Race and Income Disparity in Ischemic Stroke Care: Nationwide Inpatient Sample Database, 2002 to 2008

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Background: Health care disparities exist between demographic groups with stroke. We examined whether patients of particular ethnicity or income levels experienced reduced access to or delays in receiving stroke care. *Methods:* We studied all admissions for ischemic stroke in the Nationwide Inpatient Sample (NIS) database between 2002 and 2008. We used statistical models to determine whether median income or race were associated with intravenous (IV) thrombolysis treatment, in-hospital mortality, discharge disposition, hospital charges, and LOS in high- or low-volume hospitals. *Results:* There were a total of 477,474 patients with ischemic stroke: 10,781 (2.3%) received IV thrombolysis, and 380,400 (79.7%) were treated in high-volume hospitals. Race ($P < .0001$) and median income ($P < .001$) were significant predictors of receiving IV thrombolysis, and minorities and low-income patients were less likely to receive IV thrombolysis. Median income was a predictor of access to high-volume hospitals ($P < .0001$), with wealthier patients more likely to be treated in high-volume hospitals, which had lower mortality rates ($P = .0002$). Patients in high-volume hospitals were 1.84 times more likely to receive IV thrombolysis ($P < .0001$). *Conclusions:* African Americans, Hispanics, and low median income patients are less likely to receive IV thrombolysis for ischemic stroke. Low median income patients are less likely to be treated at high-volume hospitals. High-volume hospitals have lower mortality rates and a higher likelihood of treating patients with IV thrombolysis. There is evidence for an influence of socioeconomic status and racial disparity in the treatment of ischemic stroke. **Key Words:** Hospital charges—ischemic stroke—length of hospitalization—socioeconomic—thrombolytic.

Individuals with lower median income or who are of certain ethnicities may have limited access to care for acute stroke.[1,2-5] Intravenous (IV) thrombolysis is a treatment option for acute ischemic stroke that is readily available, and the current guidelines recommend treatment within up to 4.5 hours after the onset of stroke symptoms.[6-8] Given the narrow therapeutic window for thrombolytic therapy, timely transport to an appropriate medical facility is critical.

Factors that contribute to disparity in stroke treatment may include a lack of awareness of stroke symptoms and the necessity for emergent care, social limitations, such as language barriers, inequality of income, and lack of insurance.[2] Certain minorities or low-income groups may arrive in a delayed fashion, decreasing the likelihood that they will arrive within the time window for IV thrombolysis, or they may lack access to high-volume hospitals that achieve better outcomes in stroke.[3-5]

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Materials and Methods

We collected data regarding hospitalizations for ischemic stroke between 2002 and 2008 using the Nationwide Inpatient Sample (NIS) database obtained from the Agency for Healthcare Quality and Research's Healthcare Cost and Utilization Project (Rockville, MD). These data included all patients with *International Classification of Diseases, 9th revision* (ICD-9) codes for ischemic stroke (e.g., 433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434.01, 434.11, 434.91, and 437.1). We studied the effect of race and income on: (1) treatment in a hospital with a high stroke case volume and (2) treatment with IV thrombolysis. We adjusted each analysis for age, gender, and medical comorbidity score. We also analyzed whether treatment in a hospital with a high stroke case volume has an effect on discharge disposition, hospital charges, or length of stay (LOS). The NIS database is the largest all-payer hospital inpatient database in the United States, which is an administrative claim–based database and contains data approximating a 20% stratified sample of US hospitals.

For each sampled hospital, all inpatient admissions for the year are contained in the NIS, permitting annual case volumes for hospitals to be calculated for each year from 2002 to 2008. Hospital annual case volumes for stroke admissions were determined by ranking the total stroke admissions across all sampled hospitals. Each hospital's volume of stroke admissions was defined as "high volume" if its stroke case volume met or exceeded the 67th percentile (148 stroke cases per year) and "low volume" if below this threshold. Treatment with IV thrombolysis was determined by ICD-9 code 99.10. There is some inherent limitation of using this code for thrombolysis outcome, because coding error(s) exist in the NIS database. We adjusted each analysis for age, gender, and medical comorbidity score. Medical comorbidity score has been described and validated previously.[9]

The NIS classifies median income into quartiles: low, low to middle, middle to high, and high. This is determined by the estimated median household income of residents in the patient's ZIP code. Median ZIP code income has been shown to have the highest correlation with individual income, and median income has been seen as a sensible single aggregate measure to use to estimate socioeconomic status.[10] These quartiles and values are updated annually in the NIS database. Race was classified as white, African American, Hispanic, Asian/Pacific Islander, Native American, or other. Secondary outcomes were: (1) inflation-adjusted hospital charges, (2) LOS, and (3) discharge disposition. We defined discharge disposition as "favorable" if the patient was sent home, transferred to a short-term facility, or left the hospital against medical advice. We defined discharge disposition as "poor" if the patient was sent to a long-term facility or to hospice, and discharge disposition as "deceased" if the patient died in the hospital, at home, or in another medical facility. The primary payer was classified as Medicaid, Medicare, private insurance, self-pay, no charge, or other. Hospital bed size was classified as small, medium, or large. Hospital location was classified as Northeast, Midwest, South, and West.

Statistical Methods

For the primary analysis, there were 2 outcome variables of interest: IV thrombolysis (yes or no) and stroke case volume of the hospital (high or low). There were 2 predictor variables of interest: race and median income. Race and median income were studied independently to avoid confounding effects. We used general estimating equations (GEEs; SAS PROC GENMOD function [version 9.1; SAS, Inc., Cary, NC), performing 4 analyses on the dataset that contained only hospitalizations in which the patient had suffered a stroke. We assumed a binomial distribution for the outcome variable and used a logit link function. Along with the primary predictor variable, we included gender, age, and comorbidity index as covariates. To account for the clustering of observations by hospital, we treated hospital as a repeated factor, and we assumed an exchangeable working correlation matrix. We retained the default convergence criteria set by the SAS system when fitting the model.

The secondary analyses included 4 outcomes: (1) in-hospital mortality; (2) total hospital charges; (3) LOS; and (4) discharge disposition. There were 2 predictors of interest: hospital stroke case volume and IV thrombolysis. For all outcome measures, our independent variables were the predictor of interest and gender, age, comorbidity score, year of admission, median income, primary payer, hospital size, and region. For the in-hospital mortality outcome, discharge disposition, and LOS, we used GEE, assuming a binary distribution and logit link function. For total charges, we first adjusted all charges for inflation by adding 3% per year for each year before 2008. For adjusted charges and LOS, we took the natural log of adjusted charges (or of LOS) as our outcome variable to meet the assumptions of a general linear model. We then used GEE, assuming a normal distribution and identity link function. For the discharge disposition outcome, we used GEE, assuming a multinomial distribution and a cumulative logit link function.

Results

Between 2002 and 2008, there were 477,474 patients in the NIS database with ICD-9 codes for ischemic stroke (433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434.01, 434.11, 434.91, and 437.1). Patient demographics and hospital characteristics by race and median income by ZIP code are shown in Tables 1 and 2, respectively. Of 477,474 patients, 10,781 (2.3%) received IV thrombolysis and 380,400 (79.7%) were admitted to hospitals with high stroke case volumes.