

Mode of Delivery and Unplanned Cesarean: Differences in Rates and Indication by Race, Ethnicity, and Sociodemographic Characteristics

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Abstract

Objective We aimed to examine the relationship of sociodemographic variables with racial/ethnic disparities in unplanned cesarean births in a large academic hospital system. Secondly, we investigated the relationship of these variables with differences in cesarean delivery indication, cesarean delivery timing, length of second stage and operative delivery.

Study Design We conducted a retrospective cohort study of births >34 weeks between 2017 and 2019. Our primary outcome was unplanned cesarean delivery after a trial of labor. Multiple gestations, vaginal birth after cesarean, elective repeat or primary cesarean delivery, and contraindications for vaginal delivery were excluded. Associations between mode of delivery and patient characteristics were assessed using Chi-square, Fisher exact tests, or *t*-tests. Odds ratios were estimated by multivariate logistic regression. Goodness of fit was assessed with Hosmer Lemeshow test.

Results Among 18,946 deliveries, the rate of cesarean delivery was 14.8% overall and 21.3% in nulliparous patients. After adjustment for age, body mass index (BMI), and parity, women of Black and Asian races had significantly increased odds of unplanned cesarean delivery; 1.69 (95% CI: 1.45, 1.96) and 1.23 (1.08, 1.40), respectively. Single Hispanic women had adjusted odds of 1.65 (1.08, 2.54). Single women had increased adjusted odds of cesarean delivery of 1.18, (1.05, 1.31). Fetal intolerance was the indication for 39% (613) of cesarean deliveries among White women as compared to 63% (231) of Black women and 49% (71) of Hispanic women ($p < 0.001$).

Conclusion Rates of unplanned cesarean delivery were significantly higher in Black and Asian compared to White women, even after adjustment for age, BMI, parity, and zip code income strata, and rates of unplanned cesarean delivery were higher for Hispanic women self-identifying as single. Racial and ethnic differences were seen in cesarean delivery indications and operative vaginal deliveries. Future work is urgently needed to better understand differences in provider care or patient attributes, and potential provider bias, that may contribute to these findings.

Keywords

- ▶ racial disparities
- ▶ ethnic disparities
- ▶ pregnancy
- ▶ zip code income strata
- ▶ provider bias
- ▶ non-reassuring fetal status
- ▶ labor dystocia
- ▶ cesarean
- ▶ operative vaginal delivery
- ▶ equity

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Key Points

- Racial, ethnic, and socioeconomic differences exist in the odds of unplanned cesarean.
- Indications for unplanned cesarean delivery differed significantly among racial and ethnic groups.
- There may be unmeasured provider level factors which contribute to disparities in cesarean rates.

Black women have two times the risk of severe morbidity and mortality^{1,2} and are three to four more times to die of pregnancy-related causes compared to White women.³ Additionally, Black women in the United States are at increased risk of cesarean birth (35%),⁴ which carries increased morbidity including postpartum hemorrhage, thromboembolic events, infection, surgical infection, need for transfusion, and increased risks in future pregnancies. Given the risks associated with cesarean delivery and the rates of cesarean delivery in the United States of 31.9%, there has been a focus on decreasing the rates of cesarean sections.^{4,5} To date it is unclear why Black women are more likely to give birth via cesarean, though contributing factors may include provider bias,⁶ patient level factors, and health care system factors.⁷⁻⁹ Historical literature has often considered race as a risk factor rather than a social construct, an approach that risks perpetuating disparities associated with structural racism and provider and systems bias.^{10,11}

Data also suggest that marital status, socioeconomic status, and primary language may be associated with health outcomes such as diabetes and cardiovascular disease.¹²⁻¹⁹ As race can be considered a social construct which may be associated with perinatal outcomes but should not be causative, similarly, we questioned whether other demographic variables may also be associated with rates of cesarean birth. We aimed to examine the relationship of sociodemographic variables including marital status, zip code, income status, and language, with racial and ethnic disparities in unplanned Cesarean births at a large academic hospital system.

Secondarily, we aimed to examine elements of clinical management that inform mode of delivery and may be influenced by provider or patient -level factors, such as documented indication for cesarean birth and decision for operative vaginal delivery, under the hypothesis that management decisions may similarly trend with sociodemographic factors.

Materials and Methods

We conducted a retrospective cohort study of deliveries between January 1st, 2017 through December 31st, 2019 at two academic institutions within the same urban health system. The Institutional Review Board granted exemption as the project met the criteria for exemption 45 CFR 46.101 (b) (Project number: 2020P001552). The two academic institutions have a shared residency program, and Labor and Delivery units at both hospitals are staffed by certified nurse midwives, Ob/Gyn specialists, and Maternal Fetal Medicine subspecialists.

All births after 34 weeks gestational age for women eligible for vaginal delivery and at risk of an unplanned

cesarean delivery were included. Thirty-four weeks was chosen to include late preterm pregnancies. We excluded multiple gestations, prior cesarean, elective primary cesareans, and those cesarean deliveries in which the provider documented the indication of breech/malpresentation, prior uterine surgery, placenta previa, macrosomia, or fetal anomaly.

Patient demographic characteristics including age, gravidity and parity, self-reported race and ethnicity, marital status, language, body mass index (BMI), and zip code were collected from the electronic medical record. Patients whose demographic characteristics were unavailable were excluded from analysis. Race was categorized as non-Hispanic White, Black, Hispanic, Asian or other. There were 12 women who self-identified as Hispanic Black. These women were categorized as Black, as previous data from our institution has suggested outcomes for this group may track more closely with Black rather than Hispanic White.²⁰ Self-reported marital status was categorized as single, married, and other, which included separated, divorced, and widowed.

Median family income by zip code was obtained from 2018 U.S. American Community Survey census data. Women with addresses outside Massachusetts were removed as income data were only available for Massachusetts zip codes. Women's zip codes of residence were categorized into quartiles based on the median income for each zip code such that the zip codes with lowest 25% of median incomes were the first quartile and the zip codes with the highest 25% of median incomes were in the fourth quartile.

Mode of delivery (spontaneous vaginal, operative vaginal, cesarean), indication for cesarean, delivery time, length of second stage and provider were extracted from the electronic medical record. Cesarean indications were characterized as failure to progress in labor, non-reassuring fetal status, or maternal indication, which included worsening maternal status in labor or maternal medical complication. In cases of cesarean deliveries for which the indication was missing from automatic extraction, chart review was completed to obtain the indication. For 3,477 missing pregravid BMI values, the cohort average of 25.21 was substituted.

The length of the second stage of labor was defined as the length from the start of the second stage until delivery. Lengths of second stage documented as greater than 400 minutes were not included in analyses of comparisons of second stage lengths to reduce influence from outliers which were likely erroneous entries. For analysis of variations in mode of delivery with time of delivery, births were categorized as daytime, change of shift, or nighttime.

Associations between mode of delivery and patient characteristics were assessed using Chi-square or Fisher exact

tests for categorical variables and *t*-tests for continuous variables. Bivariate analysis was used to measure unadjusted odds ratio (OR) and adjusted odd ratios (aOR) of cesarean delivery. Models were adjusted for a priori variables including age, gestational age, and pregravid BMI as continuous variables, and parity, marital status, and language as categorical variables. Generalized estimating equations logistic regression models were used to account for multiple deliveries from the same subject during the study time period. Statistical analyses were conducted with SAS 9.4.

Results

A total of 18,946 deliveries were included in the analyses. The rate of cesarean birth was 14.8% among all deliveries and 21.3% among nulliparous patients. The demographics of the cohort are in [Table 1](#). The average gestational age at delivery was 39 weeks and 2 days. The cohort was 58.3%

White, 10.2% Black, 11.5% Asian, 6.6% Hispanic, and 13.3% were other, declined or unknown. Private practice groups delivered 6,043 (32.0%) women within the cohort and academic obstetric or Certified Nurse Midwife provider groups delivered 12,855 (68.0%). These practices are grouped as academic obstetric providers perform cesareans for the midwifery groups. There were no significant differences in rates of cesarean delivery between the two hospitals among all deliveries or only nulliparous patients. Racial breakdown by zip code income quartiles is seen in [Table 2](#).

Maternal Characteristics

Maternal sociodemographic characteristics by mode of delivery for all births are shown in [Table 1](#). Maternal self-reported race was significantly associated with odds of cesarean birth. In univariate analyses, Black and Asian women had significantly higher rates of cesarean birth than did White or Hispanic mothers. Additionally, older maternal age, primary language of English, single marital status, and mean

Table 1 Cohort characteristics by mode of delivery

	All deliveries	Vaginal deliveries	C-sections	p-Value
<i>N</i>	18,946	16,159	2,787	
	Mean (SD)	Mean	Mean	
Age	33.78 (5.16%)	33.67	34.40	<0.0001
Gestational age	39.25 (1.35%)	39.23	39.36	<0.0001
BMI	25.21 (5.22%)	25.03	26.25	<0.0001
Gravidity	2.28 (1.51%)	2.34	1.93	
Parity	0.71 (0.98%)	0.78	0.34	<0.0001
	<i>N</i> (%)	<i>N</i>	<i>N</i>	<0.0001
Nulliparous	10,035 (52.97%)	7,896(48.86%)	2,139 (76.75%)	
Multiparous	8,911 (47.03%)	8,263 (51.14%)	648 (23.25%)	
Race/Ethnicity	<i>N</i> (%)	<i>N</i>	<i>N</i>	<0.0001
White	11,052 (58.33%)	9,480(58.67%)	1,572(56.40%)	
Black	1,933 (10.20%)	1,567(9.70%)	366 (13.13%)	
Asian	2,181 (11.51%)	1,833(11.34%)	348 (12.49%)	
Hispanic	1,255 (6.62%)	1,111 (6.88%)	144 (5.17%)	
Other	2,525 (13.33%)	2,168 (13.42%)	357 (12.81%)	
Marital status	<i>N</i> (%)	<i>N</i>	<i>N</i>	0.0461
Married	13,541 (71.47%)	11,597(71.77%)	1,944 (69.75%)	
Single	4,695 (24.78%)	3,952 (24.46%)	743 (26.66%)	
Other	710 (3.75%)	610 (3.77%)	100 (3.59%)	
Zip code by income quartiles	%	<i>N</i>	<i>N</i>	<0.0001
Q1 (<\$60,474)	25.31%	4,102 (25.39%)	694 (24.90%)	
Q2 (\$60,474–91,125)	24.74%	3,922 (24.27%)	765 (27.45%)	
Q3 (\$81,335–109,893)	25.37%	4,072 (25.20%)	734 (26.34%)	
Q4 (>109,893)	24.58%	4,063 (25.14%)	594 (21.31%)	
Primary language	<i>N</i>	<i>N</i>	<i>N</i>	0.0091
English	16,612 (87.68%)	14,120 (87.38%)	2,492 (89.42%)	
Spanish	1,387 (7.32%)	1,215 (7.52%)	172 (6.17%)	
Other	947 (5.00%)	824 (5.10%)	123 (4.41%)	

Table 2 Race and ethnicity by zip code income quartile

Income quartile	Race/Ethnicity N (%)						p <0.0001
	Asian	Black	Hispanic	Other	White	Total	
Q1 (<\$60,474)	336 (15.41)	999 (51.68)	691 (55.06)	1,406 (55.68)	1,364 (12.34)	4,796	
Q2 (\$60,474–91,125)	542 (24.85)	580 (30.01)	352 (28.05)	598 (23.68)	2,615 (23.66)	4,687	
Q3 (\$81,335–109,893)	734 (33.65)	231 (11.95)	124 (9.88)	310 (12.28)	3,407 (30.83)	4,806	
Q4 (>109,893)	569 (26.09)	123 (6.36)	88 (7.01)	211 (8.36)	3,666 (33.17)	4,657	
Total	2,181 (11.51)	1,933 (10.2)	1,255 (6.62)	2,525 (13.33)	11,052 (58.33)	18,946	

Table 3 Odds of unplanned cesarean delivery by demographic characteristic

	Unadjusted OR			Adjusted OR		
	OR	95% Confidence interval		AOR ^a	95% Confidence interval	
Age	1.03	1.02	1.04	1.08	1.07	1.09
Gestational Age	1.08	1.05	1.12	1.08	1.04	1.11
BMI	1.04	1.03	1.05	1.05	1.04	1.06
Parity						
Nulliparous	Ref			Ref		
Multiparous	0.29	0.26	0.32	0.22	0.20	0.25
Race						
White	Ref			Ref		
Black	1.41	1.24	1.60	1.69	1.45	1.96
Asian	1.15	1.01	1.30	1.23	1.08	1.40
Hispanic	0.78	0.65	0.94	1.09	0.89	1.34
Other	0.99	0.88	1.12	1.21	1.04	1.41
Marital status						
Married				Ref		
Single	1.12	1.02	1.23	1.18	1.05	1.31
Other	0.98	0.79	1.22	0.98	0.78	1.24
Zip code by income quartiles						
Q1	1.16	1.03	1.30	1.13	0.98	1.30
Q2	1.33	1.19	1.50	1.14	1.01	1.29
Q3	1.23	1.10	1.39	1.05	0.93	1.19
Q4	Ref			Ref		
Primary Language						
English				Ref		
Spanish	0.80	0.68	0.95	1.07	0.88	1.31
Other	0.85	0.70	1.03	0.94	0.76	1.16

^aModel including age, GA, parity, language, BMI, zip code strata, language, and race.

income of zip code of residence were also significantly associated with increased odds of cesarean birth.

Many of these relationships were maintained in a multivariable model (→Table 3). In the adjusted models, the likelihood of cesarean delivery increased by 8% (aOR 1.08) per 1-year increase in maternal age, as well as by 8% (aOR

1.08) per 1 week increase in gestational age. The adjusted odds of cesarean delivery increased with single marital status compared to married status in adjusted models (aOR 1.18, CI 1.05, 1.31).

After adjustment for age, BMI, and parity, women of Black and Asian races had significantly increased odds of cesarean

Table 4 Indication for c-section by race/ethnicity

Cesarean Indication	Race/Ethnicity					Total %	<i>p</i> < 0.0001
	White N (%)	Black N (%)	Hispanic N (%)	Asian N (%)	Other N (%)		
Non-reassuring fetal evaluation	613 (38.99%)	231 (63.11%)	71 (49.31%)	149 (42.82%)	179 (50.14%)	1,243 (44.60%)	
Failure to progress	837 (53.24%)	117 (31.97%)	63 (43.75%)	187 (53.74%)	155 (43.42%)	1,359 (48.76%)	
Maternal indication	122 (7.76%)	18 (4.92%)	10 (6.94%)	12 (3.45%)	23 (6.44%)	185 (6.64%)	
						Total 2,787	

delivery as compared with White women, with aORs of 1.69 (95% CI 1.45, 1.96) and 1.23 (1.08, 1.40). While Hispanic women had similar odds of Cesarean to the reference group overall, Hispanic women self-identifying as single had significantly increased odds of 1.65 (95% CI 1.08, 2.54)

Clinical Characteristics

Indications for cesarean delivery (– Table 4) were significantly different between race/ethnicity groups (*p* < 0.001). Fetal intolerance was the indication for 39% (613) of cesarean deliveries among White women as compared to 63% (231) of Black women and 49% (71) of Hispanic women. Labor dystocia in the first or second stage was the indication for 53% (837) of cesarean deliveries among White women, but 32% (117) of Black women and 44% (63) of Hispanic women. Among nulliparous patients, indications for cesarean delivery showed the same pattern such that fetal intolerance was the indication for cesarean delivery among 37% (479) of White women compared to 64% (146) of Black women, 42% (34) of Hispanic women, and 40% (120) of Asian women (*p* < 0.001).

There were 586 women who had a cesarean with an indication of labor dystocia and who had a recorded second stage length. The average second stage length was 256.3 minutes. Comparison of second stage length between racial and ethnic groups did not show a significant difference. There were 190 women within this group who had a cesarean in the second stage of labor for indication of fetal distress. The average second stage length was 154.7 minutes. Among women who had a cesarean delivery for the indication of fetal distress and had progressed into the second stage prior to cesarean, there was no difference in second stage length between race/ethnicity groups.

We evaluated odds of cesarean birth by shift. When comparing delivery timing by cesarean indications, deliveries for maternal indication were more likely to occur during the day. When cesarean deliveries for maternal medical complication or worsening maternal status were excluded, there was no significant difference in timing of delivery based on indication, however, the overall likelihood of cesarean delivery during change of shift and night shift was decreased compared to the day shift with odds ratios of

0.85 (0.77, 0.94) and 0.82 (0.75, 0.91). When stratified by race, White women had significantly lower odds of change of shift (OR 0.77 [0.64, 0.88]) or night shift cesarean (OR 0.76 [0.67, 0.86]) compared to delivery during the day. Odds ratios for Black women for change of shift or night shift cesarean were 0.83 (0.63, 1.09) and 0.76 (0.58, 1.01), respectively. Odds ratios for Hispanic women for change of shift or night shift cesarean were 0.88 (0.57, 1.36) and 1.012 (0.67, 1.53), respectively. Odds ratios for Asian women for change of shift or night shift cesarean were 1.02 (0.77, 1.34) and 0.92 (0.70, 1.22), respectively.

Rates of operative vaginal delivery differed in racial and ethnic groups (– Table 5). In multivariable analysis adjusted for age, gestational age, BMI, parity, marital status, language and income by zip code, Asian women were significantly more likely to undergo operative vaginal delivery (aOR 1.35 [1.14, 1.60]). Lower rates of operative vaginal delivery in Black and Hispanic women were seen only in univariable analyses.

Discussion

Black women in this large, diverse cohort had the highest adjusted odds of unplanned cesarean birth and were most likely to be delivered for an indication of non-reassuring fetal status, however, other trends related to race and ethnicity were also seen. Asian women had significantly higher rates of unplanned cesarean birth as compared to White women, as well as significantly higher rates of operative vaginal delivery compared to all other groups. Like Black women, Hispanic women were significantly more likely to have a cesarean birth for the indication of non-reassuring fetal status, while White women were more likely to have unplanned cesarean deliveries on day shifts.

Some of our findings are consistent with other studies, which have identified an increased risk of unplanned cesarean delivery among Black and Hispanic women compared to non-Hispanic White women.^{21–23} A recent study by Stark et al which examined the relationship between race and primary cesarean delivery concluded that racial disparities in cesarean delivery remained despite adjusting for maternal factors, such as maternal diabetes or hypertension, perinatal factors including oligohydramnios or preterm delivery, and

Table 5 Odds of operative vaginal delivery						
	Unadjusted OR			Adjusted OR		
	OR	95% Confidence interval		aOR	95% Confidence interval	
Age	1.01	1	1.02	1.03	1.02	1.05
Gestational age	1.21	1.15	1.27	1.14	1.09	1.20
BMI	0.95	0.94	0.97	0.98	0.96	0.99
Parity						
Nulliparous	Ref	–	–	Ref	–	–
Multiparous	0.17	0.14	0.2	0.17	0.14	0.20
Race						
White	Ref	–	–	Ref	–	–
Black	0.59	0.46	0.75	0.87	0.67	1.14
Asian	1.35	1.14	1.60	1.25	1.04	1.49
Hispanic	0.43	0.30	0.60	0.80	0.55	1.15
Other	0.65	0.53	0.80	0.94	0.73	1.21
Marital status						
Married	Ref	–	–	Ref	–	–
Single	0.75	0.64	0.87	1.00	0.84	1.18
Other	0.65	0.45	0.94	0.88	0.60	1.29
Zip code by income quartiles						
Q1	0.65	0.54	0.78	0.89	0.72	1.10
Q2	1.01	0.85	1.19	0.99	0.83	1.18
Q3	1.11	0.95	1.31	0.95	0.80	1.12
Q4	Ref	–	–	Ref	–	–
Primary language						
English						
Spanish	0.42	0.30	0.58	0.75	0.51	1.12
Other	0.95	0.72	1.26	0.96	0.71	1.29

systems factors including insurance status and night float.²⁴ This study also identified that non-reassuring fetal tracing was more likely to be the indication for primary cesarean delivery among Black and Hispanic women, which has been seen in prior studies as well,^{24–27} though to date no biologically plausible explanation for this observation exists. A study by Yee et al²⁷ also had similar findings regarding increased odds of unplanned cesarean delivery among Black women and Hispanic women as well as increased odds of cesarean for non-reassuring fetal status among Black women (defined as Apgar score less than 7). While looking at labor management strategies, they did not see differential use of labor management strategies intended to reduce the cesarean delivery rate such as application of guidelines for failed induction of labor, arrest of dilation, arrest of descent, non-reassuring fetus status, or cervical ripening.

If race can be considered a social construct, certainly marital status is as well. Marital status cannot be plausibly associated with biologic risk of cesarean, yet women self-identifying as “single” had increased odds of cesarean compared to those who consider themselves “married.” It is

unknown how patient and provider factors may interact with clinical care decisions, particularly those which also introduce the opportunity for subjectivity and bias. Our findings suggest that there are unmeasured factors, which may include provider biases, that impact how women are cared for in labor, how clinical findings are interpreted and translated into care plans, and ultimately, patient’s odds of cesarean delivery or operative vaginal delivery, which warrant further study.

The strengths of our study include a large and diverse cohort of patients from two academic institutions, reducing the likelihood that these results are related to chance. The patients within our cohort were cared for by nurse midwives, residents, private and academic Ob/Gyn specialists, as well as maternal fetal medicine sub-specialists representing a variety of obstetric practice. Additionally, the window during which our data was collected is after algorithms included in “Preventing the first cesarean delivery”²⁸ were widely accepted which may contribute to homogeneity in labor management. An additional strength of our study includes the use of median income by patient zip code as a proxy for

socioeconomic status, which may be more a more sensitive marker than insurance status or educational attainment.

Limitations of this study include that perinatal complications including diabetes, hypertension or more specific clinical data regarding management of labor such as regional anesthesia and rates of induction of labor could not be extracted from the medical record due to the medical record limitations. Though our study did not control for patient comorbidities, similar findings have persisted in prior studies where comorbidities were controlled for.^{25,28} Therefore, it is unlikely that these comorbidities alone explain the racial and ethnic or socioeconomic disparities in risk of unplanned cesarean delivery. Additionally, race, ethnicity, and marital status are typically self-reported to an employee who enters this into the record, which may introduce error. Our overall rate of cesarean delivery was 14.8 for nulliparous and multiparous patients; therefore our results may not be generalizable to populations with differing cesarean rates. Lastly, as this was a retrospective cohort study, there may be bias introduced due to unmeasured variables.

The variations in rates of unplanned cesarean birth and operative vaginal delivery observed here cannot be plausibly attributed to differences in race or marital status, and therefore may be the result of unmeasured factors, perhaps provider or systems bias or racism, that explain the increased risk of cesarean delivery among Black and Asian women within our institutions and the racial differences in cesarean section indication. Particularly, future research should further investigate the diagnosis of non-reassuring fetal tracing as it appears that this may have a significant influence of increased rates of unplanned cesarean for Black women. Rather than correlation with Apgar score, A future studies could investigate how the diagnosis of non-reassuring fetal status is prospectively applied as it is a diagnosis with inherent subjectivity. As national efforts to increase equity in health outcomes progress, and we aim to develop anti-racist institutions, more research is needed to investigate the cultural factors, clinical management, and subjective clinical decision making that may contribute to the racial and ethnic disparities in obstetric outcomes.

Conflict of Interest

None declared.

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