4–17.1)
Prepregnancy BMI (kg/m ²)			
<18.5	19 (4)	1.3 (0.8–2.1)	1.1 (0.7–1.9)
18.5–24.9	178 (40)	Reference	Reference
25–29.9	101 (23)	1.1 (0.9–1.4)	1.0 (0.8–1.3)
30–34.9	67 (15)	1.5 (1.1–1.9)	1.3 (0.9–1.7)
35–39.9	42 (10)	2.3 (1.6–3.2)	1.8 (1.3–2.5)
40	37 (8)	3.4 (2.4–4.9)	2.3 (1.6–3.4)
Gestational age at delivery (wk)			
28	21 (4)	6.2 (4.0–10.0)	5.2 (3.2–8.6)
29–32	24 (5)	5.3 (3.5–8.0)	3.9 (2.4–6.3)
33–36	80 (16)	2.8 (2.2–3.6)	2.2 (1.6–2.9)
37	369 (75)	Reference	Reference
Delivery mode			
Spontaneous VD	221 (45)	Reference	Reference
Failed TOLAC	28 (6)	1.9 (1.3–2.8)	1.8 (1.1–2.7)
Primary cesarean	134 (27)	2.5 (2.0–3.1)	2.0 (1.7–2.8)
Repeat cesarean	96 (19)	2.0 (1.6–2.5)	1.7 (0.6–4.9)
Insurance			
Private	169 (34)	Reference	Reference
Government	304 (62)	1.7 (1.4–2.0)	1.6 (1.3–2.1)
Other	17 (3)	2.5 (1.5–4.1)	1.6 (0.9–3.0)
Conditions and events at delivery hospitalization			
Chorioamnionitis	15 (3)	1.0 (0.6–1.7)	0.9 (0.5–1.5)
Pre-eclampsia	69 (14)	0.9 (0.5–1.5)	0.9 (0.5–1.5)
Severe maternal morbidity	57 (12)	8.2 (6.2–10.8)	0.6 (0.2–1.6)
Sepsis	5 (1)	20.0 (8.1–47.3)	2.2 (0.1–3.2)
Hemorrhage	37 (7)	2.7 (1.9–3.8)	3.0 (2.1–4.3)

Characteristic		Readmission with sepsis (vs. no readmission with sepsis) (<i>n</i> = 494)	
		OR (95% CI)	aOR ^a (95% CI)
Urinary tract infection	12 (2)	4.9 (2.8–8.7)	2.9 (1.5–5.5)
Pyelonephritis	2 (0.4)	4.2 (1–16.8)	4.3 (1.3–14.5)
Pneumonia	5 (1)	15.6 (6.5–37.6)	7.3 (2.9–18.3)

Abbreviations: aOR, Adjusted odds ratio; BMI, body mass index; CI, confidence interval; DM, diabetes mellitus; OR, odds ratio; TOLAC, trial of labor after cesarean; VD, vaginal delivery.

Note: Data are *N*(%), adjusted OR (95% confidence interval), unless otherwise stated.

^aMultivariable logistic regression analysis adjusting for: maternal age, race/ethnicity, maternal education, parity, gestational age at delivery, prepregnancy BMI, insurance—oiohbjtype, prenatal care initiation, mode of delivery, number of prior cesarean deliveries.