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The Influence of Detailed Maternal Ethnicity on Cesarean Delivery: Findings from the U.S. Birth Certificate in the State of Massachusetts

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Introduction

A reduction in the prevalence and variability of primary cesarean rates due to safety, quality, and cost concerns is a current focus in obstetrical care (1). Risk adjusted primary cesarean delivery rates are considered a quality performance measure and efforts to reduce these rates in low-risk primipara are a national (2) and international (3) public health priority. Yet, primary cesarean delivery rates among low-risk women in the U.S. remain high, 26.4% in 2010 (2), with wide regional and hospital variation (4; 5). Additionally, evidence of persistent racial and ethnic disparities exist, (6) which may be contributing to the variability in the overall rate of primary cesareans. Compared to Non-Hispanic white women, African American or non-Hispanic black women have higher risk adjusted rates (7). However, the data are inconsistent for Hispanic and Asian/Pacific Islander women, indicating equivalent (8), lower (9), and higher rates (10). This variation possibly reflects significant differences between subgroups of women within these broadly defined aggregates.

Primary cesarean delivery rates have crucial public health significance as they are more costly to the health care system, (4) associated with increased risks for mothers and infants, (11) and contribute to the high prevalence of repeat cesareans (12). Yet, few studies (10; 13–15) have examined the racial and ethnic variability in cesarean risk among a group of women considered “low-risk” for the procedure (16)—nulliparous women with term, singleton, and vertex presentation deliveries (NTSV population). Examination of this population has four advantages. First, the definition of low risk is consistent with the Healthy People 2020 objective MICH 7.1 (2) and the Joint Commission on Accreditation in Healthcare perinatal core measure PC-02 (17), which are national and hospital-based performance measures aimed at primary cesarean reduction among the NTSV population. Second, this population is less likely to have unmeasured differences in other risk factors for

cesarean delivery. The American College of Obstetrics and Gynecology recommends that inter-hospital comparisons of cesarean rates should focus on the NTSV population, as rates are expected to vary minimally under “optimal” conditions (18). Third, the influence of the management and outcome of previous pregnancies on the risk of cesarean delivery for the index pregnancy is removed. Fourth, this group is at highest risk for unplanned cesarean deliveries that may be amenable to prevention strategies (11).

Racial and ethnic variation in cesarean deliveries has implications for health disparities in obstetric care. Previous studies suggest that non-white women have a disproportionately higher risk adjusted cesarean rates as compared with white women, even after taking into account socioeconomic, behavioral, medical, and institutional level factors (7–10; 13–15; 19; 20). However, with few exceptions, the applicability of these findings are limited by their use of broad racial/ethnic categories, which can mask considerable within-group heterogeneity. Therefore, this study employed a population-based dataset to examine the likelihood of primary cesarean delivery for childbearing women at low-risk for cesarean among each major ethnic group in the U.S. state of Massachusetts. We also compared our results to broad classifications of race/ethnicity more commonly employed in biomedical and public health research. The study was conducted in Massachusetts because it is one of the few U.S. states to have collected detailed ethnicity data on the birth certificate for over 15 years.

Methods

Study population

We obtained information on all live births in Massachusetts from the Registry of Vital Records and Statistics for years 1996 through 2010. The Standard Certificate of Live Birth (1989 Revision) is populated by data collected from a Parent Worksheet for Birth Certificates, which contains the legal and socio-demographic information on the child’s mother and father. The parent(s) are required to complete the legal portion of the Parent Worksheet. The birth certificate also contains data from the Hospital Worksheet for Birth Certificates, which is completed by a designated hospital representative (e.g., nurse, midwife, or hospital birth registrar) who reports on prenatal care, labor and delivery, neonatal, and discharge conditions and procedures.

All women who delivered a live birth in Massachusetts over a fifteen-year period between January 1, 1996 and December 31, 2010 were considered for inclusion. Among the 1,162,099 live births, 431,231 were nulliparous (first birth), term (>36 or <42 weeks of gestational age), singleton (one offspring), and vertex (head down) deliveries. We excluded a further 3,838 records with missing information on delivery mode and/or ethnicity as well as births that occurred out of the hospital, in unknown locations, at birth centers, or in hospitals with less than 15 births over the study period. The result was a final analytic sample of 427,393 NTSV births.

Outcome measure

Mode of delivery was the primary outcome for the analysis. Each birth was indicated on the birth certificate as being delivered by one of two modes: vaginal (spontaneous or operative) or cesarean, which was defined as a binary outcome. Cesarean deliveries included those that were scheduled or occurred after a trial of labor.

Race/ethnicity measures

The primary independent variable was maternal ancestry or ethnic heritage (henceforth referred to as ethnicity). Ethnicity was derived from the following open-ended question on the Parent Worksheet for the birth certificate, “*Please mark one category that best describes the mother’s ancestry or ethnic heritage*”, of which 39 mutually exclusive options were self-reported. Single reporting of ethnicity occurred during the entire study period. Mothers from 8 categories with 1,800 mothers or less were included in the relevant “Other” categories (e.g., Other Asian/Pacific Islander, Other Central American). As defined by the Massachusetts Department of Public Health, mothers who reported their race as Black and ethnicity as American were recoded as African American ethnicity, which is consistent with the African American ethnicity option on the Parent Worksheet. “American” mothers were defined as non-black and non-Hispanic who self-identified their ethnicity as “American.” As a result, 31 unique ethnic categories were included in the analysis. “American”, the majority ethnic group, was the category with which all other ethnic groups were compared. The parent worksheet also asks “*Please mark one category that best describes the mother’s race*” and White, Black, Asian/Pacific Islander, American Indian, and Other are listed. The maternal race and ethnicity questions were combined to construct the standard OMB categories. The five broad racial/ethnic categories used to compare our main results were: Non-Hispanic white, Non-Hispanic black, Hispanic, Asian/Pacific Islander, and Other, which approximate standard Office of Management and Budget (OMB) classifications for federal data in the U.S. (21). Non-Hispanic white, the majority group, was the racial/ethnic category with which the other categories were compared.

Independent variables

We included the following independent variables: maternal age (24, 25–29, 30–34, 35 years), maternal education (less than high school, high school graduate, some college, college graduate and higher), marital status (married or not married), maternal place of birth (U.S. or foreign born), prenatal care adequacy (adequate or less than adequate), infant birthweight (low birthweight <2500 grams, normal birthweight 2,500–3,999 grams, and high birthweight 4000+ grams), and delivery source of payment (private, public, other).

We determined women to be foreign born if they listed their country of birth anywhere other than the continental U.S. We considered women in Puerto Rico to be foreign born for these purposes. The Adequacy of Prenatal Care Utilization (APNCU) Index was used to classify the level of prenatal care into adequate and inadequate (22). Adequate prenatal care was defined as 80% or greater on the APNCU Index (sum of the adequate and adequate plus categories) and the rest were considered less than adequate. Missing values for maternal education were coded as missing to be included in the analysis.

The Boston College Institutional Review Board reviewed the study and considered it exempt.

Statistical Methods

In descriptive analyses, we examined the frequency of cesarean delivery by all study variables. We then conducted two logistic regression models, using a stepwise approach, to examine differences in the risk of cesarean delivery between each of the 31 ethnic groups relative to American mothers. In model 1, we adjusted for maternal age, to account for the increasing risk of cesarean delivery with advancing age, (23; 24) and year of birth, to account for the increasing nationwide trend in cesarean (25). In model 2, we added the remaining maternal socio-demographic characteristics (maternal education, marital status, place of birth, delivery source of payment), birth characteristics (prenatal care adequacy, infant birth weight), and a hospital fixed effect to control for the known hospital differences in cesarean deliveries (4; 26). We repeated the two regression models with the five broad race/ethnicity categories relative to Non-Hispanic white mothers. All analyses were conducted using SPSS, V20.

Results

From 1996 through 2010, average primary cesarean deliveries among NTSV births increased from 16.8% to 27.6%. The mean cesarean delivery rate for self-identified “American” mothers was 23.3%, and cesarean delivery rates varied from 12.9% for Cambodian women to 32.4% for Nigerian women (Table 1). Figure 1 illustrates the wide variation in cesarean rates across ethnic groups.

The distribution of the study sample and percent of NTSV cesarean deliveries by maternal and birth characteristics are shown in Table 2. The proportion of cesareans was higher among mothers who were married, of advanced age, higher education, private insurance, and higher birthweight babies. There were few differences in the proportion of cesarean births by maternal place of birth and adequacy of prenatal care.

In model 1 (Table 3), adjusted for maternal age and year of birth, the odds of a primary cesarean delivery relative to “Americans” was higher for women from 15 of the 30 ethnic groups (range of adjusted odds ratios [AORs] 1.09–1.52), while women from 10 of the 30 ethnic groups had lower odds (range of AORs 0.51–0.98). There were no differences in cesarean delivery for the remaining ethnic groups.

In model 2 (Table 3), after including additional maternal socio-demographic, and birth characteristics, as well as a hospital fixed effect, we found that the majority of associations remained and often strengthened in magnitude. Compared to self-identified “Americans”, women from 21 of the 30 ethnic groups had higher odds of a primary cesarean (range of AORs 1.09–1.77), while only Chinese, Cambodian, and Japanese women had lower odds (range of AORs 0.66–0.92). Overall, Brazilian mothers (AOR 1.77 [95% CI 1.67, 1.86]) were at the highest risk of cesarean delivery, while Cambodian (AOR 0.66 [95% CI 0.59, 0.74]) and Japanese (AOR 0.66 [95% CI 0.57, 0.76]) mothers were at the lowest risk. In

comparison to self-identified “American” women, there were no differences in cesareans for the remaining 6 ethnic groups.

We repeated the analyses using 5 broad racial/ethnic categories and found that in the fully adjusted model, Non-Hispanic black and Hispanic women as well as those in the “Other” category had higher odds of cesarean delivery relative to Non-Hispanic white women (Table 4). In contrast, there were no differences in risk of cesarean delivery between Asian/Pacific Islander and Non-Hispanic white women.

Discussion

Using a population-level dataset of all births in Massachusetts over a 15-year period, we found significant racial and ethnic variations in primary cesarean delivery rates among mothers considered at low-risk for the procedure. Compared with self-identified “American” women, the majority of ethnic groups (21/30) had higher odds of cesareans, independent of mothers’ socio-demographic, birth, and hospital characteristics. Although we found no differences in cesarean deliveries between Asian/Pacific Islander and Non-Hispanic white women, using detailed ethnicity we identified Chinese, Cambodian, and Japanese women as having lower odds of cesareans compared to self-identified “American” ethnicity. Categorization by detailed maternal ethnicity is better at identifying groups of women at risk for primary cesareans than widely used broad racial/ethnic classifications that employ only one binary ethnicity category (Hispanic/not-Hispanic).

The patterns of primary cesarean rates would be different had mothers been grouped into the traditional, broadly defined racial/ethnic categories, as shown in Table 4. The heterogeneous results, among the subgroups of women that comprise the broad Asian/Pacific Islander category, would not have been revealed. As illustrated in Table 3, Chinese, Cambodian, and Japanese mothers had lower odds of cesareans than Asian Indian, Vietnamese, Filipino, and Other Asian Pacific Islander mothers who had higher odds relative to self-identified “American” mothers. More nuanced data on ethnicity, as illustrated in our study, may help explain the inconsistencies seen in previous studies on the effect of race/ethnicity on cesarean section rates; (27) particularly, for the Asian American/Pacific Islander population that is composed of vastly diverse cultural subgroups.

Comparisons with previous studies are difficult as classifications of race and ethnicity are not universally accepted nor consistently applied. Further, few studies have examined racial/ethnic differences in cesarean delivery among a NTSV population. Coonrod et. al., (14) analyzed 28,863 Arizona birth certificates from 40 hospitals in 2005. In the adjusted models, including clinical indicators and institutional-level predictors, African American and all Hispanic women had higher rates of cesarean delivery than Non-Hispanic white women. The study did not have an Asian racial/ethnic category. The higher rates among African American and Hispanic women is consistent with our findings. Specific to Asian American women, Rao et. al., (28) analyzed the labor and delivery records of 3,779 Asian and Pacific Islander women by detailed ethnicity in one academic medical center from 1998–2003. In the adjusted models, including clinical indicators, Chinese and Japanese women had lower odds of cesarean delivery and Pacific Islander women had higher odds in comparison to the

Asian American group as a whole. Our findings are consistent with these results. However, the study also found no differences in the odds of cesarean delivery for Filipino, Asian Indian, and Vietnamese women, while we found higher odds for these ethnic groups relative to self-identified “American” women.

Although recent evidence from Massachusetts documents hospital-level variation in the risk of a cesarean delivery for NTSV pregnancies, (26) we found that ethnic differences in cesarean deliveries remained even after controlling for the hospital of birth. This implies that hospital or institutional practices cannot fully account for the observed differences. Previous studies have suggested that provider practices and bias, either explicit or implicit, impact labor management decisions (29; 30). However, in the context of shared decision making, women’s preferences also interact with provider’s obstetric evaluations, contributing to utilization decisions (31).

While exact causative factors are difficult to determine from the data, the higher and lower odds among some ethnic groups suggests either that these groups may have different obstetrical risk and/or different cultural norms that impact delivery preferences and decision-making. While we lack data on specific clinical indications, there is little empirical data that suggests obstetric risk for cesarean deliveries vary according to the patterns seen in our data (30). Ethnicity, a basic proxy for culture, can predispose women to higher or lower rates of cesarean delivery. Cross-cultural differences in women’s preference for mode of birth are well documented (32–35). Maternal attitudes about childbirth, including the degree of confidence in realizing vaginal delivery, (36) whether birth is considered a natural event, (37) and expectations of childbirth pain (38) shape women’s preferences for mode of delivery. The determinants of these attitudes are inherently linked to culture (39). Although little evidence supports the view that maternal request is a significant contributor to the rising cesarean rate, (40) culture is thought to influence women’s preferences, and the dynamics of interactions with providers that underlie mode of delivery decisions.

In the case of Brazilian women, for example, their socialization in a culture with the one of the highest rates of operative deliveries in the world may culturally predispose them to a greater willingness to use or accept obstetric intervention. In Brazil, nearly 50% of all deliveries are cesareans and this rate is as high as 80% in the private sector (41). The high prevalence has been associated with widespread beliefs about pain management, perceptions regarding sexual function following vaginal delivery, and risk perceptions (42; 43). The procedure is also associated with higher socio-economic status and therefore with the idea of high-quality care (42). Persistence of these culturally learned beliefs provides one explanation for the higher odds of cesarean delivery among Brazilian women in Massachusetts and that of Brazilians in Portugal, (44) Norway, (45) and Switzerland (45) relative to majority populations. Determination of salient sociocultural childbirth beliefs and customary practices (including participation in decisions with providers about delivery) might help better explain observed differences among other ethnic groups, both with higher and lower rates of cesarean deliveries relative to self-identified American women. As an example, comparing the cultural predispositions towards obstetric interventions between Brazilian and Cambodian women might lead to practical strategies for the reduction in primary cesareans rates and ethnic disparity in obstetric care.

To our knowledge this is one of the first studies to examine NTSV cesarean rates across a range of ethnic groups with adequate power to allow for sufficient disaggregation into meaningful subgroups. Since the data are population-based there is no selection bias as in hospital-based studies. While there are some limitations to the use of birth certificate data, a population based validation study suggests no significant differences in reporting of race and ethnicity by mode of delivery, concluding that these data can be reliably used in studies of maternity care (46). A limitation to our analysis is that we did not have complete data on the clinical characteristics of mothers that may place them at greater risk of cesarean section, such as obesity and placental disorders. However, other studies that included more complete clinical data found that racial/ethnic estimates varied only a small amount (10; 47) and actually increased (7) after adjustment for clinical indications.

Accurate and reliable measurement of ethnicity is challenging, even when self-reported, because of the fluidity of personal identify, the intersection between race and ethnicity, multiethnic identities, and the social-cultural heterogeneity within groups (48–49). Ethnicity can represent national origin, cultural affinity, ancestral origin and personal identity, depending on personal and social context. These factors contribute to the potential for misclassification and are a limitation of the use of birth certificate data. However, recognizing the complexities in conceptualization and measurement of ethnicity, epidemiologists are encouraged to continue the study of racial and ethnic patterns of health care, while improving upon the methods used to measure race and ethnicity (48). This study compared a traditional race/ethnicity categorization that employed a binary measure of ethnicity to a multiple self-reported measure of ethnicity with 39 options, which is consistent with recommendations on the use of race and ethnicity in epidemiology and public health research (50).

Conclusion

Primary cesarean rates are an important public health measure, and strategies to reduce the variation in this major surgical procedure are urgently needed. Our study demonstrated that detailed maternal ethnicity explains the variation in NTSV cesarean rates better than broad race/ethnicity categories and identifies specific populations that can be targeted for public health campaigns aimed at preventing primary cesareans. Further investigation into the cultural specificities that shape women's preferences and interactions with providers about delivery decisions may help enable the development of culturally tailored interventions for addressing cesarean delivery rates. We suggest the need for more research investigating the existence of shared beliefs, behaviors, and customary practices related to cesarean delivery; to specify both the potential pathways of influence, how they may differ across ethnic groups, and their relative influence. Societies are increasingly racially and ethnically diverse. The challenge of this diversity requires a culturally informed public health response to improve quality and assure equality in maternity care.

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Figure 1.
Percent NTSV Cesarean Deliveries by Ethnicity, Massachusetts Births 1996–2010

Table 1

Percent NTSV cesarean delivery by maternal ethnicity, Massachusetts 1996–2010 (N = 427,393)

Ethnicity	n (%)	% Cesarean delivery
American	191282 (44.8)	23.3
African American	16017 (3.7)	23.7
Native American	1452 (0.3)	22.7
Puerto Rican	22274 (5.2)	19.5
Dominican	9193 (2.2)	21.0
Mexican	2412 (0.6)	21.3
Columbian	2147 (0.5)	23.5
Salvadoran	4362 (1.0)	15.5
Other Central American	4767 (1.1)	18.8
Other South American	2953 (0.7)	25.0
Other Hispanic	1427 (0.3)	20.0
Haitian	5333 (1.2)	30.9
Jamaican	1399 (0.3)	26.8
Other West Indian/Caribbean	1969 (0.5)	25.5
Cape Verdean	4622 (1.1)	23.6
Brazilian	11000 (2.6)	31.5
Other Portuguese	7724 (1.8)	25.1
European	82605 (19.3)	25.5
Lebanese	1400 (0.3)	22.1
Other Middle Eastern	3277 (0.8)	22.8
Nigerian	796 (0.2)	32.4
Other African	4938 (1.2)	31.8
Asian Indian	8109 (1.9)	29.2
Chinese	9175 (2.1)	22.3
Vietnamese	4380 (1.0)	21.7
Cambodian	3027 (0.7)	12.9
Korean	2298 (0.5)	23.5
Filipino	1347 (0.3)	31.3
Japanese	1302 (0.3)	16.9
Other Asian/Pacific Islander	3442 (0.8)	21.9
Other	10964 (2.6)	22.3
TOTAL	427393 (100)	23.8

Table 2

Description of study population and percent NTSV cesarean deliveries, Massachusetts, 1996–2010 (N = 427,393^a)

	n (%)	% Cesarean delivery
Maternal age (years)		
<24	139050 (32.5)	16.8
25–29	115395 (27.0)	22.7
30–34	117481 (27.5)	26.8
35+	55467 (13.0)	37.0
Maternal education		
Less than high school	46897 (11.0)	16.2
High school graduate	106829 (25.0)	22.6
Some college	92509 (21.6)	25.4
College graduate and higher	180422 (42.2)	25.6
Missing	736 (0.2)	19.8
Marital Status		
Married	275907 (64.6)	25.5
Not Married	151486 (35.4)	20.6
Maternal Place of Birth		
U.S. Born	314127 (73.5)	23.8
Foreign Born	112961 (26.4)	23.7
Delivery Payment		
Private	294074 (68.8)	25.2
Public	128063 (30.0)	20.7
Other	5184 (1.2)	17.1
Prenatal Care		
Adequate	354136 (82.9)	24.1
Less than adequate	73257 (17.1)	22.0
Birthweight		
Low birthweight	11027 (2.6)	25.4
Normal birthweight	375622 (87.9)	21.6
High birthweight	40517 (9.5)	43.5

^a. Missing values: maternal place of birth (305), delivery payment (72), birthweight (227)

Table 3

Adjusted models of NTSV cesarean deliveries by maternal ethnicity (N = 427,099)

Ethnicity	AOR 1 ^a	[95% CI]	AOR 2 ^{a,b}	[95% CI]
American	1.00	[Reference]	1.00	[Reference]
African American	1.32	[1.27, 1.37]	1.47	[1.41, 1.53]
Native American	1.16	[1.02, 1.31]	1.12	[0.99, 1.27]
Puerto Rican	1.11	[1.07, 1.16]	1.30	[1.24, 1.35]
Dominican	1.09	[1.04, 1.15]	1.21	[1.14, 1.29]
Mexican	0.96	[0.87, 1.06]	1.15	[1.03, 1.27]
Colombian	1.02	[0.92, 1.13]	1.21	[1.08, 1.34]
Salvadoran	0.73	[0.67, 0.80]	1.00	[0.92, 1.10]
Other Central American	0.91	[0.84, 0.98]	1.12	[1.03, 1.21]
Other South American	1.11	[1.02, 1.21]	1.26	[1.15, 1.38]
Other Hispanic	1.08	[0.94, 1.23]	1.26	[1.10, 1.45]
Haitian	1.50	[1.41, 1.59]	1.72	[1.61, 1.84]
Jamaican	1.34	[1.18, 1.51]	1.58	[1.39, 1.79]
Other West Indian/Caribbean	1.24	[1.12, 1.38]	1.41	[1.27, 1.57]
Cape Verdean	1.27	[1.18, 1.36]	1.20	[1.11, 1.29]
Brazilian	1.52	[1.46, 1.59]	1.77	[1.67, 1.86]
Other Portuguese	1.28	[1.22, 1.35]	1.18	[1.11, 1.25]
European	0.98	[0.96, 1.00]	0.99	[0.97, 1.01]
Lebanese	0.94	[0.83, 1.07]	1.01	[0.88, 1.15]
Other Middle Eastern	0.89	[0.81, 0.96]	1.09	[1.00, 1.19]
Nigerian	1.47	[1.27, 1.72]	1.72	[1.47, 2.01]
Other African	1.40	[1.31, 1.49]	1.67	[1.56, 1.79]
Asian Indian	1.25	[1.19, 1.31]	1.61	[1.52, 1.70]
Chinese	0.77	[0.73, 0.81]	0.92	[0.87, 0.98]
Vietnamese	0.92	[0.85, 0.99]	1.12	[1.03, 1.21]
Cambodian	0.61	[0.55, 0.68]	0.66	[0.59, 0.74]
Korean	0.86	[0.77, 0.94]	1.08	[0.97, 1.20]
Filipino	1.33	[1.18, 1.50]	1.56	[1.39, 1.77]
Japanese	0.51	[0.44, 0.59]	0.66	[0.57, 0.76]
Other Asian/Pacific Islander	0.90	[0.83, 0.98]	1.13	[1.03, 1.23]
Other	0.98	[0.94, 1.03]	0.99	[0.94, 1.04]

^aModel adjusted for year of birth and maternal age^bModel adjusted for maternal education, marital status, place of birth, delivery source of payment, prenatal care, birthweight, and hospital of birth

Table 4

Adjusted model of NTSV cesarean deliveries by broad racial/ethnic categories (N = 427,045)

	n	% Cesarean delivery	AOR 1^a	95% CI	AOR 2^{a,b}	95% CI
Non-Hispanic White	311458	24.1	1.00	[Reference]	1.00	[Reference]
Non-Hispanic Black	31077	26.9	1.37	[1.33, 1.40]	1.47	[1.42, 1.51]
Hispanic	42684	19.8	1.02	[0.99, 1.05]	1.12	[1.08, 1.15]
Asian/Pacific Islander	32550	23.2	0.90	[0.87, 0.92]	1.01	[0.98, 1.04]
Other	9570	23.6	1.14	[1.08, 1.20]	1.19	[1.13, 1.25]

^aModel adjusted for year of birth and maternal age^bModel adjusted for maternal education, marital status, place of birth, delivery source of payment, prenatal care, birthweight, and hospital of birth