Published in final edited form as:
Am J Obstet Gynecol. 2012 October ; 207(4): 322.e1–322.e6. doi:10.1016/j.ajog.2012.06.049.

The Effect of Race/Ethnicity on Adverse Perinatal Outcomes among Patients with Gestational Diabetes

Brian T. NGUYEN, MD[1], **Yvonne W. CHENG, MD PhD**[2], **Jonathan M. SNOWDEN, PhD**[1], **Tania F. ESAKOFF, MD**[3], **Antonio E. FRIAS, MD**[1], and **Aaron B. CAUGHEY, MD PhD**

[1] Oregon Health and Science University, Department of Obstetrics and Gynecology. Portland, OR.

[2] University of California, San Francisco, Department of Obstetrics, Gynecology and Reproductive Sciences. San Francisco, CA.

[3] Cedars Sinai Medical Center, Obstetrics and Gynecology Department. Los Angeles, CA.

Abstract

OBJECTIVE—To determine racial/ethnic differences in perinatal outcomes among women with gestational diabetes mellitus (GDM).

STUDY DESIGN—Retrospective cohort study of 32,193 singleton births among GDMs in California from 2006, using Vital Statistics Birth and Death Certificate and Patient Discharge Data. Women were divided by race/ethnicity: White, Black, Hispanic, or Asian. Multivariable logistic regression analyzed associations between race/ethnicity and adverse outcomes, controlling for potential confounders. Outcomes included: primary cesarean, preeclampisa, neonatal hypoglycemia, preterm delivery, macrosomia, fetal anomaly, respiratory distress syndrome (RDS).

RESULTS—Compared to other races, Black women had higher odds of preeclampsia [aOR=1.57, 95%CI(1.47-1.95)], neonatal hypoglycemia [aOR=1.79, 95%CI(1.07-3.00)], and preterm delivery <37 weeks [aOR=1.56, 95%CI(1.33-1.83)]. Asians had the lowest odds of primary cesarean [aOR=0.75, 95%CI(0.69-0.82)], large for gestational age infants [aOR=0.40, 95%CI(0.33-0.48)], and neonatal RDS [aOR=0.54, 95%CI(0.40-0.73)].

CONCLUSION—Perinatal outcomes among women with GDM differ by race/ethnicity and may be attributed to inherent sociocultural differences that may impact glycemic control, the development of chronic co-morbidities, genetic variability, and variation in access to as well as quantity and quality of prenatal care.

Keywords

Gestational Diabetes; Perinatal Outcomes; Race/Ethnicity

Corresponding Author, for questions and reprint requests: Brian T. Nguyen, MD Department of Obstetrics and Gynecology Oregon Health and Science University 3181 SW Sam Jackson Park Road, Box L466 Portland, OR 97239 Ph: 714-854-2079, nguyebri@ohsu.edu.

Disclosure: None of the authors have a conflict of interest.

This research was presented as a poster presentation at the 32nd Annual Meeting of the Society for Maternal Fetal Medicine, February 11, 2012. Abstract # 269393

INTRODUCTION

Gestational diabetes mellitus (GDM) is defined as glucose intolerance with onset or first recognition during pregnancy.[1] GDM affects approximately 7-14% of all pregnant women[2] and is associated with multiple obstetric and neonatal complications, including cesarean delivery (CD),[3] preeclampsia,[4] preterm delivery (PTD),[5] fetal macrosomia,[6] shoulder dystocia,[7] neonatal jaundice,[8] and neonatal hypoglycemia.[9] The incidence of GDM has increased dramatically in the past decade in all racial/ethnic groups.[10] Studies of the racial/ethnic distribution of GDM have shown significant variation in its prevalence. Studies have found higher rates of GDM among Asians, Hispanics, Native Americans, and African Americans as compared to non-Hispanic Whites.[11] Asians, with a reported rate as high as 15%, are more likely to have GDM than any other race, particularly when controlling for body mass index (BMI) and socioeconomic status (SES).[12] Variations in the distribution of GDM by race/ethnicity may be related to genetic factors affecting insulin resistance, diet, lifestyle, socio-cultural factors, health care access/utilization, or even provider discrimination. As maternal hyperglycemia is associated with increased birthweight and insulin levels in the offspring, lifestyle modifications or medical treatment may lower the risk of adverse perinatal outcomes.[13,14,15]

Yet under the same treatment regimens, significant disparities persist in analysis of adverse perinatal outcomes by race and ethnicity.[16] Given that Hispanics are projected to be California's racial/ethnic majority within the next three decades,[17] research and subsequent clinical recommendations should be culturally sensitive and appropriately tailored to their risk. Understanding racial/ethnic differences in GDM diagnosis, management, and outcomes is thus an important step towards the resolution of disparity and widespread improvement of maternal and child health.

A recent study of GDM compared outcomes among the most common racial/ethnic groups in the United States (White, Black, Latina/Hispanic, Asian). After controlling for maternal age, parity, obesity, gestational age (GA) at delivery, weight gain during pregnancy, maternal education, and primary language, their findings confirmed an increased risk of primary CD, PTD, and fetal demise in Black women compared to other groups. GDM was still most common however, among Asians and Latinas/Hispanics.[18] Unfortunately this study was not detailed enough to capture many of the neonatal complications associated with GDM, such as shoulder dystocia, neonatal jaundice, respiratory distress, and neonatal hypoglycemia and only examined NICU admission rates. Neonatal complications associated with maternal hyperglycemia are important factors for both patient and provider counseling and decision-making, as infants who are born with neonatal hypoglycemia are up to 3.5 times more likely to have neurodevelopmental impairment at up to 5 years of age.[19,20] Given this background, we sought to study perinatal outcomes among women with GDM. Specifically, we compared a broad range of maternal and neonatal outcomes by race/ethnicity.

STUDY DESIGN

This is a retrospective cohort study of 32,193 singleton births among GDMs in California from 2006, using Vital Statistics Birth and Death Certificate files linked with California Patient Discharge Data. Institutional Review Board approval was obtained from the University of California, San Francisco, Oregon Health & Science University, and the State of California. Since the linked dataset did not contain patient privacy and identification information, informed consent was exempted.

Inclusion criteria were women with singleton pregnancies, delivering in California. Diagnosis of GDM was obtained via review of ICD-9 codes from hospital discharge data. Patients with pre-gestational (Type 1 or Type 2) diabetes were excluded.

Outcomes analyzed were those associated with increased maternal or neonatal morbidity and use of hospital resources, including preeclampsia, primary CD, PTD before 37 weeks, PTD before 32 weeks, small for gestational age, large for gestational age, macrosomia, intrauterine fetal demise, fetal anomaly, neonatal hypoglycemia, neonatal jaundice, and respiratory distress. Some of these outcomes are specifically defined with little expected variation in diagnosis such as preterm delivery less than 37 or 32 weeks' gestation or macrosomia as birthweight greater than 4,000g. However, other outcomes are designated by the clinicians caring for the parturients or their neonates. Neonatal jaundice is variably defined by a total bilirubin in the 95th percentile (13-18 mg/dL).[21] Similarly practitioners may adopt varying thresholds for the diagnosis and treatment of neonatal hypoglycemia, ranging from 36-50 mg/dL.[22] Shoulder dystocia is a subjective clinical diagnosis made when the routine practice of gentle, downward traction of the fetal head fails to deliver the anterior shoulder. Often underreported, it has been described as the need for ancillary maneuvers to deliver the shoulder and/or a head-to-body delivery time greater than 60 seconds.[23]

Demographic information and maternal characteristics, such as parity, history of CD, and gestational age at delivery were obtained from either birth certificate entries or hospital discharge information. Maternal race/ethnicity was self-reported by patients and categorized into four groups: White, Black, Hispanic/Latina, and Asian.

Outcomes were coded and entered into STATA v10 (StataCorp, College Station, TX, USA 2007). Multiple variables were collapsed from continuous or categorical into binary variables, including age (>35 years) and education (college attendance). Chi-squared tests were used to compare dichotomous outcomes. Statistical significance was indicated by a p-value <0.05. Multivariable logistic regression analyses were then performed to determine associations between race/ethnicity and perinatal outcome, controlling for the following potential covariates: advanced maternal age, college education, initiation of prenatal care in the 1st trimester, pre-pregnancy obesity, parity, gestational age at delivery, and chronic hypertension. The results were reported as adjusted odds ratios with 95% confidence intervals.

RESULTS

Of the 516,837 women delivering within the reviewed timeframe (2006), 6.2% (n=32,193) were diagnosed with GDM and had sufficient records for inclusion in data analysis. The largest proportion were Hispanic (47.9%), as compared to White (34.6%), Black (5.5%), and Asian (12.0%). The unadjusted prevalence of GDM by race/ethnicity, however showed a greater proportion of Asians with GDM (10.0%), compared to White (4.6%), Black (4.5%), and Hispanic (6.9%). Maternal characteristics separated by race are shown in Table 1. The proportion of women with maternal age ≥35 years at time of delivery was higher in both White and Asians (35.8-38.0%) than in Blacks and Hispanics (~29.5%, p<0.01). The proportion of women with less than a college education was highest in Hispanics at 76.2%, compared to at most 41.2% in other groups. Obesity was more prevalent among Black women (11.5%) as compared to White (5.1%), Hispanic (4.8%), and Asian women (1.2%). Nulliparity was most common among Hispanics (76.1%). Chronic hypertension was present in 3.5% of the sample population, however Black women made up the greatest proportion of this group (11.6%, p<0.01). All groups had an average gestational age at delivery of at least 38 weeks (Table 1).

Table 2 provides data on peripartum adverse outcomes stratified by race/ethnicity. Black women had the highest proportions of preeclampsia (11.6% vs. 4.1-6.0%), primary Cesarean (29.3% vs. 20.7-26.0%), PTD <37 weeks (19.4% vs. 11.4-16.1%), and PTD at <32 weeks (2.8% vs. 1.0-1.1%; Table 2) compared to other the other racial/ethnic groups. Shoulder dystocia was most prevalent among Black and Hispanic women at 1.9-2.1% compared to Asian women at 1.5% (Table 2).

With respect to fetal/neonatal outcomes, Black women again exhibited higher proportions of neonatal hypoglycemia (1.7% vs. 0.5-0.8%), respiratory distress syndrome (3.5% vs. 1.4-2.1%), and fetal anomalies (12.1% vs. 7.2-8.2%; all $p<0.01$, Table 3). Asian women had the highest proportion of SGA infants (14.0% vs. 7.5-12.4%) and the accordingly lowest proportion of LGA infants (2.7% vs. 5.4-6.6%; both $p<0.01$; Table 3) compared to other groups. The proportion of women with intrauterine fetal demise did not differ significantly between groups.

Multivariable logistic regression analysis (Table 4) controlled for potential confounders (advanced maternal age, college education, early prenatal care, pre-pregnancy obesity, parity, chronic hypertension, and gestational age at delivery) affecting associations of race/ethnicity with GDM-related peripartum outcomes. White race was the designated reference group. The association of Black race with greater GDM-related peripartum morbidity remained after logistic regression. Black race was associated with 1.6 times the risk of preeclampsia and PTD before 37 weeks, compared to White women (adjusted odds ratio [aOR] 1.57, 1.56; 95% confidence interval [CI], 1.47-1.95, 1.33-1.83 respectively). No other race was significantly associated with PTD. Asians were significantly less likely than both Black and White women to undergo primary CD (Table 4).

Neonates born to Black women had elevated odds of neonatal hypoglycemia, small for gestational age, and fetal anomalies compared to White women (Table 4). After controlling for gestational age at birth, White women had odds of neonatal respiratory distress syndrome higher than those of Hispanics and Asians. Hispanic and Asian women did not experience any increased odds of neonatal hypoglycemia. Race did not affect odds of fetal demise in women with GDM.

COMMENT

Despite the high prevalence of GDM among Asians (10.0%) and Hispanics (6.9%) in our study population, they are the least likely to suffer from adverse perinatal outcomes as compared to women from other racial groups. In our study of more than 32,000 GDM affected pregnancies, we found that while Black women had increased odds of preeclampsia, PTD before 37 weeks, primary CD, and neonatal hypoglycemia compared to White women; Asian and Hispanic women had similar, if not decreased odds. Differences in GDM-related outcomes in Black women as compared to women from other racial/ethnic groups, even when controlling for demographic and socioeconomic factors, raises many questions about the origins of disparities.

That Hispanic and Asian women did not have a prominently increased risk of adverse perinatal outcomes compared to White and Black women despite a higher prevalence of GDM has been supported in previous studies,[24] and is potentially explained by the “Healthy Immigrant” hypothesis. Immigrants to the United States may be self-selected for pre-pregnancy health through official screening and employability. Immigrants are also less likely to be exposed to unfavorable Western behaviors such as drinking, smoking, drug use, overeating, consuming high fat and high sugar diets, and adopting sedentary lifestyles.[25,26] A study of supermarket sales confirmed that goods purchased by Blacks contained almost

25% more products with a high sugar content than those purchased by Hispanics.[27] Immigrants may also retain extended families that may provide financial, social, and emotional support for healthy pregnancy care. Over time, this discrepancy might become less significant with acculturation. These lifestyle factors may also add to the risk of Blacks developing other chronic co-morbidities such as hypertension, hyperlipidemia, and renal dysfunction, thereby differentially increasing their observed risk of preeclampsia and possibly iatrogenic preterm delivery. While pre-gestational diabetes is associated with the development of preeclampsia and congenital anomalies, the association of these two outcomes and actual gestational diabetes is more controversial.[28,29] Our data suggesting that Black women have increased odds of both preeclampsia and fetal anomalies support the possibility that these women are more likely to have undiagnosed pre-gestational diabetes and unmeasured chronic co-morbidities. As our findings controlled for early enrollment in prenatal care, more efforts should be directed towards preconception counseling, performing early glucose tolerance tests, and blood pressuring monitoring for high risk groups, such as Black women. We note also that while the odds of fetal anomalies were increased among Asian women with GDM, the odds of preeclampsia were decreased. Asians are at increased for type 2 diabetes, thus it may be that they also had greater rates of undiagnosed pre-gestational diabetes.

Though women with GDM have uniformly set treatment guidelines in California and are counseled by trained physicians and dieticians, their comprehension of management plans and ability to comply may be affected by discrepant health literacy. One study examining racial disparity in scores on the Test of Functional Health Literacy in Adults found that only 64% of Black women and 47.1% of Hispanic women achieved an adequate score, compared to 100% of White women taking the test.[30] As pregnancy is a period during which women are seen frequently, their development of a relationship with their care provider that allows communication and comprehension of treatment goals is also important. Among female diabetics, patient-provider communication may be the most significant factor impacting adherence.[31] While non-Hispanic White patients are more likely to feel connected to their providers,[32] Black women may suffer from less trusting relationships with physicians. As Black physicians made up a mere 3.5% of the American physician population in 2008, increasing provider diversity may be a specific directed strategy to improve health care experiences for members of racial/ethnic minority groups.[33] Furthermore, as Hispanics made up the largest group of California's pregnancies during the study period, it is likely that prenatal care providers have become more culturally sensitive and readily aware of their increased risk of GDM, altering screening and treatment plans accordingly.[34] Provider bias may also contribute to higher rates of primary CD among Black women compared to other groups in our sample. However, Black women with pre-gestational diabetes have an average HgbA1C that is 1% greater than their White counterparts,[35] suggesting that Black women have poorer glycemic control even after receiving a diagnosis, potentially leading to some of the differences in perinatal outcomes seen. Additionally, as Black women may be perceived by clinicians to have comparably poorer glycemic control and greater risk of delivery complications, they may be delivered at an earlier gestational age, which may, in turn, impact mode of delivery, gestational age, and neonatal outcomes.[36]

The large sample size of this study enabled us to look at the effect of race on relatively rare outcomes while adjusting for relevant confounding effects. We were limited however by the inability to obtain information on glycemic control and treatment with lifestyle modifications versus medications. We also recognize that discharge data likely underreport diagnoses of obesity, given that the highest rate of obesity in our sample was the 11.5% among Black women, markedly lower than the national average of approximately 20%.[37] More accurate reporting of obesity might decrease the strength of association between Black race and GDM-related adverse outcomes. In addition the discharge data do not distinguish

between iatrogenic and spontaneous preterm deliveries, thereby preventing any comment on the mechanism of increased preterm delivery risk among Blacks. Furthermore, our data do not provide information on immigrant status or country of origin, which might be valuable for addressing the "fetal origins" hypothesis whereby immigrants from countries with high rates of malnutrition may have been born with low birth weights and thereby programmed in utero to develop GDM when in more resource plentiful contexts.[38] Without record of country of birth, our data do not permit us to remark on the effect of acculturation.

We recognize that by only using the four most common race/ethnicity categories from birth certificates in California, that some mixed-race and minority populations may have been overlooked; however a validation study comparing reported race on California birth certificates with those obtained from face-to-face interviews showed a sensitivity from 94 to 99%, indicating that the contribution of mixed race persons may be small.[39]

The study of race and ethnicity is valuable for being a complex marker of many difficult to measure influences on pregnancies complicated by GDM. Even when controlling for demographic, anthropometric, and socioeconomic factors, disparities in race and ethnicity continued to be apparent in the study of GDM prevalence and GDM-related adverse perinatal outcomes. Though Asian women in our sample population had the highest rates of GDM, their pregnancies were at decreased risk for some of the most notable adverse perinatal outcomes of GDM, such as preeclampsia, cesarean delivery, preterm delivery, macrosomia, neonatal hypoglycemia, and neonatal respiratory distress. Black women with GDM however had an increased risk of preeclampsia, preterm delivery, and neonatal hypoglycemia. Remaining explanations for such racial disparity include sociocultural support structures and traditions, health care utilization, patient-provider relations and biases, and inherent genetic predispositions. Given the variation in outcomes, future research should focus on whether there are racial/ethnic variations in the benefits from particular kinds of treatment for GDM.

Acknowledgments

Financial Disclosure:

1. Dr. Cheng is supported by the National Institute of Child Health and Human Development, Grant WRHR K12 HD01262
2. Dr. Frias is supported by the:
    a. National Institute of Diabetes and Digestive and Kidney Diseases, Grant R24 DK0909640-01
    b. National Center for Research Resources, Grant P51 RR00163
    c. National Heart, Lung and Blood Institute, Grant R21 HD0688896-01

References

1. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2006; 29:S43–S48. [PubMed: 16373932]
2. American Diabetes Association. Gestational Diabetes Mellitus. Diabetes Care. Jan; 2003 26(1):s103–s105. [PubMed: 12502631]
3. Naylor CD, Sermer M, Chen E, et al. Cesarean delivery in relation to birth weight and gestational glucose tolerance: pathophysiology or practice style? JAMA. 1996; 275:1165–1170. [PubMed: 8609683]
4. Bryson CL, Ioannou GN, Rulyak SJ, et al. Association between gestational diabetes and pregnancy induced hypertension. Am J Epidemiol. 2003; 158:1148–1153. [PubMed: 14652299]

5. Hedderson MM, Ferrara A, Sacks DA. Gestational Diabetes Mellitus and Lesser Degrees of Pregnancy Hyperglycemia: Association with Spontaneous Preterm Birth. Obstet Gynecol. Oct; 2003 102(4):850–856. [PubMed: 14551018]
6. Willman SP, Leveno KJ, Guzick DS, et al. Glucose threshold for macrosomia in pregnancy complicated by diabetes. Am J Obstet Gynecol. 1986; 154:470–475. [PubMed: 3511714]
7. Casey BM, Lucas MJ, Mcintire DD, et al. Pregnancy outcomes in women with gestational diabetes compared with the general obstetric population. Obstet Gynecol. 1997; 90:869–873. [PubMed: 9397092]
8. Barnes-Powell LL. Infants of diabetic mothers: the effects of hyperglycemia on the fetus and neonate. Neonatal Netw. 2007; 26:283–290. [PubMed: 17926658]
9. Landon MB, Mele L, Spong CY, et al. The relationship between maternal glycemia and perinatal outcome. Obstet Gynecol. Feb; 2011 117(2,1):218–24. [PubMed: 21309194]
10. Ferrara A, Kahn HS, Quesenberry C, et al. An increase in the incidence of gestational diabetes mellitus: Northern California, 1991–2000. Obstet Gynecol. 2004; 103:526–533. [PubMed: 14990417]
11. Beckles, GLA.; Thompson-Reid, PE. Diabetes and women's health across the life stages: Centers for Disease Control and Prevention. 2006. <http://www.cdc.gov/diabetes/pubs/pdf/women.pdf>
12. Hunsberger M, Rosenberg KD, Donatelle RJ, et al. Racial/Ethnic Disparities in Gestational Diabetes Mellitus: Findings from a Population-Based Survey. Women's Health Issues. Sep; Oct; 2010 20(5):323–328. [PubMed: 20800768]
13. The HAPO Study Cooperative Research Group. Hyperglycemia and Adverse Pregnancy Outcomes. N Engl J Med. May.2008 358:1991–2002. [PubMed: 18463375]
14. Crowther CA, Hiller JE, Moss JR, McPhee AJ, et al. Effect of treatment of gestational diabetes mellitus on pregnancy outcomes. N Engl J Med. 2008; 352:2477–2486. [PubMed: 15951574]
15. Langer O, Yogev Y, Most O, Yexakis EMJ. Gestational diabetes: the consequences of not treating. Am J Obstet Gynecol. 2005; 192:989–997. [PubMed: 15846171]
16. Silva JK, Kaholokula JK, Ratner R, et al. Ethnic Differences in perinatal outcome of gestational diabetes mellitus. Diabetes Care. 2006; 29:2058–2063. [PubMed: 16936153]
17. State of California, Dept of Finance. Population Projections by Race/Ethnicity for California and Its Counties, 2000–2050. Sacramento, California: Jul. 2007 <http://www.dof.ca.gov/research/demographic/reports/projections/p-1/>
18. Esakoff TF, Caughey AB, Block-Kurbisch I, et al. Perinatal outcomes in patients with gestational diabetes mellitus by race/ethnicity. J of Maternal-Fetal and Neonatal Medicine. Mar; 2011 24(3): 422–42.
19. Lucas A, Morley R, Cole TJ. Adverse neurodevelopmental outcome of moderate neonatal hypoglycemia. BMJ. 1988; 297:1304–1308. [PubMed: 2462455]
20. Duvanel CB, Fawer CL, Cotting J, et al. Long-term effects of neonatal hypoglycemia on brain growth and psychomotor development in small-for-gestational age preterm infants. J Pediatr. 1999; 134:492–498. [PubMed: 10190926]
21. Kaplan, M.; Wong, RJ.; Sibley, E.; Stevenson, DK. Neonatal-Perinatal Medicine: Diseases of the Fetus and Infant, 9th.. Vol. 2. Elsevier Mosby; St. Louis: 2011. Neonatal jaundice and liver disease.; p. 1443
22. Cornblath M, Hawdon JM, Williams AF, et al. Controversies regarding definition of neonatal hypoglycemia: suggested operational thresholds. Pediatrics. 2000; 105(5):1141. [PubMed: 10790476]
23. Beall MH, Spong C, McKay J, Ross MG. Objective definition of shoulder dystocia: a prospective evaluation. Am J Obstet Gynecol. 1998; 179(4):934. [PubMed: 9790373]
24. Berggren EK, Boggress KA, Jonsson Funk M, et al. Racial Disparities in Perinatal Outcomes Among Women with Gestational Diabetes. Journal of Women's Health. Jan.2012 E-publication.
25. De la Rosa IA. Perinatal outcomes among Mexican Americans: a review of an epidemiological paradox. Ethn Dis. 2002; 12(4):480–7. Fall. [PubMed: 12477133]
26. Johnson RJ, Segal MS, Sautin Y, et al. Potential role of sugar (fructose) in the epidemic of hypertension, obesity and the metabolic syndrome, diabetes, kidney disease, and cardiovascular disease . Am J of Clinical Nutrition. Oct; 2007 86(4):899–906. [PubMed: 17921363]

27. Kerr GR, Amante P, Decker M, Callen PW. Supermarket sales of high-sugar products in predominantly black, Hispanic, and white census tracts of Houston, TX. Am J Clin Nutr. 1983; 37:622–31. [PubMed: 6837494]
28. Bryson CL, Ioannou GN, Rulyak SJ, Critchlow C. Association between Gestational Diabetes and Pregnancy-induced Hypertension. Am J Epidemiol. 2003; 158(12):1148–1153. [PubMed: 14652299]
29. Allen VM, Anthony BA. Teratogenicity Associated With Pre-Existing and Gestational Diabetes. J of Obstet Gynaecol Canada. Nov.2007 200:927–934.
30. Endres LK, Sharp LK, Haney E, et al. Health Literacy and Pregnancy Preparedness in Pregestational Diabetes. Diabetes Care. Feb; 2004 27(2):331–334. [PubMed: 14747209]
31. Matthews SM, Peden AR, Rowles GD. Patient-provider communication: understanding diabetes management among adult females. Patient Educ Couns. 2009; 76(1):31–37. [PubMed: 19157762]
32. Atlas SJ, Grant RW, Ferris TG, Chang Y, Barry MJ. Patient-physician connectedness and quality of primary care. Ann Intern Med. 2009; 150(5):325–335. [PubMed: 19258560]
33. Cooper LA, Roter DL, Johnson RL, et al. Patient-Centered Communication, Ratings of Care, and Concordance of Patient and Physician Race. Annals of Internal Medicine. Dec; 2003 139(11):907–915. [PubMed: 14644893]
34. Lawrence JM. Trends in the prevalence of preexisting diabetes and gestational diabetes mellitus among a racially/ethnically diverse population of pregnant women, 1999-2005. Diabetes Care. May; 2008 31(5):899–904. [PubMed: 18223030]
35. Holcomb WL, Mostello DJ, Leguizamon GF. African-American Women Have Higher Initial HbA_{1c} Levels in Diabetic Pregnancy. Diabetes Care. Feb; 2001 24(2):280–283. [PubMed: 11213879]
36. Almeida MF, Guinsberg R, da Costa J, et al. Non-urgent Caesarean delivery increases the need for ventilation at birth in term newborn infants. Arch Dis Child Fetal Neonatal Ed. 2010; 95:F326–F330. [PubMed: 20584803]
37. Shu SY, Kim SY, Bish CL. Prepregnancy Obesity Prevalence in the United States, 2004–2005. Maternal and Child Health 2009. 13(5):614–620.
38. Barker DJ. The origins of the developmental origins theory. Journal of Internal Medicine. 2007; 261:412–417. [PubMed: 17444880]
39. Baumeister L, Marchi K, Pearl M, Williams R, Braveman P. The validity of information on ‘race’ and ‘Hispanic ethnicity’ in California birth certificate data. Health Services Research. 2000; 35:869–883. [PubMed: 11055453]

Table 1

Maternal characteristics stratified by race/ethnicity, expressed in prevalence

Maternal Characteristics	Maternal Race/Ethnicity, % (n)				p-value
	White	Black	Hispanic	Asian	
Advanced maternal age (≥35)	35.9% (2736)	29.8% (360)	29.5% (4916)	38.0% (2237)	<0.01
Education: At least some college	65.8% (5021)	58.7% (709)	23.8% (3967)	79.5% (4678)	<0.01
Prenatal Care: Prior to 2nd trimester	90.4% 6882	86.6% (1040)	86.1% (14309)	90.5% (5311)	<0.01
Use of Public Health Insurance	27.1% (2069)	49.9% (602)	65.1% (10856)	17.8% (1045)	<0.01
Obesity	5.1% (386)	11.5% (139)	4.8% (801)	1.2% (71)	<0.01
Nulliparity	62.3% (4748)	65.7% (792)	76.1% (12672)	57.1% (3355)	<0.01
Chronic Hypertension	4.2% (318)	11.6% (140)	3.0% (499)	3.1% (185)	<0.01
Gestational Age at delivery (mean number of weeks ± SD)	38.62 ± 2.31	38.12 ± 2.95	38.58 ± 2.23	38.51 ± 2.18	<0.01

Am J Obstet Gynecol. Author manuscript; available in PMC 2013 October 01.

Table 2

Peripartum outcomes stratified by race/ethnicity, expressed in prevalence

Peripartum Adverse Outcomes	Maternal Race/Ethnicity, % (n)				p-value
	White	Black	Hispanic	Asian	
Preeclampsia	5.4% (409)	11.6% (140)	6.0% (1003)	4.1% (242)	<0.01
Primary Cesarean Section	26.0% (1985)	29.3% (354)	20.7% (3454)	22.5% (1325)	<0.01
Preterm Delivery <37wks	12.1% (916)	19.4% (233)	13.2% (2182)	11.4% (672)	<0.01
Preterm Delivery <32wks	1.1% (80)	2.8% (34)	1.2% (192)	1.1% (64)	<0.01
Shoulder Dystocia	1.8% (136)	1.9% (23)	2.1% (348)	1.5% (86)	0.02

Table 3

Fetal/neonatal outcomes stratified by race/ethnicity, expressed in prevalence

Fetal/Neonatal Adverse Outcomes	Maternal Race/Ethnicity, % (n)				p-value
	White	Black	Hispanic	Asian	
Neonatal Hypoglycemia	0.8% (61)	1.7% (20)	0.6% (101)	0.5% (29)	<0.01
Small for Gestational Age	7.5% (503)	12.4% (122)	8.5% (1240)	14.0% (735)	<0.01
Macrosomia (Birth Weight > 4000g)	15.1% (1151)	13.6% (164)	15.3% (2546)	6.0% (355)	<0.01
Large for Gestational Age	6.6% (504)	5.4% (65)	5.8% (972)	2.7% (159)	<0.01
Neonatal Jaundice	21.5% (1638)	20.4% (246)	20.0% (3330)	29.3% (1727)	<0.01
Respiratory Distress Syndrome	2.1% (161)	3.5% (42)	1.7% (282)	1.4% (80)	<0.01
Intrauterine Fetal Demise	0.2% (14)	0.3% (3)	0.3% (50)	0.2% 14	0.41
Fetal Anomalies	7.2% (552)	12.1% (146)	8.2% (1365)	8.2% (485)	<0.01

Am J Obstet Gynecol. Author manuscript; available in PMC 2013 October 01.

Table 4

Peripartum and fetal outcomes stratified by race/ethnicity, controlling for potential confounders *

	Maternal Race Adjusted OR [95% Confidence Interval] †		
	Black	**Hispanic**	**Asian**
Peripartum Adverse Outcomes			
Preeclampsia	1.57 [1.47-1.95]	1.18 [1.04-1.34]	0.78 [0.66-0.93]
Primary Cesarean Section	1.20 [1.04-1.39]	0.93 [0.87-1.00]	0.75 [0.69-0.82]
Repeat Cesarean Section	0.74 [0.49-1.12]	1.08 [0.87-1.34]	0.73 [0.56-0.94]
Preterm Delivery <37wks	1.56 [1.33-1.83]	1.06 [0.97-1.15]	0.94 [0.85-1.05]
Preterm Delivery <32wks	0.45 [0.30-0.68]	0.96 [0.73-1.26]	0.99 [0.71-1.36]
Shoulder Dystocia	1.07 [0.69-1.68]	1.00 [0.81-1.23]	0.84 [0.64-1.10]
Fetal Adverse Outcomes			
Neonatal Hypoglycemia	<1.79 [1.077-3.00]	0.69 [0.50-0.96]	0.64 [0.41-1.00]
Small for Gestational Age **	1.76 [1.42-2.17]	1.22 [1.09-1.37]	1.98 [1.76-2.23]
Large for Gestational Age **	0.75 [0.57-0.97]	0.84 [0.74-0.94]	0.40 [0.33-0.48]
Macrosomia	0.82 [0.69-0.98]	0.90 [0.83-0.97]	0.39 [0.34-0.44]
Neonatal Jaundice	0.80 [0.69-0.94]	0.94 [0.88-1.01]	1.47 [1.36-1.59]
Respiratory Distress Syndrome	0.94 [0.63-1.39]	0.69 [0.55-0.87]	0.54 [0.40-0.73]
Intrauterine Fetal Demise	1.42 [0.29-7.05]	1.99 [0.86-4.62]	1.52 [0.53-4.43]
Fetal Anomalies	1.51 [1.24-1.84]	1.11 [1.00-1.23]	1.15 [1.02-1.31]

* Controlled for advanced maternal age, college education, prenatal care within the first trimester, pre-pregnancy obesity, nulliparity, chronic hypertension, and gestational age at delivery.

** Gestational age omitted from regression.

† White population is the reference group. OR, odds ratio.