Sex Differences in US Mortality Rates for Stroke and Stroke Subtypes by Race/Ethnicity and Age, 1995–1998

Carma Ayala, PhD; Janet B. Croft, PhD; Kurt J. Greenlund, PhD; Nora L. Keenan, PhD; Ralph S. Donehoo, MPH; Ann M. Malarcher, PhD; George A. Mensah, MD

Background and Purpose—Ischemic stroke accounts for 70% to 80% of all strokes, but intracerebral and subarachnoid hemorrhagic strokes have greater fatality. Age-standardized death rates from overall stroke are higher among men than women, but little is known about sex differences in stroke subtype mortality by race/ethnicity.

Methods—We analyzed 1995 to 1998 national death certificate data to compare sex-specific age-standardized death rates (per 100,000) for ischemic stroke (n=507,256), intracerebral hemorrhagic stroke (n=98,709), and subarachnoid hemorrhagic stroke (n=27,334) among whites, blacks, American Indians/Alaska Natives, Asians/Pacific Islanders, and Hispanics. We calculated rate ratios and 95% CIs comparing women with men within age and racial/ethnic groups.

Results—Age-specific rates of ischemic and intracerebral hemorrhagic stroke deaths were lower for women than for men aged 25 to 44 and 45 to 64 years but were higher for ischemic stroke among older women, aged ≥65 years. Only among whites did women have higher age-standardized rates of ischemic stroke. Age-standardized death rates for intracerebral hemorrhagic stroke among women were lower than or similar to those among men in all racial/ethnic groups. Women had higher risk of death from subarachnoid hemorrhagic; this sex differential increased with age.

Conclusions—The female-to-male mortality ratio differs for stroke subtypes by race/ethnicity and age. A primary public health effort should focus on increasing the awareness of stroke symptoms, particularly among people at high risk, to decrease delay in early detection and effective stroke treatment. (Stroke. 2002;33:1197-1201.)

Key Words: ethnic groups ■ intracerebral hemorrhage ■ stroke, ischemic ■ stroke mortality ■ subarachnoid hemorrhage

Ischemic stroke accounts for 70% to 80% of all strokes; however, intracerebral hemorrhagic stroke (ICH) and subarachnoid hemorrhagic stroke (SAH) have a higher risk of fatality. Among stroke survivors, those with hemorrhagic strokes may have greater degrees of functional impairment at admission to and discharge from patient rehabilitation than those with ischemic strokes. Although the case fatality rates for hemorrhagic and ischemic stroke are similar for men and women, admissions to nursing homes for stroke disabilities are higher among women than men. Although the overall stroke mortality rate is higher among men than women, little is known about sex differences in mortality rates from stroke subtypes. Overall stroke mortality rates vary considerably among men and women in the major racial/ethnic groups in the United States and sex differences may vary among racial/ethnic groups. Therefore, we examined the patterns of sex differences in stroke subtype mortality rates among racial/ethnic populations to help target specific populations for primary and secondary prevention efforts.

Subjects and Methods

Data from death certificates from the National Center for Health Statistics were used to determine death rates by stroke subtype among persons aged ≥25 years for the 4-year period of 1995 to 1998. Medical examiners, coroners, and practicing physicians report the cause of death on the death certificates. Death certificates are processed in state vital statistics offices and then sent to the National Center for Health Statistics at the Centers for Disease Control and Prevention for consolidation into a national detailed mortality database. Stroke as the underlying cause of death was classified according to the International Classification of Diseases, Ninth Revision (ICD-9) codes 430 to 434 and 436 to 438. For this report, stroke subtypes were categorized as SAH (ICD-9 code 430), ICH (ICD-9 codes 431 to 432); and ischemic stroke (ICD-9 codes 433 to 434 and 436). Deaths attributed to transient ischemic attack (ICD-9 code 435) were excluded; these deaths accounted for <1% of stroke deaths. Information regarding how the stroke subtype categories were obtained for the death certificate (eg, clinical assessment, neuroimaging, or autopsy) was not available. Demographic information such as age, sex, race, and ethnicity are reported on death certificates by funeral directors on the basis of observation or information with which they are provided, usually by family members. Since 1992, information on both race and Hispanic origin is provided on death certificates. By use of the guidelines given by the

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From the Cardiovascular Health Branch, Division of Adult and Community Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, Ga.

Correspondence to Dr Carma Ayala, Cardiovascular Health Branch, Division of Adult and Community Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, 4770 Buford HWY NE, Atlanta, GA 30341-3717. E-mail cia1@cdc.gov

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Results

During 1995 to 1998, there were 633,299 stroke deaths among US residents, excluding 1588 (0.25%) deaths in which transient ischemic attack was cited as the underlying cause of death. Sixty-one percent of the stroke deaths were among women. Of these 386,377 stroke deaths among women, 81.7% were from ischemic stroke, 13.7% were from ICH, and 4.6% were from SAH (Table 1). Among men, 77.7% of 246,922 stroke deaths were from ischemic stroke, 18.5% were from ICH, and 3.8% were from SAH. The percentage of stroke deaths attributed to ischemic stroke ranged from 61% among API women (63% among API men) to 83% among white women (80% among white men). Black, AIAN, API, and Hispanic men and women had higher percentages of stroke deaths attributed to ICH strokes than did white men and women. Almost one third of stroke deaths among API adults were attributed to ICH. The proportion of deaths attributed to SAH was higher among API, AIAN, and Hispanic women than among black or white women.

Age-standardized stroke death rates were 92.6/100 000 for women and 98.3/100 000 for men, or 0.94 deaths among women for each stroke death among men. Age-standardized stroke death rates per 100 000 for ischemic stroke were 74.3 for women and 78.8 for men (RR 0.94); for ICH, the rates were 13.3 for women and 16.2 for men (RR 0.8); and for SAH, the rates were 4.9 for women and 3.1 for men (RR 1.6) (Table 2). The risk of ischemic stroke death was higher for black women than for white men (RR 1.21, 95% CI 1.21 to 1.22), but for all other racial/ethnic groups of women, the risk was lower or similar to that of men (Table 2). The risk of ICH death was lower or similar for women compared with men among all racial/ethnic groups. The risk for SAH death was higher for women than for men among all racial/ethnic groups and ranged from 55% higher among white men (RR 1.55, 95% CI 1.51 to 1.60) to 2.6 times (95% CI 1.8 to 3.7) higher for AIAN women than for men.

The female-to-male ratio of mortality rates varied with age for each stroke subtype (Figure). For example, women had a lower risk of ischemic stroke than did men at ages <65 years, but women had a higher risk than men at ages ≥65 years. Similarly, women had a lower risk of ICH death than men at ages <65 years, but the risk was comparable for older women and men aged ≥65 years. Compared with men, women had a higher risk of SAH death at all ages. Furthermore, this excess differential regarding the sex of the individual for SAH stroke mortality increased with age such that rate ratios (and 95% CIs) were 1.29 (1.22 to 1.37) at ages 25 to 44 years, 1.54 (1.48 to 1.61) at ages 45 to 64 years, and 1.83 (1.76 to 1.90) at ages ≥65 years.

Office of Management and Budget, the racial and ethnic categories are used in terms of social, cultural, and ancestral characteristics and do not refer to biological or genetic characteristics. We defined 5 mutually exclusive groups for race/ethnicity: Hispanics, non-Hispanic blacks, non-Hispanic American Indians and Alaska Natives (AIANs), non-Hispanic Asian Americans and Pacific Islanders (APIs), and non-Hispanic whites.

Mortality rates (per 100 000 population) among US residents for 1995 to 1998 were calculated as the number of deaths for each stroke subtype divided by the population counts for groups defined by sex, race/ethnicity, and age. Because the number of deaths in a given year was quite small for some subgroups, we combined data for the years 1995 to 1998 to create more robust estimates. Population estimates was quite small for some subgroups, we combined data for the years 1995 to 1998 to create more robust estimates. Population estimates.

<table>
<thead>
<tr>
<th>Race/Ethnic Group</th>
<th>Overall Total Deaths, N</th>
<th>Ischemic Stroke</th>
<th>ICH</th>
<th>SAH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Deaths, n</td>
<td>% of Total</td>
<td>Deaths, n</td>
<td>% of Total</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whites</td>
<td>327,589</td>
<td>315,521</td>
<td>81.7</td>
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<td>68,830</td>
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<td>AIANs</td>
<td>1126</td>
<td>818</td>
<td>72.6</td>
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<tr>
<td>APIs</td>
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<td>3279</td>
<td>61.0</td>
<td>1523</td>
</tr>
<tr>
<td>Hispanics</td>
<td>10,961</td>
<td>7582</td>
<td>69.2</td>
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<tr>
<td>Men</td>
<td>246,922</td>
<td>191,735</td>
<td>77.7</td>
<td>45,815</td>
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<tr>
<td>Non-Hispanics</td>
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<tr>
<td>Whites</td>
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<tr>
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<td>65.4</td>
<td>3,598</td>
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</tbody>
</table>

Values are for ischemic stroke (ICD-9 codes 433–434 and 436–438), ICH (ICD-9 codes 431–432), and SAH (ICD-9 code 430).

Female-to-male mortality rate ratios and 95% CIs for 3 stroke subtypes among adults aged ≥25 years, by age group (United States, 1995 to 1998). Age groups are as follows: 25 to 44 years, 45 to 64 years, and ≥65 years.

Overall age-standardized stroke death rates for the entire US population in 1995 to 1998 showed that there were 0.9 female deaths for every 1 male death. We also observed a female-to-male ratio of 0.9 for ischemic stroke deaths, 0.8 for ICH deaths, and 1.6 for SAH deaths. However, this female-to-male ratio varied for stroke subtypes by race/ethnicity and age. In particular, younger women (25 to 44 years) were less likely to die from ischemic stroke than were younger men, but older women were more likely to die from ischemic stroke than were older men. This is consistent with previous reports on sex differences for overall stroke mortality rates as well as stroke incidence rates. The sex differential for ICH mortality that we found is consistent with that in other reports.

In contrast, our finding that US women were more likely to die from SAH than were men and that this sex differential increased with age differs from the findings of other reports. In a multinational study of SAH, no consistent pattern was observed in the sex differential of stroke incidence or case-fatality rates. Inconsistencies may be due to the inclusion of differing ICD-9 codes or to temporal, geographic, or demographic variations between the populations in the multinational study and the populations covered by US vital statistic data. We cannot be sure how much of the sex differential of these 2 studies reflects differences in incidence or case fatality. Regardless of these differences and despite improvements in surgery and medical care for SAH, case fatality is high, with a considerable proportion of SAH deaths occurring before any specific treatment can be initiated.

Variation in stroke subtype mortality rates between men and women by age and racial/ethnic groups may reflect differences in life expectancy and competing causes of death, socioeconomic status, and other factors influencing death rates, such as lack of access to medical care (which may be influenced by lack of health insurance, differential access to or acceptance of invasive procedures, transportation difficulties, and lack of knowledge about early warning signs of stroke). Variations in sex differences in death rates for stroke subtypes among racial/ethnic populations may be further attributable to variations in the prevalence of risk factors such as hypertension, obesity, diabetes, inactivity, poor nutrition, cigarette smoking, and alcohol abuse. Deaths from stroke can be delayed or reduced by preventing and controlling these risk factors and by removing barriers to early and effective treatment.

Educating the public about signs and symptoms of stroke can help promote prompt and effective treatment for stroke. The success of thrombolytic therapy, which can improve patient outcomes for acute ischemic stroke, is time dependent on the early recognition of symptoms and timely arrival and evaluation in the emergency department. Women are more likely to recognize at least 1 stroke warning sign than are men. However, among stroke victims, women had increased delay times for arrival to emergency rooms and underwent fewer carotid endarterectomies and angiograms than did men, although others have reported no such sex differential in the time between presentation and initial examinations. Both men and women have been shown to...
experience significant delays in presentation for treatment of stroke.36,37 In a recent stroke registry, only 32% of the patients arrived at the emergency department within 1.5 hours of stroke onset, and only 46% arrived within 3 hours.36 Black patients were significantly more likely than white patients to arrive at the emergency department >3 hours after having a stroke, but there was no significant sex difference in arrival times.36 Because stroke patients who attribute their symptoms to a stroke have shorter delay times,37 increasing public awareness of stroke signs and symptoms is key to decreasing treatment delay. Guidelines developed by the National Institute of Neurological Disorders and Stroke state that patients with stroke symptoms should be evaluated by a physician within 10 minutes of arrival at the emergency department and that a CT scan to rule out ICH and SAH should be initiated within 25 minutes and interpreted within 45 minutes of arrival.38 Recent studies demonstrate greater delay times for each of these end points.35,36 Timing of access to care may be an important determinant of delay in acute-stroke treatment, because it has been shown that the time between stroke occurrence and treatment could be a deciding factor in outcome regardless of stroke subtype.32,39–41 The main reason that few stroke patients present to the hospital in time to receive effective treatment is simply that most of the public remains uninform ed about stroke; thus, many stroke victims fail to recognize that they are having a stroke.42,43 Educational efforts aimed at health professionals and the public can increase the ability to recognize stroke symptoms and thus reduce delay in presentation and referral of stroke patients.44

Few studies have examined sex differential in stroke mortality among AIANs and APIs because of small population sizes. AIANs have a greater prevalence of smoking and obesity than do whites, which may result in a greater prevalence of hypertension and diabetes,45 2 important risk factors for stroke. In the present study, AIAN women had a 2.6 times higher risk of SAH mortality than AIAN men.

Underreporting of AIAN, API, and Hispanic origin on death certificates and undercoverage on census population counts can lead to underestimates of the risk of stroke deaths in these groups.46–48 A report from the National Center of Health Statistics suggests that racial/ethnic reporting biases caused by miscoding on death certificates and undercoverage in census counts could result in deaths rates being underreported by as much as 21% for AIANs, 11% for APIs, and 2% for Hispanics and being slightly overreported for blacks and whites.37 Whether the reporting of stroke deaths also has a sex bias is unknown.

Another potential limitation of the present study is the accuracy of reporting the cause of death by using ICD-9 codes. Historically, during the 1970s and 1980s, the classification of stroke subtypes was not considered very accurate.49 Ever since the advent of widespread use of CT, a death certificate diagnosis of intracranial hemorrhage versus nonhemorrhagic stroke appears to be sufficiently accurate for use in epidemiological studies.50 Findings from a previous report suggest that there was no racial/ethnic difference among men and women in ICD-9–defined classifications within stroke subtypes.7

Since the 1960s, it has been evident that considerable geographic variations in stroke incidence and stroke mortality exist, with the highest rates observed in the stroke belt of the southeastern United States.31,52 The patterns of age-specific excess risk for overall stroke death in the stroke belt differed between black and white men and women.53 However, it is beyond the scope of the present study to examine geographic variations for stroke subtypes between sex and racial/ethnic groups.

Our results highlight the need to reduce disparities in stroke mortality rates between men and women within racial/ethnic groups, particularly among AIAN populations. Educating the public about the signs and symptoms of a stroke may be key to preventing stroke deaths among women who may perceive stroke as a man’s disease. Further epidemiological studies may help reveal clusters of risk factors associated with specific stroke subtypes, especially among those at highest risk. Targeted research and evaluation among these high-risk populations may also help to identify further risk factors, such as lower socioeconomic or educational levels or adverse environmental factors. Consequently, the identification and continued monitoring of high-risk subgroups by stroke subtype are important components of stroke prevention and treatment efforts, especially because symptomatology and appropriate treatment vary by subtype. Public health media campaigns aimed at people in these high-risk groups must stress the importance of their immediately seeking health care for certain signs and symptoms so that they can receive prompt and appropriate treatment. Emergency care treatment guidelines and protocols must also ensure that proper diagnosis and evaluation be performed in a timely manner for patients with stroke symptoms.

References

Revisions to the Standards for the Classification of Federal Data on Race and Ethnicity


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