# Is There a Sex or Race Difference in Stroke Mortality?

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*Objectives:* We sought to confirm previous studies for the presence and direction of sex and race difference in stroke mortality. *Methods:* Administrative data for 40,450 Medicare beneficiaries who were hospitalized in 1994 to 1996 with acute stroke were used in regression analyses to study sex and race differences in 1-year all-cause mortality among patients with different types of stroke and cause-specific mortality in patients with all types of stroke combined. Hazard ratios were adjusted for age, sex or race, state, year of index stroke, past stroke, subsequent stroke, and fatal coexisting conditions excluding cerebrovascular diseases. *Results:* Men with ischemic cerebral infarction, nonspecific stroke, or all types of stroke combined were at 21% to 35% higher risk of all-cause mortality than women, but there was no sex difference among patients with subarachnoid or intracerebral hemorrhage. Nonwhite patients with ischemic cerebral infarction had 11% higher all-cause mortality than white patients, but there were no race differences after adjustments for fatal coexisting conditions. Compared with women, mortality was higher in men with all types of stroke regardless of the cause of death. There was higher risk of death caused by cerebrovascular diseases in white patients with all types of stroke combined, but the risk of death caused by cardiovascular diseases other than ischemic heart disease was higher in nonwhite patients. *Conclusions:* There was no sex or race difference in all-cause mortality in patients with hemorrhagic stroke and higher risk in men with ischemic and nonspecific stroke. Relatively higher risk of mortality caused by cerebrovascular diseases was found in men and white patients. **Key Words:** Stroke—mortality—definition—measurement—sex difference—race difference.


The interaction between racial, ethnic, or sex disparities in health and health care in the United States is well recognized.[1-4] An understanding of the causes of differences between subpopulations is necessary to improve preventive and therapeutic care and outcomes.[5] Observed differences may be a result of unadjusted or uncontrolled differences between the subpopulations with respect to covariates that are associated with the outcome. It is, therefore, necessary to determine whether the observed differences are real or not.

Although stroke mortality in the United States has considerably declined in the last few decades,[6-11] in nonwhites, it increased by more than 8% between 1992 and 1996.[12] Several population-based studies[6,8,12-16] have demonstrated age, sex, or race differences in stroke mortality. Age-adjusted stroke mortality in nonwhites was almost twice that among whites.[17] This racial difference exists for most types of stroke.[12,18-22] Several studies[8,23-26] did not find a significant sex or race difference in stroke mortality. Others found a relatively higher risk among men[12,15,22] or among women.[9,14,19,25,27] Excessive risk of death among nonwhite patients with stroke, compared with white patients, was a common finding in all studies that found race differences.

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In view of these conflicting findings, further investigation is required. Most of the previous studies did not adjust the relative risk of stroke mortality for prevalent comorbid conditions or fatal coexisting conditions. Some of these investigations studied mortality associated with only subarachnoid hemorrhage,[19] intracerebral hemorrhage,[18] ischemic stroke,[22] or cerebral infarction.[16,21] Many studies examined mortality after stroke without specifying its type. The objective of this population-based epidemiologic study was to determine whether there is a sex or race difference in stroke mortality. It examined 1-year all-cause mortality among patients with different types of acute stroke and cause-specific mortality that was adjusted for covariates.

## Methods

### *Study Population and Sources of Data*

The study population comprised all Medicare beneficiaries aged 65 to 99 years who resided in the States of Indiana and Kentucky in the United States, were enrolled in the fee-for-service sector of the Medicare program, and who were admitted as a hospital inpatient between January 1, 1994, and December 31, 1996, for acute stroke as indicated by the primary discharge diagnosis. (The Medicare program is a U.S. Government–financed and –administered health care program for the elderly and chronically disabled.) This cohort of patients and their demographics were identified from the Medicare Provider Analysis Review (MedPAR) inpatient claims records and the enrollment database. The index stroke was defined as the first acute care hospital admission for acute stroke recorded in the MedPAR files for the 3 years. The death certificate data for the years 1994 to 1997 were obtained from the state vital statistics agencies in Indiana and Kentucky. Using social security numbers, Medicare data were matched with death certificate data to determine the date of death and the underlying cause of death for each member of the study cohort. The cohort was followed up for 12 months from the index stroke to ascertain hospital admissions for subsequent acute strokes and mortality. Data on a past history of stroke and subsequent strokes were obtained from the MedPAR files for the years 1992 to 1997. One-year mortality was estimated for the study population.

### *Study Variables*

Using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*), the index stroke was stratified into 4 types: subarachnoid hemorrhage (*ICD-9-CM* code 430), intracerebral hemorrhage (431), ischemic cerebral infarction (ICI) (433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434.01, 434.11, and 434.91), and other or nonspecific (stroke type not specified) (436, 438, 997.02). The study covariates were age at the time of hospital admission for index stroke, sex or race (white or nonwhite), most recent state of residence, the year of hospital admission for the index stroke, a past history of stroke within 2 to 5 years before the index stroke, and subsequent strokes within 1 year after the index stroke. (Subsequent strokes were a risk factor for mortality during the 1-year follow-up period among those patients who survived the acute phase of index stroke.) The nonwhite race was not further stratified according to ethnicity because of the small numbers and because of the unreliable classification of ethnicity in the Medicare enrollment database.[28] The causes of death were stratified into 6 groups: cerebrovascular diseases (*ICD-9-CM* codes 430-438), ischemic heart disease (410-414), respiratory diseases (460-519), cancer (140-208), other cardiovascular diseases (390-409, 415-429, and 440-459), and all other causes. The death certificate data were also used to create five categories of fatal conditions coexisting with stroke. These categories correspond with the groups of causes of death. Cerebrovascular diseases causing death were excluded from fatal coexisting conditions. These conditions, prevalent at the onset of stroke or during the 1-year follow-up period, were the underlying causes of death during that period.

### *Statistical Analyses*

The differences in mean age and categorical variables were evaluated using the $t$ test and the $\chi^2$ test, respectively. The logistic regression was used to estimate the crude odds ratios. For descriptive purposes, sex- and race-specific crude mortality was estimated for each 5-year age group. Sex and race differences in 1-year mortality were estimated from the Cox proportional hazard regression models in which the hazard ratio (HR) was adjusted for the covariates. Age was used as a continuous variable. First, sex and race differences in all-cause mortality were examined among all stroke patients. Then, these differences were separately examined for each type of stroke. Sex and race differences among all patients with stroke were also examined according to the causes of death. Finally, the stroke type-specific HRs and the ratios for all types of stroke combined were adjusted in separate models for fatal coexisting conditions in addition to the adjustments for other covariates. The cause-specific mortality HRs were not adjusted for fatal coexisting conditions. All $P$ values are 2-sided. The statistical analyses were performed using SAS software (Release 8.2, SAS Institute Inc, Cary, NC).

## Results

During 1994 to 1996, 40,450 Medicare beneficiaries were admitted in acute care hospitals in Indiana and Kentucky with acute stroke. Among this cohort, 3355