OBSTETRICS

Postpartum hemorrhage outcomes and race

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BACKGROUND: How race is associated with adverse outcomes in the setting of postpartum hemorrhage is not well characterized.

OBJECTIVE: The objective of this study was to assess how race is associated with adverse maternal outcomes in the setting of postpartum hemorrhage.

STUDY DESIGN: This retrospective cohort study utilized the National (Nationwide) Inpatient Sample (NIS) from the Agency for Healthcare Research and Quality for the years 2012–2014. Women aged 15–54 years with a diagnosis of postpartum hemorrhage were included. Race and ethnicity were categorized as non-Hispanic white, non-Hispanic black, Hispanic, Asian or Pacific Islander, Native American, other, and unknown. Overall risk for severe morbidity based on Centers for Disease Control and Prevention criteria was analyzed along with risk for specific outcomes such as disseminated intravascular coagulation, hysterectomy, transfusion, and maternal death. Risk for severe morbidity was stratified by comorbid risk and compared by race. Weights were applied to create population estimates. Log-linear regression models were created to assess risk for severe morbidity with risk ratios and associated 95% confidence intervals as measures of effect.

RESULTS: A total of 360,370 women with postpartum hemorrhage from 2012 to 2014 were included in this analysis. Risk for severe morbidity was significantly higher among non-Hispanic black women (26.6%) than non-Hispanic white, Hispanic, or Asian or Pacific Islander women (20.7%, 22.5%, and 21.4%, respectively, $P < .01$). For non-Hispanic black compared with non-Hispanic white, Hispanic, and Asian or Pacific Islander women risk was higher for disseminated intravascular coagulation (8.4% vs 7.1%, 6.8%, and 6.8%, respectively, $P < .01$) and transfusion (19.4% vs 13.9%, 16.1%, and 15.8%, respectively, $P < .01$). Black women were also more likely than non-Hispanic white women to undergo hysterectomy (2.4% vs 1.9%, $P < .01$), although Asian or Pacific Islander women were at highest risk (2.9%). Adjusting for comorbidity, black women remained at higher risk for severe morbidity ($P < .01$). Risk for death for non-Hispanic black women was significantly higher than for nonblack women (121.8 per 100,000 deliveries, 95% confidence interval, 94.7–156.8 vs 24.1 per 100,000 deliveries, 95% confidence interval, 19.2–30.2, respectively, $P < .01$).

CONCLUSION: Black women were at higher risk for severe morbidity and mortality associated with postpartum hemorrhage.

Key words: maternal risk, obstetric hemorrhage, racial disparities

Postpartum hemorrhage is a leading cause of maternal mortality and severe morbidity. While postpartum hemorrhage has decreased as a proportionate cause of maternal death in the United States,[1] risk for postpartum hemorrhage and associated severe morbidity including hysterectomy and other complications may be rising.[2,3]

Additionally, hemorrhage is frequently identified as one of the most common causes of preventable maternal mortality, with state and national death reviews estimating 66–93% of deaths are avoidable.[4-7] Many cases of maternal death related to hemorrhage involve inadequate monitoring, failure to escalate care in the setting of abnormal vital signs, communication miscues, suboptimal coordination with consultants, and lack of timely involvement of senior clinicians.[5] Recent efforts directed at reducing adverse outcomes related to hemorrhage have focused on optimizing identification and standardizing management of this condition.[8]

Maternal race is another major factor in risk for maternal mortality and severe morbidity.[9] Prior analyses have addressed racial disparities in overall risk for severe morbidity and mortality. The Centers for Disease Control and Prevention's (CDC) Pregnancy Mortality Surveillance System demonstrated an increased mortality risk for all women over recent decades, with the risk highest among non-Hispanic black women. From 2011 to 2013, the mortality ratio for non-Hispanic black compared with non-Hispanic white women was 3.4.[1]

Black women are also at increased risk for severe morbidity based on CDC criteria.[10] However, how race is related specifically to severe morbidity and mortality associated with postpartum hemorrhage is unknown. Given that severe morbidity and mortality outcomes in the setting of postpartum hemorrhage may account for an important part of overall maternal disparities, the objective of this study was to determine whether race was associated with an increased risk for mortality and severe morbidity in the setting of this obstetrical complication.

Materials and Methods

The National (Nationwide) Inpatient Sample (NIS) from the Agency for Healthcare Research and Quality for the years 2012–2014 was used for this analysis. The NIS is the largest publicly available, all-payer inpatient database in the United States and contains a sample of approximately 20% of all hospitalizations for all conditions nationally.[11]

These hospitalizations are selected via a stratified systemic random sample to generate a population systematically drawn from a list of hospitalizations sorted on discharge characteristics that can be weighted to be representative of the entire United States across medical

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AJOG at a Glance

Why was the study conducted?

The objective of this study was to assess how race is associated with adverse maternal outcomes in the setting of postpartum hemorrhage.

What are the key findings?

Black women were at higher risk for severe morbidity and mortality associated with postpartum hemorrhage.

What does the study add to what is already known?

There is a large differential in risk for mortality compared with morbidity associated with postpartum hemorrhage for black women.

specialties and includes academic, community, nonfederal, general, and specialty-specific centers.[12] In 2010, approximately 8 million hospital stays from a total of 45 states were included in the NIS.[13]

For this analysis, index delivery hospitalizations were captured with *International Classification of Diseases*, ninth revision, *Clinical Modification* (ICD-9-CM) diagnosis codes 650 and V27.x. These criteria ascertain >95% of delivery hospitalizations.[14] The years 2012−2014 were used for the analysis, given that the proportion of missing data for race in the NIS for these years is small compared with preceding iterations. Because the data are deidentified, the Columbia University Institutional Review Board deemed this analysis exempt.

Women aged 15−54 years with a diagnosis of postpartum hemorrhage (ICD-9-CM 666.x) were included in the analysis. The primary exposure evaluated was self-reported maternal race and ethnicity as categorized by the NIS: non-Hispanic white, non-Hispanic black, Hispanic, Asian or Pacific Islander, Native American, other, or unknown.

The primary outcome of this study was severe maternal morbidity as defined by the CDC. The CDC definition of severe maternal morbidity includes 21 diagnoses including shock, stroke, heart failure, transfusion, and other conditions all identified using ICD-9-CM codes.[15] Additionally, because the most common diagnosis in the severe morbidity composite is transfusion (ICD-9-CM 99.0x), a sensitivity analysis was performed excluding transfusion and restricted to the remaining 20 conditions representative of nontransfusion severe morbidity.

We evaluated 3 secondary outcomes. First, we evaluated individual risk for severe morbidity diagnoses specifically associated with postpartum hemorrhage including disseminated intravascular coagulation, transfusion, and hysterectomy.

Second, we evaluated the risk for maternal in-hospital death for women with postpartum hemorrhage. In evaluating mortality, we performed a sensitivity analysis excluding amniotic fluid embolism, given that this diagnosis is highly associated with unpreventable death.[4]

Third, we evaluated the risk for severe morbidity among with postpartum hemorrhage by race stratified by an obstetric comorbidity index that measures underlying patient risk.[16] In creating the obstetric comorbidity index, a list of maternal comorbidities that potentially conferred increased risk for maternal morbidity and mortality was developed.

These risk factors were analyzed within a development sample of an obstetric population that was used to construct a multivariable logistic regression model using a fully stepwise selection algorithm for both entry and retention in the model. The outcome variable was the presence of maternal end-organ injury or death during delivery hospitalizations and postpartum.

Candidate risk factors included 24 maternal comorbidities and maternal age categorized as <19, 20−34, 35−39, 40−44, and >44 years of age. Significant risk factors were retained in the model and then retested in the validation cohort of the same population.

The final model included 20 maternal conditions and maternal age. This comorbidity index provides weighted scores for comorbidity for individual patients based on the presence of specific diagnosis codes and demographic factors present in administrative data. Higher scores are associated with increased risk for severe morbidity. In the initial study validating the comorbidity index in a general obstetric population, patients with the lowest score of 0 had a 0.68% risk of severe morbidity, whereas a score of >10 was associated with a risk of severe morbidity of 10.9%.

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This comorbidity index was subsequently validated in an external population.[17] We categorized women based on the comorbidity index scores: 0 (lowest risk), 1 or 2, and >2 (highest).

Demographic and hospital characteristics were evaluated by NIS race categories. Hospital characteristics included bed size (small, medium, or large), location and teaching status (urban teaching, urban nonteaching, and rural), and region (Northeast, Midwest, South, or West). Demographic categories included year of delivery, insurance status (Medicaid, private, Medicare, other, uninsured), and ZIP code income quartile.

Demographic comparisons and temporal trends were evaluated using the χ^2 test. Adjusted risk ratios for severe morbidity with 95% confidence intervals (CIs) as measures of effect accounting for demographic and hospital factors were derived from fitting a log-linear regression model. This model was