

Racial/ethnic differentials in infant and neonatal mortality following a cesarean delivery

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ABSTRACT: Rates of all and low-risk cesarean deliveries have recently risen and have been found to be more common among racial/ethnic minorities. This study investigates racial/ethnic differentials in infant and neonatal mortality following all, low-risk, and very low-risk cesarean deliveries. Using NCHS infant birth/death data (1998-2002) overall cesarean mortality risks are higher for NH-blacks and NH-American Indians and nonsignificant for Mexican Origin, Other Hispanics, and NH-Asian and Pacific Islanders compared with risks for NH-whites. For low-risk cesareans, NH-American Indians have higher mortality risks while NH-blacks have a higher risk for only infant mortality. Both Hispanic groups have significantly lower risks. In the very-low risk model, NH-American Indians continue to demonstrate higher risks, Mexican Origin and Other Hispanics continue to have lower risks, and NH-blacks and NH-Asian and Pacific Islanders do not differ significantly from NH-whites. These differentials are consistent with those identified in previous studies that included vaginal and cesarean deliveries.

KEYWORDS: cesarean deliveries, racial/ethnic differentials, infant mortality, neonatal mortality

There is a growing concern over the increase in cesarean deliveries in the United States. Although the percentage of live births delivered via cesarean decreased during the early 1990's, there has been a steady increase in surgical deliveries since 1996 (1). Additionally, the percentage of low-risk cesarean deliveries (singleton, full-term, no malpresentation, and no previous cesarean delivery among multiparous women) and very low-risk cesarean deliveries (singleton, 37-41 weeks of gestation, no malpresentation, no previous cesarean delivery among multiparous women, no medical risks, and no labor complications) also increased during the same time period (1-3).

Although the adoption of surgical delivery has resulted in substantial improvements in both maternal and fetal outcomes in certain situations (e.g. cord prolapse, placenta separation prior to birth, hemorrhaging, toxemia), cesarean births are also associated with potential health risks. While some of the health risks are correlated with the need for a cesarean. Recent studies have found some risks for low-risk or elective cesareans (4,5). Specifically, these studies have found that infants born by cesarean had lower Apgar scores, higher incidences of respiratory problems including Respiratory Distress Syndrome and transient tachypnea, and a greater risk of neonatal mortality compared with those born vaginally (2,6-10). Additionally, elective cesarean deliveries have been found to be associated with greater maternal morbidity and mortality immediately following the surgery as well as a heightened risk of long-term effects such as infertility, miscarriage, uterine rupture, placenta previa, and placenta abruption (11).

Many minority groups in the United States are at a heightened risk of poor pregnancy outcomes (12-14), yet, at this time there is very little information available regarding racial/ethnic differentials in outcomes following cesarean births. While studies have found that certain minority groups are often at greater risk of a cesarean delivery (1, 12, 15-19), we were only able to locate one study

that examined racial/ethnic differences in pregnancy outcomes following a cesarean delivery. According to MacDorman et al (2), neonatal mortality rates following a low-risk cesarean delivery (singleton, 37-41 weeks of gestation, no malpresentation, no previous cesarean delivery among multiparous women, no medical risks, and no labor complications) were highest among non-Hispanic blacks (2.01 deaths per 1,000 live births) and non-Hispanic whites (1.85) and lowest among Hispanics (1.50) and Asian or Pacific Islanders (1.29). While this study was important in identifying the existence of race/ethnic differentials in neonatal mortality following a cesarean delivery, its focus was on overall rates and, thus, did include any findings regarding race/ethnicity from multivariate analyses. In this paper, our goal is to conduct the first direct study of racial/ethnic differentials in pregnancy outcomes following a cesarean birth. We will explore not only how the differentials vary by type of cesarean (i.e., risk level) but if the differentials hold after controlling for important sociodemographic and medical factors as well.

Methods

Data for the study were derived from the National Center for Health Statistics (NCHS) linked birth and infant death cohort files for the years 1998-2002. The final dataset was limited to records with nonmissing data where the mode of delivery was cesarean (n = 4,055,902). The two main variables of interest in this study are infant mortality and neonatal mortality. The infant mortality rate is defined as the number of children who died before the age of one divided by the number of children born alive in a given year multiplied by 1,000. The neonatal mortality rate is defined as the number of children who have died on or before 28 days divided by number of children born alive in a given year multiplied by 1,000. Because we are using linked infant/death cohort files, we are able to

construct cohort measurements of both infant and neonatal mortality rates and, thus, both the denominators and numerators consist of the same children.

Race/ethnicity was derived from maternal self-reports with non-Hispanic whites constituting the largest racial/ethnic group in the dataset (n=2,481,266) followed by Hispanics (n=716,031), non-Hispanic blacks (n=641,198), non-Hispanic Asian and Pacific Islanders (n=182,172), and non-Hispanic American Indians (n=35,235). Based upon previous studies that have found differences in infant mortality rates among Hispanic subgroups (21,22), we further differentiated between Mexican origin (n=469,683) and other Hispanics (n=246,348).

To explore differences in infant and neonatal mortality by risk level, we distinguished between low-risk and very low-risk cesarean births. Low-risk cesareans were identified as surgical births occurring among women who had not previously had a cesarean delivery and were pregnant with only one fetus who was full-term and not in a breech position. Very low-risk cesareans included the above criteria as well as a gestational age of less than 42 weeks, a birthweight below 4,000 grams, no medical risks, and no delivery complications.

Additional control variables included sex of the infant, previous loss, maternal characteristics, and pregnancy characteristics. Maternal characteristics consisted of nativity, marital status, education, age, and parity. Pregnancy-related variables included in the analysis were prenatal care, weight gain, and smoking status. Prenatal care was based on the Kotelchuck's Access to Prenatal Care Utilization (APNCU) index which uses both initiation of prenatal care and number of prenatal care visits proportional to gestational age to measure adequacy of prenatal care(20). Due to the high number of missing cases on certain variables (education, smoking, and

weight gain), we opted not to exclude those women and, instead, created a specific category for each variable to indicate missing information.

Infant and neonatal mortality rates were calculated for each racial/ethnic group as well as all other control variables included in subsequent analyses. Rates were provided separately for each risk level: all cesareans, only low-risk cesareans, only very low-risk cesareans. Logistic regression analyses were conducted to evaluate overall racial/ethnic differentials in mortality rates. Two models were run for each risk level. Model 1 provided the unadjusted odds of mortality following a cesarean birth while Model 2 provided the adjusted odds of mortality following a cesarean birth. All analyses were conducted using SAS.

Results

Table 1 displays the infant mortality rates (IMR) and the neonatal mortality rates (NMR) for the cesarean births from 1998 to 2002 by risk level. Among the 4,055,902 women that delivered by cesarean, 1,622,593 qualify as low-risk, and 282,384 qualify as very low-risk. Not surprisingly, mortality rates are lowest among very low-risk cesareans and highest among all cesareans. However, while there is a substantial decline in both NMR and IMR when comparing all cesareans and low-risk cesareans, the decline is much smaller between low-risk and very low-risk cesareans. In fact, for several control variables, mortality rates are actually higher for the latter compared to the former.

Non-Hispanic blacks and non-Hispanic American Indians have the highest IMRs and NMRs at all risk levels. Conversely, Other Hispanics and non-Hispanic Asian and Pacific Islanders have the lowest rates. Infants born to immigrant mothers consistently have lower mortality rates. For all risk categories, infant mortality decreases as maternal age increases but neonatal mortality does not

follow the same pattern. For all cesareans, neonatal mortality decreases with age but for the two low-risk categories, the lowest rates are found among women between the ages of 20 and 34 followed by women that are aged 19 and below. Being married, higher maternal education, lower parity, no previous loss, higher weight gain, no smoking during pregnancy, and female infant are all associated with lower mortality rates. In terms of prenatal care, the none/inadequate and adequate plus categories are associated with higher infant mortality compared to the intermediate and adequate categories.

The unadjusted and adjusted odds ratios (ORs) of an infant death following a cesarean delivery are presented in Table 2 for each race/ethnicity groups and by risk level. While non-Hispanic blacks have a significantly greater risk of infant mortality when compared to non-Hispanic whites in the all and low-risk cesarean models, the OR for non-Hispanic blacks declines quite a bit in the low-risk model and, finally, becomes nonsignificant in the very low-risk adjusted model. Non-Hispanic American Indians also demonstrate greater risk of infant mortality in the all cesarean model but, in contrast to non-Hispanic blacks, their risk actually increases in the latter two models.

Mexican Origin infants shows a slight disadvantage in all risk level categories for the unadjusted models; yet, once models include control variables, the pattern changes completely. While the risk of an infant death following any cesarean delivery is significantly lower among Mexican Origin infants compared with non-Hispanic white infants, the risk is significantly higher when looking at only low-risk cesareans. However, in the very low-risk model, their risk, once again, is significantly lower than the risk for their non-Hispanic white counterparts. While Other Hispanics do not demonstrate a significant difference in their risk of infant mortality in the all cesarean models, they do have a significantly lower risk in both the low-risk and very low-risk models (both

adjusted and unadjusted). Finally, although non-Hispanic Asian and Pacific Islanders show an advantage in the unadjusted models for each risk category, there is no significant difference between non-Hispanic Asian and Pacific Islanders and whites in the adjusted models.

The ethnic/racial trends for neonatal mortality following a cesarean delivery presented in Table 3 differ only slightly from those seen in Table 2. As with infant mortality, the risk of neonatal mortality for non-Hispanic blacks is significantly higher than the risk for non-Hispanic whites in the all cesarean model but the OR declines and becomes nonsignificant in the low-risk and very low-risk models (although for infant mortality the OR only reached nonsignificance in the final model). And, while the OR for non-Hispanic American Indians is nonsignificant in the any of the models, the risk of neonatal mortality among this group does increase consistently as the study population becomes more limited. As with Table 2, the risk of mortality among Mexican origin and Other Hispanic infants decreases across the three models and results in significantly lower risks when compared to non-Hispanic whites. Finally, while the OR declines quite a bit in the latter two models for non-Hispanic Asian and Pacific Islanders, their risk of neonatal mortality never differs significantly from the risk for non-Hispanic whites.

Discussion

This study examined racial/ethnic differentials in infant and neonatal mortality among all, low-risk, and very low-risk cesarean births during the years 1998 through 2002. Although cesareans do prevent higher neonatal and infant mortality among high-risk pregnancies (3,4), the recent rise in low-risk cesareans births in the US has brought attention to the mortality outcomes within these

groups. Despite known racial and ethnic differentials in the risk of a cesarean delivery (including low-risk cesarean deliveries), no previous study has focused on the racial differentials in outcomes following cesarean deliveries.

The data used for this study encompasses all recorded births in the United States, which covers almost the entire US-born population born from 1998 to 2002. The inclusivity of the data allows for a fairly accurate representation of the US population and obviously the large number of cases allows us to be able to infant mortality and neonatal mortality despite the infrequency of the events. However, it is important to keep in mind that the data is derived from birth certificates, which is a standardized document that as not specifically designed to investigate the outcomes of cesarean deliveries. As a result, it is possible that pertinent information about the delivery and health of the infant or mother could be missing.

That being said, we do identify clear racial/ethnic differentials in infant and neonatal mortality following a cesarean delivery, the pattern is not completely consistent and varies depending on the risk-level of the cesarean delivery. For cesarean deliveries of all risk levels, both non-Hispanic blacks and American Indians have significantly higher risks of infant mortality while only non-Hispanic blacks have significantly higher risks of neonatal mortality (as compared to the risk among non-Hispanic whites). Among the Mexican Origin, Other Hispanic, and non-Hispanic Asian and Pacific Islander groups only Mexican Origin infants have a significantly lower risk of infant mortality while in the neonatal mortality model none of the groups have a significantly lower (or higher) risk.

In terms of low-risk cesarean deliveries, again, both non-Hispanic blacks and non-Hispanic American Indians have significantly higher risks of infant mortality while there is no significant difference between these two groups and non-Hispanic whites in terms of neonatal mortality. In contrast, both Mexican Origin and Other Hispanic infants have a significantly lower risks of infant

and neonatal mortality compared to white infants while there is no significant difference in risk between non-Hispanic whites and non-Hispanic Asian and Pacific Islanders for either infant or neonatal mortality.

Finally, among very low-risk cesarean deliveries only non-Hispanic American Indians have a significantly higher risk of mortality *vis-à-vis* the risk for whites and only for the infant mortality model. As with low-risk cesareans, Mexican Origin and Other Hispanic infants have a significantly lower risk of infant and neonatal mortality and non-Hispanic Asian and Pacific Islander infants do not demonstrate any significantly different risk when compared to non-Hispanic white infants.

While there are some clear differences among the various racial/ethnic groups, it is important to also examine whether these differences are consistent with trends that have been identified in studies that included all modes of delivery. For example, Frisbie and Song (22) used NCHS linked infant birth/death data for 1995-1997 found significantly lower odds of infant mortality among Mexican Origin infants compared with the odds for non-Hispanic White infants after controlling for relevant social, demographic, health, and behavioral characteristics. These findings are consistent with a previous study by Hummer et al. (14) who used 1989-1991 linked data and found that, after controlling for many of the same characteristics, non-Hispanic blacks had a higher odds of infant mortality while Mexican Origin infants had a lower odds. Among other Hispanic groups he found that there was no sig difference between whites and Cubans but for all others (Puerto Ricans, Central/South Americans, and other Hispanics) the odds were significant and below one.

While these studies were more limited in the number of racial/ethnic groups included in their analyses, there are similarities between their results and our all cesarean models as we also found significantly higher mortality risks among non-Hispanic blacks and

significantly lower mortality risks among Mexican Origin and Other Hispanics compared with the mortality risk for non-Hispanic whites.

In addition, the Hummer et al. study (14) also included a regression model that controlled not only for social, demographic, health, and behavioral factors but also pregnancy outcomes (birthweight and gestational age) as well. In these models, the authors found that the risk of mortality declined for all the Hispanic groups as well as for non-Hispanic blacks who no longer exhibited an elevated risk of infant mortality compared with the risk for non-Hispanic whites. Doyle et al. (13) found a similar finding in his study neonatal and postneonatal mortality (deaths occurring between 28 days and one year) using NCHS linked infant birth/death from 1989 to 1991. In logistic regression models that included, among others, measures of gestational age and birthweight, the risk of neonatal mortality was significantly lower for African American infants when compared with the risk for whites while the risk of postneonatal mortality was significantly higher. For Mexican American infants the mortality risks were significantly lower for both neonatal and postneonatal mortality. These results correspond quite closely with our findings for the low-risk and very low-risk cesarean models which include both gestational age and birthweight as part of the definition of low-risk and, thus, are also controlled for in those models.

Conclusions

In summary, it would appear that while there are clear racial/ethnic differentials in mortality following a cesarean delivery, these differentials do not differ substantially from what has been found in other studies that looked at overall infant and neonatal mortality. Studies that modeled infant mortality controlling for social, demographic, health, and behavior factors (but not pregnancy

outcomes) had findings that were quite similar to our models that included all cesarean births, namely that non-Hispanic black infants have a significantly higher risk of mortality while Mexican Origin and Other Hispanic infants have lower risks when compared with non-Hispanic white infants. However, when these studies also include controls for pregnancy outcomes, their findings are more closely aligned with our low-risk cesarean delivery models. While the difference in mortality risks between non-Hispanic whites and Hispanic groups becomes greater, the difference between non-Hispanic whites and non-Hispanic blacks changes completely from a greater risk among non-Hispanic blacks to a nonsignificant or lower risk. For both our study and the previous studies this change appears to be a result of controlling for variables that are on the causal pathway to infant mortality.

Table 1. Infant Mortality Rates¹ (IMR) and Neonatal Mortality Rates² (NMR) following a cesarean delivery by select characteristics and risk level: U.S., 1998-2002

	All		Low Risk		Very Low Risk	
	Cesarean Sections IMR	NMR	Cesarean Sections IMR	NMR	Cesarean Sections IMR	NMR
Race						
NH-White	7.3	4.8	3.4	1.9	3.6	1.9
NH-Black	13.3	7.7	5.1	2.4	4.6	2.0
Mexican Origin	7.8	5.2	3.9	2.0	3.8	1.8
Other Hispanic	7.2	4.7	2.8	1.6	2.4	1.2
NH-Asian	6.0	3.7	2.6	1.4	2.3	1.2
NH-American Indian	12.3	6.4	6.5	2.7	9.1	3.9
Nativity						
US-born	8.7	5.4	3.8	2.0	3.8	1.9
Foreign-born	6.9	4.6	3.2	1.8	3.1	1.6
Maternal Age						
≤ 19	14.6	8.7	5.4	2.1	5.4	2.0
20-34	8.0	5.0	3.5	1.9	3.5	1.7
≥ 35	7.0	4.7	3.5	2.2	3.2	2.1
Marital Status						
Married	6.8	4.6	3.1	1.8	3.1	1.8
Unmarried	11.8	6.8	4.9	2.2	4.8	1.9
Education						
Less than 12 years	12.1	7.0	5.7	2.5	5.3	2.2
12 years	9.3	5.8	4.2	2.2	4.6	2.2
More than 12 years	6.3	4.3	2.7	1.6	2.5	1.4
Missing	14.2	10.2	6.3	3.8	4.2	2.6
Parity						
One live birth	7.4	5.0	2.9	1.5	2.9	1.4
2 or 3 live births	8.1	5.0	5.6	3.0	4.9	2.6
4 or more live births	13.6	8.2	8.8	4.9	8.7	4.5
Previous Loss						
No	8	5.0	3.7	1.9	3.6	1.8
Yes	9.2	5.9	3.7	2.0	3.7	1.8
Prenatal Care						
None/Inadequate	12.5	7.2	6.0	2.8	6.4	2.1
Intermediate	5.7	3.3	3.7	2.0	3.5	1.7
Adequate	4.7	2.8	3.1	1.7	2.9	1.5
Adequate Plus	11.9	8.0	3.9	2.1	4.1	2.3
Weight Gain*						
< 15 lbs	19.1	13.3	5.3	2.8	5.5	2.5
15-40 lbs	7.9	4.9	3.7	2.0	3.4	1.7
> 40 lbs	4.9	2.6	3.0	1.5	3.3	1.6
Missing	9.1	6.0	4.1	2.2	4.0	2.1
Smoking Status*						
Smoked	12.5	6.7	5.9	2.5	5.8	2.1
Did not smoke	8.0	5.2	3.4	1.9	3.5	1.8
Sex of Child						

Table 2. Unadjusted and adjusted odds ratios and 95% confidence intervals for risk of infant death¹ following a cesarean delivery for race/ethnic groups by risk level: U.S., 1998-2002

	<u>All Cesareans</u>			<u>Low-Risk Cesareans</u>			<u>Very Low-Risk Cesareans</u>		
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	
NH-White	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
NH-Black	1.83 (1.79 - 1.88)	1.35 (1.31 - 1.39)	1.50 (1.41 - 1.60)	1.13 (1.05 - 1.21)	1.27 (1.09 - 1.48)	0.91 (0.77 - 1.08)			
Mexican Origin	1.07 (1.03 - 1.11)	0.92 (0.88 - 0.97)	1.15 (1.06 - 1.25)	0.88 (0.79 - 0.97)	1.04 (0.88 - 1.25)	0.72 (0.57 - 0.91)			
Other Hispanic	0.98 (0.93 - 1.03)	0.95 (0.90 - 1.00)	0.85 (0.75 - 0.96)	0.78 (0.68 - 0.88)	0.66 (0.49 - 0.89)	0.56 (0.41 - 0.78)			
NH-Asian	0.81 (0.76 - 0.86)	1.06 (0.99 - 1.13)	0.75 (0.65 - 0.86)	0.94 (0.81 - 1.10)	0.64 (0.46 - 0.87)	0.73 (0.51 - 1.04)			
NH-American Indian	1.68 (1.53 - 1.85)	1.24 (1.13 - 1.37)	1.93 (1.55 - 2.39)	1.37 (1.10 - 1.70)	2.54 (1.49 - 4.32)	1.78 (1.04 - 3.04)			

¹ Death to infants less than one year

Table 3. Unadjusted and adjusted odds ratios and 95% confidence intervals for risk of neonatal infant death¹ following a cesarean delivery for race/ethnic groups by risk level: U.S., 1998-2002

	<u>All Cesareans</u>			<u>Low-Risk Cesareans</u>			<u>Very Low-Risk Cesareans</u>		
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	
NH-White	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
NH-Black	1.61 (1.56 - 1.67)	1.21 (1.16 - 1.25)	1.25 (1.15 - 1.37)	1.03 (0.94 - 1.14)	1.02 (0.81 - 1.29)	0.84 (0.65 - 1.08)			
Mexican Origin	1.08 (1.03 - 1.13)	0.94 (0.89 - 1.00)	1.08 (0.97 - 1.21)	0.84 (0.73 - 0.97)	0.96 (0.75 - 1.23)	0.71 (0.51 - 0.99)			
Other Hispanic	0.98 (0.93 - 1.04)	0.95 (0.89 - 1.02)	0.87 (0.74 - 1.02)	0.80 (0.67 - 0.95)	0.63 (0.41 - 0.95)	0.57 (0.36 - 0.89)			
NH-Asian	0.78 (0.72 - 0.84)	0.93 (0.85 - 1.02)	0.73 (0.61 - 0.88)	0.82 (0.66 - 1.01)	0.63 (0.41 - 0.96)	0.66 (0.40 - 1.08)			
NH-American Indian	1.33 (1.17 - 1.52)	1.04 (0.91 - 1.19)	1.45 (1.04 - 2.01)	1.14 (0.82 - 1.59)	2.03 (0.91 - 4.57)	1.67 (0.74 - 3.78)			

¹Death to infants less than 28 days

References

1. Menacker F. Trends in cesarean rates for first births and repeat cesarean rates for low-risk women: United States, 1990-2003. *Natl Vital Stat Rep.* 2005;54(4):1-12.
2. McDorman MF, Declercq E, Menacker F, Malloy MH. Infant and neonatal mortality for primary cesarean and vaginal births to women with “no indicated risk,” United States, 1998-2001 birth cohorts. *Birth.* 2006; 33(3):173-182.
3. Declercq E, Menacker F, MacDorman MF. Rise in: no indicated risk” primary cesareans in the United States, 1991-2001: Cross sectional analysis. *BMJ* 2005;330;71-72.
4. Shearer EL. Cesarean section: Medical benefits and costs. *Soc Sci Med* 1993;37(10):1223-1231.
5. National Institutes of Health. *NIH State-of-the-Science Conference Statement on Cesarean Delivery on Maternal Request. Consensus Development Program.* Bethesda, Maryland, Mar 27-29, 2006. <http://consensus.nih.gov/>.
6. Hook B, Kiwi R, Amini SB, Fanaroff A, Hack M. *Pediatrics* 1997;100:348-358.
7. Burt RD, Vaughan TL, Daling JR. Evaluating the risks of cesarean section: Low apgar score in repeat c-section and vaginal deliveries. *Am J Public Health* 1988;78(10):1312-1314.
8. MacDorman MF, Declercq e, Menacker F, Malloy MH. Neonatal mortality for primary cesarean and vaginal births to low-risk women: Application of an “intention-to-treat” model. *Birth* 2008;35(1):3-8.
9. Hansen AK, Wisborg K, Uldbjerg N, Henriksen TB. Risk of respiratory morbidity in term infants delivered by elective caesarean section: cohort. *BMJ* 2008; 336:85-87.

10. Jain L, Dudell GG. Respiratory transition in infants delivered by cesarean section. *Semin Perinatol* 2006;30(5):296-304.
11. Goer H. The case against elective cesarean section. *J Perinat Neonat Nurs* 2001;15(3):23-38.
12. Frisbie WP, Song SE, Powers DA, Street JA. The increasing racial disparity in infant mortality: respiratory distress syndrome and other causes. *Demography* 2004;41(4):773-800.
13. Doyle JM, Echevarria S, Frisbie WP. Race/ethnicity, Apgar and infant mortality. *Popul Res Policy Rev* 2003;22:41-64.
14. Hummer RA, Biegler M, De Turk PB, Forbes D, Frisbie WP, Hong Y, Pullum SG. Race/ethnicity, nativity, and infant mortality in the United States. *Soc Forces* 1999;77(3):1083-1117.
15. Ibison JM. Ethnicity and mode of delivery in 'low-risk' first-time mothers, East London, 1988-1997. *Eur J Obstet Gynecol Reprod Biol* 2005;118:199-205.
16. Frank R, Frisbie WP, Pullum SG. "Race/ethnic differentials in heavy weight and cesarean births. *Popul Res Policy Rev* 2000;19:459-475.
17. Braverman, P, Egerter S, Edmonston F, Verdon M. Racial/ethnic differences in the likelihood of cesarean delivery, California. *Am J Public Health* 1995;85(5):625-630.
18. Chung JH, Garite TJ, Kirk AM, Hollard AL, Wing DA, Lagrew DC. Intrinsic racial differences in the risk of cesarean delivery are not explained by differences in caregivers or hospital site of delivery. *Am J Obstet Gynecol* 2006;194:1323-1328.

19. Frisbie WP, McKinnon S, Song S-E, Hummer R. Changing Rates of Low-Risk Cesarean Deliveries in the U.S.: Classification, Race/Ethnicity and Other Factors, 2008 Annual Meeting of the Population Association of America, New Orleans, LA
20. Kotelchuck M. An Evaluation of the Kessner Adequacy of Prenatal Care Index and a Proposed Adequacy of Prenatal Care Utilization Index. *AJPH*. 1994;84:1414-1420.
21. Hummer RA, Powers DA, Pullum SG, Gossman GL, Frisbie WP. *Demography* 2007;44(3):441-457.
22. Frisbie WP, Song SE. Hispanic Pregnancy Outcomes: Differentials over time and current risk factor effects. *Policy Stud Rev* 2003;31(2):237-252.
23. Markides KS, Coreil J. The health of Hispanics in the southwestern United States: an epidemiologic paradox. *Public Health Rep* 1986;101(3)253-265.
24. Collins JW, Shay DK. Prevalence of low birth weight among Hispanic infants with United States-born and foreign-born mothers: the effect of urban poverty. *Am J Epidemiol* 139(2):184-192.
25. Morales LS, Lara M, Kington RS, Escarce JJ. Socioeconomic, cultural, and behavior factors affecting Hispanic health outcomes. *J Health Care Poor Underserved* 2002;13(4):477-503.
26. Liao Y, Cooper RS, Cao G, Kaufman JS, Long AE, McGee DL. "Mortality from coronary heart disease and cardiovascular disease among adult U.S. Hispanics: findings from the National Health Interview Survey (1986-1994). *J Am Coll Cardiol* 1997;30(5):1200-1205.

27. Guendelman S, Chavez G, Christianson R. Fetal deaths in Mexican-American, black, and white non-Hispanic women seeking government-funded prenatal care. *J Community Health* 2005;19(5):319-330.