Disparities in Maternal Outcomes Among Four Ethnic Populations

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Objective: To examine racial disparities in adverse maternal outcomes among four ethnic groups in the United States.

Design, Setting, and Participants: A total of 1,030,350 women aged 13 to 55 who delivered in 1998 and 1999. Data were abstracted from the National Inpatient Sample.

Main Outcome Measures: Race was categorized as White, African-American, Hispanic, and Asian/Pacific Islander. Maternal outcome measures included preterm labor, hypertensive disorders of pregnancy, gestational diabetes, antepartum hemorrhage, membrane disorders, cesarean section, and postpartum hemorrhage.

Results: African Americans were more likely to have preterm labor (odds ratio [OR] 1.71), preeclampsia (OR 1.59), transient hypertension of pregnancy (THP) (OR 1.13), pregnancy-induced hypertension (PIH) (OR 1.38), diabetes (OR 1.26), placenta previa (OR 1.78), placental abruption (OR 1.52), premature rupture of membranes (PRM) (OR 1.19), infection of the amniotic cavity (IAC) (OR 1.95), and cesarean section (risk ratio [RR] 1.08); Hispanics were more likely to have diabetes (OR 1.44), placenta previa (OR 1.20), IAC (OR 1.15), and cesarean section (RR 1.06); and Asian/Pacific Islanders were more likely to have diabetes (OR 2.05), placenta previa (OR 1.57), PRM (OR 1.26), IAC (1.79), and postpartum hemorrhage (OR 1.19).

Conclusions: African Americans had the worst outcomes when adjusted for sociodemographic characteristics and comorbidities. Infection, gestational diabetes, and control of hypertension, especially among African Americans, are the most significant preventable risk factors contributing to disparities. By increasing access to health services, health education, and appropriate perinatal care in minority populations, improvements are likely to occur across multiple measures including frequencies of preterm labor, cesarean section, and gestational diabetes. (*Ethn Dis.* 2005;15:492–497)

Key Words: African American, Asian/Pacific Islander, Disparities, Hispanics, Maternal Outcome

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Introduction

Adverse maternal outcomes related to pregnancy are a significant public health problem. The most frequently occurring complications are pregnancy-induced hypertension, hemorrhage, and infection.[1] Preterm labor and gestational diabetes are also frequently cited complications.[2] In addition, complications of operative delivery may pose a threat to the health of the mother or the infant.[1] An exploration of the literature on various adverse outcomes highlights the risk and the ethnic groups most likely to be affected. Although some disparities between Whites and African Americans were expected, the number and significance of the differences were of concern. In addition, the significant disparities between Whites and Asian/Pacific Islanders were surprising.

Minorities suffer disproportionately from perinatal complications.[3] Generally, Black women, have twice the risk of poor pregnancy outcomes as White women.[4] Rates of premature rupture of membranes in African Americans are 27.8/1000 live births; Hispanics experience 18.3/1000 live births, Whites experience 22.9/1000 live births, and Asians experience 24.1/1000.[2] African Americans are more likely to have infections of the vagina and amniotic cavity,[5] pregnancy-induced hypertension,[2] lower birth weight babies, and preterm delivery.[5] Overall, African Americans are three times more likely, and Asians are twice as likely, to deliver a low birth weight baby as persons of European descent.[6] Hispanics and Chinese Americans have pregnancy outcomes that are frequently complicated by diabetes at a higher rate than Whites,[2] and Mexican women have preterm birth rates that are higher than those of Whites.[7] Although the effect of racial disparity on adverse neonatal outcomes has been investigated, research on the effect of racial disparities on maternal outcomes has been limited. The focus until now has been on neonatal outcomes, but the conditions that contribute to neonatal morbidity such as diabetes, hypertension, and vaginal/amniotic infections can be just as devastating to maternal outcomes and future maternal health. For example, gestational diabetes may result in type 2 diabetes and its complications later in life.[8] Vaginal infections may contribute to infertility as well as preterm labor.[9] Hypertension and advanced maternal age contribute to other maternal complications such as abruption and preeclampsia, which may necessitate the need for cesarean section.[10,11]

Because so few studies have been done on the topic of maternal outcomes and racial disparities, the objective of this investigation was to examine racial disparities on adverse maternal outcomes among four ethnic groups in the United States. We hypothesized that minority women had poorer maternal outcomes than White women. We believe that our findings are useful in prioritizing areas for policy intervention to eliminate racial disparities in healthcare among women in the United States.

Methods

Data

We abstracted data from the 1998 and 1999 National Inpatient Sample (NIS), Healthcare Cost and Utilization Project of the Agency for Healthcare Research and Quality (AHRQ). Through stratified sampling, the NIS contains about 20% of total discharges of community hospitals in United States. Using both diagnosis-related group (DRG codes) and International Classification of Diseases, 9th revision, clinical modification (ICD-CM-9)

Generally, Black women, have twice the risk of poor pregnancy outcomes as White women.[4]

codes obtained from AHRQ,[12] we identified a total of 1,030,350 women aged 13 to 55 who delivered at any point in 1998 and 1999. The self-reported race/ethnicity was categorized as non-Hispanic White (62%), African American (18%), Hispanic (18%), and Asian/Pacific Islander (4%). Native American was not included because of very low frequency (0.1%). White was used as the reference group in analysis.

Measures and Statistical Analysis

After reviewing the literature, we identified 11 dichotomous adverse maternal outcome measures based on the ICD-CM-9 codes. They were whether (value of 1) or not (value of 0) a patient, respectively, had preterm labor, hypertensive disorders of pregnancy (including preeclampsia, transient hypertension of pregnancy, and pregnancy-induced hypertension), gestational diabetes, antepartum hemorrhage (including placenta previa and abruptio placenta), membrane disorders (including premature rupture of membrane and infection of the amniotic cavity), cesarean section, and postpartum hemorrhage.[13] Since when frequency of a dichotomous variable is <10%, the risk ratio (RR) is close to the odds ratio (OR), and when frequency of a dichotomous variable is >10% (termed a "common event"), RR is sizably different from OR, we examined the OR of those measures with low frequency and converted the OR to RR for those measures of the common event.[14] Among the 11 measures, only the receipt of cesarean section had a frequency of higher than 10%; therefore, the OR of receiving cesarean section was converted to the RR. In addition, length of stay (LOS) and total charges across racial groups were also compared.

In multivariate analysis, maternal age and comorbidities were adjusted. Control for health insurance status based on payer sources (ie, Medicare, Medicaid, private insurance including prepaid health plans, the reference group, and uninsured, including self-pay/no charge) and median income level (ie, four levels: <$25,000 [the reference level], $25,000–$34,999, $35,000–$44,999, and >$45,000) by zip code of the patient's residence did not alter findings of the study. We also controlled for geographic location of patient residence when cesarean section was examined. For the purpose of expanding the age to a meaningful interval, we created six dummy variables to reflect six age groups (<15 years old, 15–19, 20–24, 30–34, 35–39, and >40), and age group 25–29 was used as a reference group. Because of the sampling structure of the NIS data, we used SUDAAN software (RTI, Research Triangle Park, NC) to account for the clustering factor of hospitals. We conducted logistic regression for dichotomous response variables to examine the relationship of ethnicity with the 11 maternal outcome measures and used a general linear model to compare LOS and total charges across racial groups.

RESULTS

Sociodemographic Characteristics and Unadjusted Maternal Outcomes

Patients' sociodemographic characteristics and descriptive maternal outcomes are shown in Table 1. Among the four ethnic groups, on average, African-American pregnant women were the youngest (25 years old), followed by Hispanic pregnant women (26 years old), White pregnant women (28 years old), and Asian/Pacific Islander pregnant women (29 years old). The rate of preterm labor among African Americans (4.9%) was much higher than that of Whites (2.7%) as well as Hispanics (2.5%) and Asian and Pacific Islanders (2.3%). The rate of preeclampsia was relatively higher among African Americans (1.6%) and similar among the other three ethnic groups. Transient hypertension of pregnancy and pregnancy-induced hypertension were more common among African Americans (1.3% and 3.6%, respectively) than among Whites (1.0% and 2.6%, respectively), but less common among Hispanics (0.7% and 2.1%, respectively) and Asians/Pacific Islanders (0.8% and 2.0%, respectively). Gestational diabetes was most common among Asians/Pacific Islanders (4.2%), less common among Hispanics (2.3%), and least common among African Americans (1.9%) and Whites (1.9%). Little difference in the rate of placenta previa was seen among the four ethnic groups. The rate of abruptio placenta among African Americans (0.8%) was higher than that of Whites (0.5%), Hispanics (0.4%), and Asian/Pacific Islanders (0.5%). The rate of premature rupture of membranes was 1.9%, 2.1%, 1.6%, and 2.5% for Whites, African Americans, Hispanics, and Asians/Pacific Islanders, respectively. The rate of infection of the amniotic cavity was higher among African Americans (2.1%) and Asians/Pacific Islanders (2.5%) than that of Whites (1.9%) and Hispanics (1.6%). The cesarean section rate among the four ethnic groups ranged from 20.5% among Asians/Pacific Islanders to 22.5% among African Americans. The rate of postpartum hemorrhage was the lowest among Hispanics (1.9%), followed by African Americans (2.0%) and Whites (2.2%), and the highest among Asians/Pacific Islanders (2.6%).

On average, women among the four ethnic groups stayed in the hospital from 2.2 days to 2.7 days for delivering; as Whites incurred the lowest charges of $5077, Asians/Pacific Islanders incurred the highest charges of $6846, and Af-

Table 1. Patients' sociodemographic and hospitalization characteristics*

	White (*n*=643,179)	African American (*n*=161,780)	Hispanic (*n*=183,954)	Asian (*n*=41,437)	Total (*N*=1,030,350)
Socio-demographic characteristics					
Average age (year), mean (std.)	28.0 (6.1)	25.0 (6.3)	25.9 (6.1)	29.3 (5.8)	27.2 (6.2)
Age group					
<15	633 (0.1)	1142 (0.7)	553 (0.3)	33 (0.1)	2361 (0.2)
15–19	60319 (9.4)	33730 (20.9)	28572 (15.5)	2402 (5.8)	125023 (12.1)
20–24	135575 (21.1)	50721 (31.4)	53963 (29.3)	6156 (14.9)	246415 (23.9)
25–29	180479 (28.1)	36774 (22.7)	49701 (27.0)	12269 (29.6)	279223 (27.1)
30–34	167475 (26.0)	24342 (15.1)	33126 (18.0)	12477 (30.1)	237420 (23.0)
35–39	82907 (12.9)	12370 (7.7)	14806 (8.1)	6598 (15.9)	116681 (11.3)
≥40	15791 (2.5)	2701 (1.7)	3233 (1.8)	1502 (3.6)	23227 (2.3)
Adverse maternal outcome					
Pre-term labor	17043 (2.7)	7844 (4.9)	4626 (2.5)	947 (2.3)	30460 (3.0)
Hypertensive disorders of pregnancy					
Pre-eclampsia	6296 (1.0)	2634 (1.6)	1853 (1.0)	390 (0.9)	11173 (1.1)
Transient hypertension of pregnancy	7259 (1.1)	2064 (1.3)	1319 (0.7)	334 (0.8)	10976 (1.1)
Pregnancy-induced hypertension	16607 (2.6)	5878 (3.6)	3787 (2.1)	828 (2.0)	27100 (2.6)
Gestational diabetes	12334 (1.9)	3107 (1.9)	4179 (2.3)	1751 (4.2)	21371 (2.1)
Antepartum hemorrhage					
Placenta previa	1068 (0.2)	405 (0.3)	321 (0.2)	117 (0.3)	1911 (0.2)
Abruptio placenta	3373 (0.5)	1274 (0.8)	805 (0.4)	211 (0.5)	5663 (0.6)
Membrane disorders					
Premature rupture of membrane	12240 (1.9)	3447 (2.1)	2925 (1.6)	1034 (2.5)	19646 (1.9)
Infection of the amniotic cavity	7698 (1.2)	3877 (2.4)	2578 (1.4)	877 (2.1)	15030 (1.5)
Mode of delivery					
Cesarean section	141375 (22.0)	36342 (22.5)	39856 (21.7)	8486 (20.5)	226059 (21.9)
Others					
Postpartum hemorrhage	13990 (2.2)	3190 (2.0)	3517 (1.9)	1077 (2.6)	21774 (2.1)
Resource used					
Length of stay (days), mean (std)	2.4 (2.0)	2.7 (2.5)	2.2 (1.8)	2.4 (2.0)	2.4 (2.0)
Total charges ($), mean (std)	5078 (4403)	5647 (5937)	5950 (5330)	6846 (5864)	5389 (4927)

* Data are expressed as number and percentage unless otherwise indicated.

rican Americans ($5647) and Hispanics ($5950) in between.

Comparison of Perinatal Risk Factors among the Four Ethnic Groups

Results of the multivariate analysis are shown in Table 2. Compared to White women, African-American women had a higher risk of having preterm labor (OR 1.71), preeclampsia (OR 1.59), transient hypertension of pregnancy (OR 1.13), pregnancy-induced hypertension (OR 1.38), diabetes (OR 1.26), placenta previa (OR 1.78), placental abruption (OR 1.52), premature rupture of membranes (OR 1.19), infection of the amniotic cavity (OR 1.95), and cesarean section (RR 1.09), but had a lower risk of having postpartum hemorrhage (OR 0.89).

Hispanic women were more likely to have diabetes (OR 1.44), placenta previa (OR 1.20), infection of the amniotic cavity (OR 1.15), and cesarean section (RR 1.06), but were less likely to have preterm labor (OR 0.89), transient hypertension of pregnancy (OR 0.63), pregnancy-induced hypertension (OR 0.79), abruptio placenta (OR 0.86), premature rupture of membranes (OR 0.87), and postpartum hemorrhage (OR 0.87). No significant difference was seen in preeclampsia between Hispanic and White women.

Asian/Pacific Islander women had a higher risk of having diabetes (OR 2.05), placenta previa (OR 1.57), premature rupture of membranes (OR 1.26), infection of the amniotic cavity (OR 1.79), and postpartum hemorrhage (OR 1.19) but had a lower risk of having transient hypertension of pregnancy (OR 0.67), pregnancy-induced hypertension (OR 0.73), and cesarean section (RR 0.85). No significant difference was seen in preterm labor, preeclampsia, and placental abruption between Asian/Pacific Islander and White women.

DISCUSSION

Based on this large national sample data, we found marked variations in the identified adverse maternal outcomes among the four major racial/ethnic pop-

Table 2. Adverse maternal outcomes of the four ethnic groups (*N*=1,030,350)*

Adverse Outcome	White	African American	Hispanic	Asian
Pre-term labor†	1.00	1.71 (1.60, 1.83)	0.89 (0.83, 0.97)	0.89 (0.76, 1.05)
Hypertensive disorders of pregnancy				
Pre-eclampsia‡	1.00	1.59 (1.49, 1.69)	1.00 (0.93, 1.07)	0.93 (0.81, 1.06)
Transient hypertension of pregnancy‡	1.00	1.13 (1.07, 1.20)	0.63 (0.59, 0.67)	0.67 (0.59, 0.76)
Pregnancy-induced hypertension‡	1.00	1.38 (1.31, 1.46)	0.79 (0.74, 0.84)	0.73 (0.65, 0.83)
Gestational diabetes§	1.00	1.26 (1.14, 1.40)	1.44 (1.32, 1.58)	2.05 (1.80, 2.32)
Antepartum hemorrhage				
Placenta previa‖	1.00	1.78 (1.57, 2.02)	1.20 (1.04, 1.37)	1.57 (1.27, 1.93)
Abruptio placenta‡	1.00	1.52 (1.43, 1.62)	0.86 (0.80, 0.92)	0.95 (0.83, 1.08)
Membrane disorders				
Premature rupture of membrane‡	1.00	1.19 (1.15, 1.23)	0.87 (0.84, 0.90)	1.26 (1.19, 1.34)
Infection of the amniotic cavity‡	1.00	1.95 (1.86, 2.05)	1.15 (1.09, 1.22)	1.79 (1.64, 1.95)
Mode of delivery				
Cesarean section¶	1.00	1.09 (1.07, 1.11)	1.06 (1.04, 1.08)	0.85 (0.82, 0.89)
Other				
Postpartum hemorrhage#	1.00	0.89 (0.85, 0.94)	0.87 (0.83, 0.92)	1.19 (1.09, 1.29)

* Data are expressed as odds ratios and 95% confidence intervals unless otherwise indicated.
† Adjusted for maternal age.
‡ Adjusted for maternal age, gestational diabetes, pre-existing diabetes, and pre-existing hypertension.
§ Adjusted for maternal age and pre-existing hypertension.
‖ Adjusted for maternal age and previous cesarean section.
¶ Risk ratio. Adjusted for ‡, plus pregnancy-induced hypertension, preterm labor, placenta previa, abrupture placenta, premature rupture of membrane, and infection of the amniotic cavity.
# Adjusted for maternal age, coagulation disorders, uterine tumor, and cesarean section.

ulations. African-American women were most likely to have adverse maternal outcomes. Among the 11 measures examined in our study, African Americans had a higher risk of having 10 maternal perinatal complications than their White counterparts; these complications include preterm labor, preeclampsia, transient hypertension of pregnancy, pregnancy-induced hypertension, gestational diabetes, placental previa, abruptio placenta, premature rupture of membranes, infection of the amniotic cavity, and cesarean delivery. These pregnancy complications are related in that their treatment may require an emergency cesarean section and may result in poor neonatal outcomes.

Among the 11 measures examined in our study, African Americans had a higher risk of having 10 maternal perinatal complications than their White counterparts . . .

That the incidence of postpartum hemorrhage was significantly lower in African Americans than Whites (OR 0.81) is also interesting. This finding is possibly related to the greater frequency of low birth weight babies. During the birth process, large babies may damage maternal organs with concomitant hemorrhage. However, a single cause cannot be determined. Although much of the literature and our findings highlight the high rate of diabetes in the Hispanic population, Asian/Pacific Islanders have even higher rates of diabetes than Whites, Hispanics, and African Americans.[15] Nevertheless, diabetes in all of these groups is increasing. Kiefer, Martin, and Herman, in their discussion of the impact of maternal nativity on the prevalence of diabetes and pregnancy among US ethnic groups, conclude that the predisposition to diabetes may exist, and the disease may become manifest after they migrate from their country of birth. The authors suggest that increases in physical inactivity, obesity, smoking, psychosocial stress, and dietary changes play a significant role in this process.[16] Federal, state, and local agencies are providing funds that target these risk factors. Healthcare providers should consider applying for funds to include programs on health promotion and illness prevention.

Since minority women receive less prenatal care than their White counterparts, hypertensive disorders may be underdiagnosed.[17] In addition, the fact that preeclampsia, transient hypertension of pregnancy, and pregnancy-induced hypertension are significantly higher in African Americans than in all other groups suggests both genetic and environmental association.

Abruptio placenta and placenta previa in our study was highest among African Americans. This finding is not surprising and is supported by other data, which implicate the role of maternal hypertension as the identified risk factor for abruption.[2] Reducing risk fac-

tors such as hypertension, use of cocaine, motor vehicle accidents, maternal battering, poor nutrition, and smoking are important targets for intervention.[18] Therefore, these women must have access to consistent and regular prenatal care, social support, and community resources.

The higher chance of having a cesarean section is related to clinical risk factors. Given the clinical risk factors that were controlled for in this study, minorities have a higher chance of cesarean intervention, which can expose women to complications.[19] Despite efforts to decrease the cesarean section rate, it has increased each year since 1996 (18% total increase). The rate is now the highest reported since the data first became available in 1989.[2] Our findings also showed little difference in cesarean rates between the four ethnic groups. Non-medical factors such as demographics, physician practice patterns, and maternal choice may be related to primary cesarean deliveries.[2]

Vaginal infection has been associated with first trimester bleeding and preterm birth.[20] Among all types of vaginal infection (chlamydia, gonorrhea, trichomonas, etc) bacterial vaginosis, which results from a disturbance of the normal vaginal flora due to overgrowth of bacteria, has been mentioned as an independent risk factor for preterm birth related to premature rupture of membranes. This risk factor is particularly relevant for African-American women.[5] The precise reasons for development of bacterial vaginosis are undetermined,[21] but while bacterial vaginosis does occur in virgins, evidence exists that the occurrence is higher in those with multiple sexual partners. Microbial infections of the genital tract have been associated with intraamniotic infection, premature rupture of membranes, and idiopathic preterm labor.[22] Stress leading to unhealthy behaviors such as smoking and poor nutrition has been implicated in preterm delivery.[23] The fact that African Americans and Asian/Pacific Islanders have higher rates of vaginal infection in our study is speculated to occur from the complex interrelationship of lifestyle, socioeconomic, and educational factors.[5]

Finally, because of maternal complications, all of the three groups of minority women incurred higher charges than White women during delivery, indicating that, from society's perspective, reduction in complications among minority women could not only improve the outcome, but also enhance the efficiency of maternal care.

The common limitations of using administrative data apply here. The NIS data did not allow us to examine the combination of maternal outcomes with neonatal outcomes. Second, available information on individual education, income, and cultural characteristics would also have enhanced the measurement of patients' socioeconomic status. Third, we were unable to separate Asian and Pacific Islanders from each other. This limitation made it difficult to identify more severe conditions and poorer outcomes attributed from the two subgroups or from both. Asians and Pacific Islanders appear to be quite different subpopulations in terms of culture and lifestyle.[24]

Our findings indicate that maternal outcomes remain poor for African-American women. Challenges remain for improving the health status of minority women of childbearing age. A three-pronged effort involving a partnership of communities, healthcare organizations, and faith-based initiatives should be the targets of healthcare professionals' endeavors to create change and lobby for legislative support. This change can only happen if those involved in these organizations cooperate to abandon turf and funding battles for the benefit of the overall public good. Multidisciplinary teams of professionals from public and private sectors should be encouraged to engage in service grant writing and political lobbying for increased funding for maternal child programs. In addition, the focus of these activities should be expanded to target other vulnerable groups, eg, Asian/Pacific Islanders, as well as continuing to provide services to recognized minority groups as potential recipients of interventions. Programs should provide education and increased access to appropriate perinatal service providers. Program goals should include the recruitment of culturally and linguistically competent professionals who are committed to serving at-risk vulnerable populations.

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