




# Maternal and Neonatal Morbidities by Race in College-Educated Women

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## Abstract

**Objective** Non-Hispanic black and Hispanic women experience significantly higher adverse maternal and neonatal outcomes compared with non-Hispanic white women. The purpose of this study is to explore whether disparities in obstetric outcomes exist by race among women who are college-educated.

**Study Design** This is a retrospective cohort study from a multicenter observational cohort of women undergoing cesarean delivery. Women were defined as “college-educated” if they reported completion of a 4-year college degree. Race/ethnicity was categorized as non-Hispanic white, non-Hispanic black, Hispanic, Asian, Native American, or unknown. The primary outcome was a composite of maternal morbidity, and a composite of neonatal morbidity was evaluated as a secondary outcome. A multivariable logistic regression model was then utilized to assess associations of race with the primary and secondary outcomes.

**Results** A total of 2,540 women were included in the study. After adjusting for potential confounding variables, maternal morbidity was found to be significantly higher for college-educated non-Hispanic black women compared with non-Hispanic white women (odds ratio [OR] 1.77, 95% confidence interval [CI] 1.12–2.80). The incidence of neonatal morbidity was significantly higher for non-Hispanic black (OR 1.91, 95% CI 1.31–2.79) and Hispanic (OR 3.34, 95% CI 2.23–5.01) women.

**Conclusion** In this cohort, the odds of cesarean-related maternal and neonatal morbidities were significantly higher for college-educated non-Hispanic black women, compared with their non-Hispanic white counterparts. This demonstrates that even among women with higher level education, racial and ethnic disparities persist in obstetric outcomes.

## Keywords

- ▶ racial disparities
- ▶ maternal morbidity
- ▶ neonatal morbidity
- ▶ education

While medical technology advances at unprecedented rates, severe obstetric morbidity and mortality present a significant challenge to the U.S. health care system, with a particularly high burden among black and Hispanic women.<sup>1</sup> Racial

disparities in obstetrics remain a major public health challenge as research consistently demonstrates that non-Hispanic black and Hispanic women experience higher adverse obstetric outcomes than non-Hispanic white women.<sup>2,3</sup>

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These disparities are often attributed to differences in socioeconomic status, access to care, or level of education.<sup>4</sup> However, conflating race and ethnicity with other social determinants of health can distract from, or at worst neglect, understanding the true underlying etiologies of racial disparities.

While race and ethnicity have already been well documented as independent risk factors for obstetric morbidity and mortality, this phenomenon must be clarified specifically in a population of women with a higher level of education to understand whether a true disparity exists independent of education. As there is often overlap between minority race and disadvantaged socioeconomic or educational background, it is possible that racial disparities may not exist among women with college degrees. The purpose of this research, therefore, is to investigate associations between race and maternal and neonatal morbidities in a population of college-educated women.

## Materials and Methods

This is a retrospective cohort study of a multicenter prospective cohort of women undergoing cesarean delivery (Eunice Kennedy Shriver National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network Cesarean Registry, 1999–2002). Demographic information, medical history, and obstetric data for the patients were collected from the medical chart by trained research staff; full details of the design have been described by prior studies.<sup>5–7</sup> Nulliparous women with live, nonanomalous singleton gestations who underwent primary cesarean section were included, and women were defined as “college-educated” if they reported completion of a 4-year college degree. Race and ethnicity were determined from the patient’s chart and categorized by the parent trial as non-Hispanic white, non-Hispanic black, Hispanic, Asian, Native American, or unknown. The analysis focused on non-Hispanic white, non-Hispanic black, and Hispanic women, as the other groups had limited sample sizes.

The primary outcome was a composite of maternal complications including hysterectomy, uterine atony, blood transfusion, surgical injury, arterial ligation, infection, wound complication, and ileus. We also evaluated a composite of neonatal morbidity as a secondary outcome, including death, adverse respiratory outcomes, neonatal intensive care unit (NICU) admission, and other severe complications (adverse respiratory outcomes, NICU admission, sepsis, treated hypoglycemia, seizure, hypoxic ischemic encephalopathy, necrotizing enterocolitis, cardiopulmonary resuscitation in the first 24 hours of life, 5-minute Apgar score < 3, and hospitalization  $\geq$  5 days). Both these composites have been previously utilized and described in studies from the Cesarean Registry.<sup>8–10</sup>

Baseline characteristics by race and ethnicity were assessed in univariable analyses using the Student’s *t*-test, Mann–Whitney’s *U* test, chi-square test, and Fisher’s exact test, as appropriate. We then fit a multivariable logistic regression model adjusting for selected demographic and

obstetric variables that may influence the likelihood of the primary outcome. This included maternal age, body mass index (BMI), marital status, toxic exposures (smoking, illicit drug use, and alcohol use), diabetes, preeclampsia-spectrum disorders (gestational hypertension, preeclampsia, eclampsia, and HELLP syndrome), and chorioamnionitis. All statistical tests were two-tailed, and *p*-value less than 0.05 was considered significant. The sample size was fixed from the original registry study. All analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, NC). This analysis was considered exempt by the Institutional Review Board at Columbia University Medical Center as these data are deidentified and publicly available.

## Results

Of 73,257 women in the parent trial, 2,540 women met inclusion criteria (►Fig. 1). The total incidence of the primary outcome of composite maternal morbidity was 11.9% (303 women). The total incidence of the secondary outcome of composite neonatal morbidity was 25.8% (655 women). The population was composed of 1,766 non-Hispanic white women (69.5%), 343 non-Hispanic black women (13.5%), 206 Hispanic women (8.4%), 5 Native American women (0.2%), 121 Asian women (4.9%), and 99 women who reported unknown race/ethnicity (4.0%). ►Table 1 demonstrates significant demographic and obstetric differences by racial/ethnic group. More specifically, compared with non-Hispanic white women, non-Hispanic black and Hispanic women were younger (mean age 29.5 and 30.0, respectively, vs. 30.6;  $p < 0.01$ ) and less likely to be married (51.0 and 65.0%, respectively, vs. 92.9%;  $p < 0.01$ ). Non-Hispanic black women also had higher prepregnancy BMI compared with non-Hispanic white women (27.3 vs. 24.1;  $p < 0.01$ ). Non-Hispanic white women had higher rates of smoking (6.2%, compared with 5.2 and 2.4% of non-Hispanic black and Hispanic women, respectively;  $p < 0.01$ ) and alcohol use (4.0%, compared with 2.3 and 1.5% of non-Hispanic black and Hispanic women, respectively;  $p < 0.01$ ), while non-Hispanic black women had a higher rate of illicit drug use

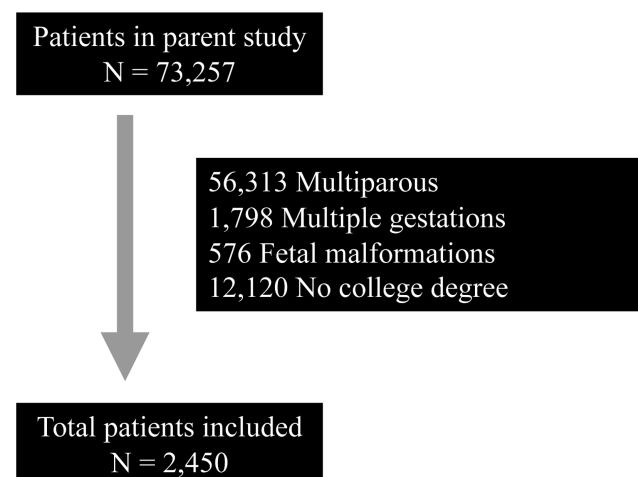


Fig. 1 Derivation of the study population.

**Table 1** Patient characteristics by race/ethnicity

	Non-Hispanic white N = 1,766	Non-Hispanic black N = 343	Hispanic N = 206	Native American N = 5	Asian N = 121	Unknown N = 99	p-Value
Maternal age, mean (SD)	30.6 (4.6)	29.5 (5.1)	30.0 (4.7)	32.4 (6.7)	31.2 (4.1)	30.0 (4.3)	< 0.01
Prepregnancy BMI, median (IQR)	24.1 (21.4–28.1)	27.3 (23.0–32.2)	24.0 (20.6–26.8)	23.3 (21.3–24.8)	21.6 (19.9–24.1)	23.4 (21.2–26.6)	< 0.01
Married, N (%)	1,640 (92.9)	175 (51.0)	134 (65.0)	5 (100.0)	107 (88.4)	83 (83.8)	< 0.01
Smoking, N (%)	109 (6.2)	18 (5.2)	5 (2.4)	0 (0)	0 (0)	2 (2.0)	< 0.01
Illicit drug use, N (%)	4 (0.2)	5 (1.5)	1 (0.5)	0 (0)	0 (0)	1 (1.0)	0.04
Alcohol use, N (%)	70 (4.0)	8 (2.3)	3 (1.5)	1 (0.2)	1 (0.8)	3 (3.0)	0.03
Diabetes, N (%)	117 (6.6)	40 (11.7)	26 (12.6)	0 (0)	10 (8.3)	6 (6.1)	< 0.01
Asthma, N (%)	134 (7.6)	36 (10.5)	12 (5.8)	0 (0)	6 (5.0)	4 (4.0)	0.13
Hypertension, N (%)	39 (2.2)	15 (4.4)	2 (1.0)	0 (0)	2 (1.7)	1 (1.0)	0.10
Renal disease, N (%)	21 (1.2)	5 (1.5)	2 (1.0)	0 (0)	0 (0)	0 (0)	0.69
Heart disease, N (%)	44 (2.5)	3 (0.9)	4 (1.9)	0 (0)	1 (0.8)	3 (3.0)	0.40
Preeclampsia-spectrum disease <sup>a</sup> , N (%)	147 (8.3)	41 (12.0)	13 (6.3)	0 (0)	3 (2.4)	18 (18.2)	0.02
Placental abruption, N (%)	33 (1.9)	2 (0.6)	2 (1.0)	0 (0)	5 (4.1)	4 (4.0)	0.07
Chorioamnionitis, N (%)	152 (8.6)	49 (14.3)	53 (25.7)	2 (0.4)	21 (17.4)	8 (8.0)	< 0.01

Abbreviations: BMI, body mass index; IQR, interquartile range; SD, standard deviation.

<sup>a</sup>Preeclampsia spectrum disorders including gestational hypertension, preeclampsia, eclampsia, and HELLP.

**Table 2** Association of race with maternal and neonatal morbidities among college-educated women

	Maternal morbidity			Neonatal morbidity		
	aOR <sup>a</sup>	95% CI	p-Value	aOR <sup>a</sup>	95% CI	p-Value
Non-Hispanic white	Reference			Reference		
Non-Hispanic black	1.77	1.12–2.80	0.01	1.91	1.31–2.79	< 0.01
Hispanic	1.20	0.70–2.07	0.50	3.34	2.23–5.01	< 0.01
Native American	2.59	0.25–26.55	0.42	20.47	1.93–217.61	0.01

Abbreviations: CI, confidence interval; aOR, adjusted odds ratio.

<sup>a</sup>Model adjusted for maternal age, body mass index, marital status, toxic exposures during pregnancy (tobacco, alcohol, and illicit drugs), maternal diabetes, preeclampsia, and chorioamnionitis.

(1.5 vs. 0.2%;  $p=0.04$ ). Non-Hispanic black and Hispanic women also had significantly higher incidence of diabetes (11.7 and 12.6%, respectively, vs. 6.6%;  $p>0.01$ ), whereas there were no significant differences in other baseline comorbidities. Specific obstetric complications, including preeclampsia-spectrum disease and chorioamnionitis also had significantly higher incidence among college-educated non-Hispanic black and Hispanic women compared with non-Hispanic white women.

Adjusted analysis with a multivariable logistic regression model demonstrated that composite maternal morbidity was significantly higher for college-educated non-Hispanic black (adjusted odds ratio [aOR] 1.77, 95% confidence interval [CI] 1.12–2.80,  $p<0.01$ ) compared with non-Hispanic white women (►Table 2). Neonatal morbidity was significantly higher in both non-Hispanic black women (aOR 1.91, 95% CI 1.31–2.79,  $p<0.01$ ) and Hispanic women (aOR 3.34, 95% CI 2.23–5.01,  $p<0.01$ ) compared with non-Hispanic white women.

## Discussion

This cohort study of college-educated women demonstrates that even among women with higher education, non-Hispanic black and Hispanic women experience significantly more maternal and neonatal complications compared with non-Hispanic white women. As the statistical models employed also controlled for several key sociodemographic and clinical variables, there is a strong implication of a fundamental disparity in morbidity by race that is not attributable to other factors. College education serves as a proxy in this study both for higher social and income status as well as a higher level of health literacy. In fact, in prior research investigating disparities in self-esteem and social resources by race in pregnant women, all differences between black, Hispanic, and white women were explained by differences in income and level of education.<sup>11</sup> These, in turn, should function as equalizers, translating into improved access to care and a better ability to understand and advocate for one's medical needs. College education, however, does not seem to mitigate the racial disparities in outcomes observed in the general obstetric patient population.

There is an emerging body of literature dedicated to the problem of racial disparities in obstetrics which has docu-

mented increased morbidity in general as well as in specific contexts such as postpartum hemorrhage and advanced maternal age.<sup>1,12–14</sup> This study examines a specific subpopulation of women with advanced education to better understand whether racial and ethnic differences are present even among women with college degrees, suggesting a true underlying disparity based solely on race. As maternal morbidity and mortality remain significant problems in our health care system, with disproportionate manifestation among women of minority race and ethnicity, research that elucidates these deeply rooted disparities is an important step in beginning to combat them. In fact, a recent study of U.S. vital statistics data demonstrated small but statistically significant differences in maternal and neonatal morbidities by race among women with at least a bachelor's degree.<sup>15</sup> If socioeconomic or health literacy differences do not account for racial disparities in morbidity among society's educated elite, it is probable that bias at the provider, hospital, and societal level may play an important role in propagating differential adverse outcomes.<sup>16,17</sup> Every effort should be made, including institutional implicit bias training and individualized patient risk assessment that incorporates race and ethnicity into counseling and decision-making, to attempt to alleviate these disparities.<sup>18</sup>

Strengths of this study include the unique ability to evaluate a focused cohort of college-educated women with composite maternal and neonatal morbidities outcomes based on research quality data, as opposed to administrative data generated from diagnosis codes. Information on patient educational status is often not available in large datasets, and this cohort offers the opportunity to gain important insight into the dynamics of race and obstetric morbidity in this subpopulation defined by higher education. The study is limited by inclusion of primarily academic medical centers in the original study and its use of data collected from 1999 to 2002, which may render it less generalizable to the obstetric patient population today. Generalizability is further limited by its inclusion only of women undergoing cesarean delivery. Prior research has already demonstrated differential rates in cesarean delivery by race, and this may impact interpretation of these findings.<sup>19</sup> The study is also confined to the variables included for analysis in the parent study as well as potential confounding by the individual racial and ethnic, sociodemographic, and educational backgrounds of the patient mix at each participating hospital.

## Conclusion

Ultimately, these data demonstrate that college-educated obstetric patients of minority race and ethnicity are still more likely to suffer significant morbidity than their non-Hispanic white counterparts. This points to a deeply entrenched and poorly understood disparity in how care is delivered to patients of color in the United States. Clinical and research efforts must target systems-level bias to tackle this pervasive problem in our health care system and effect population-wide reduction in maternal and neonatal morbidities and mortalities.

### Note

This study was presented at the Society for Reproductive Investigation 66th Annual Scientific Meeting in Paris, France (Abstract# 2199).

### Conflict of Interest

None declared.

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