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Racial differences in acute kidney injury of hospitalized adults with diabetes

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ABSTRACT

Objective: To determine whether there is a racial difference in the risk of acute kidney injury between hospitalized black and white adults with diabetes mellitus in the United States
Research Design and Methods: We analyzed cross-sectional data from the 2000–2010 National Hospital Discharge Survey (NHDS) to compare the odds of AKI among hospitalized black and white adults with diabetes. After excluding records in which race status was missing, race was other than white or black, discharge status was not provided, or end-stage renal disease was a diagnosis, we identified 276,138 eligible records for analysis. Multivariable logistic regression was used to analyze the association between race, AKI, and in-hospital mortality. Multivariable linear regression was used to analyze the association between length of stay and race among discharge records with a diagnosis of AKI.
Results: In this nationally representative sample of hospitalized U.S. adults with diabetes, blacks had a 50% higher age- and sex-adjusted odds of AKI compared to whites (odds ratio: 1.51; 95% CI 1.37–1.66). The association between black race and increased risk of AKI persisted after additional adjustment for multiple AKI-related risk factors, including chronic kidney disease, sepsis, hypertension, hypotension, length of stay, myocardial infarction, congestive heart failure, angiography, computed tomography scan, cirrhosis, admission source, payor source, hospital region, and hospital bed size (OR 1.71; 95% CI, 1.31–2.25). Among cases of AKI, there was no racial difference in length of stay or in-hospital mortality.
Conclusions: Among hospitalized adults in the U.S. with diabetes, black race is associated with a higher risk of AKI compared to white race.

1. Introduction

Race is associated with disparate clinical outcomes in multiple health conditions (Biello, Rawlings, Carroll-Scott, Browne, & Ickovics, 2010). Such disparities are particularly conspicuous in diabetes, where racial minorities have higher rates of microvascular complications and mortality (Golden et al., 2012). Compared to other racial groups, blacks with diabetes make more frequent emergency department visits for hyperglycemia and hypoglycemia (Ginde, Espinola, & Camargo, 2008; Ginde, Pelletier, & Camargo, 2006; Menchine, Wiechmann, Peters, & Arora, 2012), are hospitalized at younger ages (Biello et al., 2010), have higher readmission rates (Jiang, Stryer, Friedman, & Andrews, 2003), and experience more preventable complications (Golden et al., 2012). Among the complications of diabetes, the racial gap in disease incidence is widest in nephropathy; blacks are nearly four times more likely to progress to end-stage renal disease compared to their white counterparts (Golden et al., 2012).

Several factors may explain racial differences in the risk of diabetic chronic kidney disease (CKD), including genetics, modifiable cardiovascular risk factors (e.g., hypertension, hyperlipidemia), and socioeconomic status (Crews, Liu, & Boulware, 2014). Acute kidney injury (AKI) is also a well-described risk factor for CKD, which reciprocally

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confers an increased risk of AKI (Chawla, Eggers, Star, & Kimmel, 2014). As with CKD, black race is associated with an increased risk of AKI compared to non-black race (Grams et al., 2014). However, to our knowledge there are no studies that have examined the association between race and AKI specifically among hospitalized persons with diabetes, a population at theoretically increased risk for this outcome. Since both black race and diabetes are well-established risk factors for chronic kidney disease (CKD) (Golden et al., 2012), which is the strongest independent risk factor for AKI (Chawla et al., 2014), we hypothesized that blacks with diabetes are at higher risk of AKI.

Considering that AKI occurs in 1 of every 5 hospitalizations (Wang, Muntner, Chertow, & Warnock, 2012), it is important to understand the risk factors for this outcome to inform preventive efforts. Among Medicare recipients, hospitalization for AKI is increasing annually and the racial disparity in AKI incidence between blacks and whites is expanding (Juneja et al., 2007). Moreover, the prevalence of AKI requiring dialysis is increasing by about 10% per year, and black race has been identified as a significant risk factor for initiation of dialysis (Hsu, McCulloch, Dudley, Lo, & Hsu, 2013). AKI has significant financial and clinical repercussions, including increased length of hospital stay, higher readmission rates, risk of progression to CKD, and increased mortality (Chawla et al., 2014; Koulouridis, Price, Madias, & Jaber, 2014; Rewa & Bagshaw, 2014).

The primary aim of this study was to explore whether there is a racial difference in the risk of acute kidney injury (AKI) among hospitalized persons with diabetes. A secondary aim of our study was to examine whether outcomes following AKI, such as length of hospitalization and mortality, differ according to race. Identification of racial differences in the risk of AKI and subsequent outcomes among individuals with diabetes could have broad implications on the quality of hospital care and resource utilization.

2. Materials and methods

2.1. Data source

This study used restricted cross-sectional data from the National Hospital Discharge Survey (NHDS) databases, accessed at the Research Data Center at the National Center for Health Statistics. NHDS is a national probability survey conducted annually from 1965 to 2010 of inpatients discharged from non-Federal short-stay hospitals in the United States. Hospitals with an average length of stay fewer than 30 days were included in the survey. Federal, military, Department of Veterans Affairs hospitals, institutional hospital units, and hospitals with fewer than six beds were excluded. From 2000 to 2007, the NHDS collected data from a national sample of approximately 500 hospitals annually, and from 2008–2010 sampled 239 hospitals annually (Wanderer, Sandberg, & Ehrenfeld, 2011).

The contents of the NHDS restricted database include: demographics (age, sex, race, marital status, zipcode), length of stay, discharge status (routine to home, against medical advice, transfer to short or long-term facility, alive, dead, not stated), hospital geographic region (Northeast, Midwest, South, and West), hospital bed size, hospital ownership (proprietary, church, government, nonprofit), admission type (emergency, urgent, elective, newborn), source of admission (physician referral, clinical referral, HMO referral, transfer, emergency room, court/law enforcement, other), payment source (worker's compensation, Medicare, Medicaid, other government payments, Blue Cross/Blue Shield, HMO/PPO, other private/commercial insurance, self-pay, no charge, and other), procedure and diagnostic codes. In addition, the restricted NHDS dataset contains weighted variables, population counts of discharges within a hospital, stratum identifiers, and other survey design variables required in regression analyses to inflate estimates to the national hospitalized U.S. population.

2.2. Study population

Diagnostic and procedure codes derived from the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) were used to identify the study population of hospitalized adults with diabetes. Fig. 1 summarizes the eligibility criteria for this study. Among 2.6 million discharge records from 2000 to 2010, included records were extracted from 420,426 discharge records of adult patients (age 18 years and older) with at least one diagnostic code for diabetes mellitus (ICD-9-CM 250.00-250.93). Among these records, records were excluded if race status was not provided (27.5%), discharge status was not provided (0.7%), or ESRD was a hospital diagnosis (ICD-9-CM 585.6) (1.5%). Given that race status other than black and white represented a minority of this discharge records (4.7%), they were excluded from the analysis. After exclusion, 276,138 records were included in the final analysis.

2.3. Risk factors for AKI

The main variable of interest was race, which was defined as white or black based on demographic information provided in the dataset. Age was evaluated as a categorical variable with 18–24 years as the reference group, increasing by decade intervals up to ≥75 years. We considered the following conditions as risk factors for AKI, defined by their corresponding ICD-9-CM discharge diagnosis codes: CKD (585–585.5), hypertension (401.0, 401.1, 401.9), hypotension (458), chronic liver disease (571.0–571.9), acute myocardial infarction (410.0–410.9), congestive heart failure (428.0–428.4, 428.9), and sepsis (999.90–999.95, 038.0–038.9). Contrast-induced nephropathy was considered another possible risk factor and was evaluated using the following ICD-9-CM procedure codes: angiography (88.50–88.59), and computed tomography (87.41, 87.42, 87.03, 87.04, 88.01, 88.02, 87.71, and 88.38). Data regarding the use of intravenous contrast with computed tomography were not available.

In addition to length of stay (LOS), admission source was included as a potential indicator of patient acuity. Admission source was available for 91% of records, and was categorized as emergency department, physician/clinic, transfer, or other. Payment source information was available for 99% of records, and was categorized as Medicare, Medicaid, private insurance, or other payment. This information was included as a potential surrogate of socioeconomic status or access to health care. Other hospital-specific factors included as potential risk factors were hospital region (Northeast, Midwest, South, West), and hospital size (dichotomous variable with ≥ vs. <300 beds).

2.4. Ascertainment of AKI

The primary outcome was documented AKI, defined by ICD-9-CM codes 584.0–584.9 ascertained from discharge records. The accuracy of ICD-9-CM codes has been previously validated (Liangos et al., 2006). Data regarding admission diagnosis were only available for years 2008 to 2010 of the NHDS survey period (16.9% of all eligible records in this study); during these three years of the study period, only 286 records had an admission diagnosis of AKI. Given this limitation in the NHDS dataset, the present study was not able to distinguish cases of community-acquired AKI (i.e., hospitalization for which AKI was the reason for admission) from hospital-acquired AKI.

2.5. Mortality and length of hospitalization

Secondary outcomes included in-hospital mortality and length of stay. Since a direct association between AKI and mortality is well established, we analyzed mortality and length of stay exclusively among cases of AKI to determine whether there were differences in this outcome by race.

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