Impact of Stroke on Health-Related Quality of Life in the Noninstitutionalized Population in the United States

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Background and Purpose—Stroke is a major cause of long-term disability in the United States. This study examined the national impact of stroke on health-related quality of life (HRQoL) and disparities in HRQoL across different demographic groups.

Methods—Combined 2000 and 2002 Medical Expenditure Panel Survey data were used, which include quality-of-life measures based on the short-form generic measures (SF-12) and the EuroQol Group measures (EQ-5D index and EQ VAS) for 39 680 adults aged >18 years. Stratified analysis and ordinary least square regressions were used to compare HRQoL scores between stroke and nonstroke populations.

Results—The study included 1040 noninstitutionalized stroke survivors. After adjustment for sociodemographics, risk factors, and comorbidities, stroke survivors had statistically significantly lower mean scores for mental health (−4.1%), physical health (−7.9%), health utility (−6.9%), and self-rated health (−7.2%) (all $P<0.01$). In general, stroke did not affect differences in HRQoL among age or gender groups. However, racial and ethnic disparities in HRQoL were greater among stroke survivors than nonstroke individuals, particularly in health utility scores for black vs white participants (−0.06 in stroke survivors and −0.02 in the nonstroke population, $P<0.01$) and Hispanic versus non-Hispanic participants (−0.11 in stroke survivors and −0.01 in the nonstroke population).

Conclusions—Stroke significantly impairs HRQoL in the United States. The findings suggest that racial and ethnic disparities in HRQoL among stroke survivors are more pronounced than in the nonstroke population. The burden of nonfatal stroke, especially among racial and ethnic minorities, should be recognized more widely. (***Stroke*. 2006;37: 2567-2572.)**

Key Words: disparities ■ health-related quality of life ■ stroke

Stroke is a major cause of long-term disability in the United States.[1] More than 700 000 people experience a stroke each year. Among them, 25% will die and 15 to 30% will remain disabled.[2–4] It is estimated that there are 4.4 million stroke survivors in the United States and the number is likely to increase over the next 2 decades as the baby-boomers age beyond 65 years.[5,6] Hospitalizations for stroke and the proportion of patients who are transferred to long-term care facilities have increased in the past decade.[7] So far, the majority of stroke-related outcomes research has focused on mortality and morbidity because these outcomes are easy to observe and data are readily available. Studies examining quality of life among patients sustaining a stroke have shown that stroke has a detrimental effect on both short-term and long-term health-related quality of life (HRQoL) and that disability is a strong determinant of HRQoL among this group.[8–15] However, these studies were largely localized so the findings may not be generalizable to the US population. Despite the high prevalence of stroke survivors, the national impact of stroke on quality of life has not yet been estimated. Such information is necessary in a comprehensive assessment of the impact of stroke on health and health care in the United States. In addition, it is instrumental for evaluating the effects of different treatments or interventions on stroke prevention and treatment such as those suggested by the American Heart Association's *Get With the Guidelines*.[16]

We sought to quantify the national impact of stroke on HRQoL in the noninstitutionalized population in the United States with four commonly used HRQoL measures, each of which provides a different perspective on quality of life. Furthermore, disparities among demographic groups have been identified for stroke incidence, prevalence, premature death, and disability.[10,12,13,17–21] Such disparities may exist with respect to HRQoL as well. Therefore, the second aim of this study was to

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assess the impact of stroke on disparities in HRQoL among demographic subgroups. We examined both questions using a nationally representative survey to achieve the estimations in the United States.

Methods

Data and Study Population

Data used in this analysis were obtained from the Household Component of the Medical Expenditure Panel Survey (MEPS), which is collected by the Agency for Healthcare Research and Quality.[22] MEPS has an overlapping panel design, in which any given panel is composed of a random sample of the US civilian noninstitutionalized population interviewed five times over 30 months.[23] Except for the beginning year, two panels are interviewed each year and individual sampling weights are assigned to participants of the two panels to yield nationally representative statistics for that year. The sample in each panel was selected from households that responded to the National Health Interview Survey, which uses a multistage probability sample design to enable nationally representative estimates. Specifically, the first stage of sample selection is primary sampling units, which consist of one or more counties. Within primary sampling units, there are strata corresponding to the density of the minority population. The basic sampling unit is a housing unit in which all household members are included in the survey if the housing unit is selected.[24,25] The Household Component provides detailed information on individuals' demographic and socioeconomic characteristics as well as medical condition status. In addition, since 2000, a self-administered questionnaire, which contains HRQoL measures, has been included for adults aged ≥18 years.

The subjects in this study consist of all adults, aged ≥18 years, who were interviewed in 2000 and 2002 and assigned a nonzero sampling weight. Because the overlapping sampling panel design of MEPS, the 2001 data were excluded to avoid duplicate observations of the same individual. Therefore, after excluding adults with missing values, this study sample is composed of 39 680 adults (91% of the total adult respondents) sampled in either 2000 or 2002.

Measures

MEPS has several measures of HRQoL, including the short-form generic measure of health status (12-item Short-Form Health Survey [SF-12]) and the measures developed by the EuroQol Group (EQ-5D index and EQ visual analog scale [EQ VAS]). The SF-12 measures the following eight concepts: physical functioning, role limitations resulting from physical health problems, bodily pain, general health, vitality (energy/fatigue), social functioning, role limitation resulting from emotional problems, and mental health. A specific scoring system was developed to generate physical and mental summary scales from these concepts (SF-12 Physical Component Summary [PCS-12] and SF-12 Mental Component Summary [MCS-12]).[26] The EQ-5D index is a preference-based health status measure (ie health utility) based on the five dimensions of health in the EQ-5D descriptive system (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression). The current EQ-5D index score available in MEPS is calculated using the preference weights of the general population of the United Kingdom, which are quite different from the preference weights of the US general population.[27–29] Therefore, in this analysis, the US preference weights developed by Shaw et al[30] were used to generate the EQ-5D index score. The EQ VAS captures the self-rating of current health status using a visual "thermometer" with the end points of 100 (best imaginable health state) at the top and zero (worst imaginable health state) at the bottom.

A stroke survivor was defined as a person who "had ever been diagnosed as having had a stroke or transient ischemic attack." Several risk factors such as diabetes, hypertension, and coronary artery disease were similarly defined and were based on the questions asking about the history of these diseases. All these conditions were either self-reported or reported by a proxy. In addition, two variables measuring comorbidities (conditions other than those included as risk factors) were constructed: a dummy variable indicating whether the subject had a history of other heart disease or conditions and a count variable specifying the number of other noncardiovascular conditions during the calendar year based on the MEPS medical condition files. Risk factors and comorbidities were included in the analysis because they were unevenly distributed among the stroke and the nonstroke population and they also affected HRQoL. Also included in the analysis were sociodemographic variables and a dummy variable indicating that the HRQoL data were collected through proxy report, which has been found to affect HRQoL scores.[31]

TABLE 1. Selected Characteristics of the Study Sample, MEPS 2000 and 2002

Characteristics	Stroke Survivors (N=1040)	Nonstroke Population (N=38 640)	*P*
Sociodemographics			
Age (%)			<0.001
18–49	12.6	63.3	
50–64	26.4	21.4	
65–74	25.6	8.5	
75–84	27.7	5.3	
85 or older	7.8	1.5	
Gender (%)			0.272
Male	43.9	45.7	
Female	56.1	54.3	
Race (%)			0.002
White	78.0	81.1	
Black	17.7	13.9	
Other	4.3	5.0	
Ethnicity (%)			<0.001
Hispanic	10.3	21.9	
Non-Hispanic	89.7	78.1	
Region (%)			0.002
Northeast	15.5	15.6	
Midwest	24.9	20.7	
South	38.4	38.3	
West	21.3	25.3	
Education (no. of years: mean and SD)	11.1 (3.4)	12.3 (3.2)	<0.001
Risk factors (%)			
Hypertension	67.9	20.4	<0.001
Diabetes mellitus	27.4	6.9	<0.001
Coronary artery disease	33.9	4.8	<0.001
Smoking	23.6	22.2	0.303
Comorbidities			
Other heart disease (%)	19.4	5.5	<0.001
No. of noncardiovascular disease conditions (mean and SD)	5.2 (3.6)	2.6 (2.7)	<0.001
Proxy report (%)	26.4	12.2	<0.001

Note: P values were based on χ^2 tests if a variable is categorical and *t* tests if a variable is continuous.

TABLE 2. HRQoL in Stroke and Nonstroke Populations by Selected Characteristics, MEPS 2000 and 2002

	Mental Health Score (MSC-12)		Physical Health Score (PCS-12)		Health Utility Score (EQ-5D Index, US)		Self-Rating of Health (EQ VAS)	
	Stroke Mean (SE)	Nonstroke Mean (SE)	Stroke Mean (SE)	Nonstroke Mean (SE)	Stroke Mean (SE)	Nonstroke Mean (SE)	Stroke Mean (SE)	Nonstroke Mean (SE)
Overall	47.4 (0.4)	51.3 (0.1)	35.6 (0.5)	49.6 (0.1)	0.69 (0.01)	0.87 (0.00)	61.6 (0.8)	80.5 (0.2)
Age								
18–49	45.1 (1.2)	51.1 (0.1)	40.5 (1.2)	52.0 (0.1)	0.73 (0.02)	0.90 (0.00)	60.6 (2.2)	82.9 (0.2)
50–64	45.9 (1.0)	51.3 (0.2)	37.0 (1.0)	47.6 (0.2)	0.67 (0.01)	0.84 (0.00)	61.0 (1.5)	78.1 (0.3)
65–74	48.5 (0.9)	52.5 (0.2)	35.6 (0.7)	43.8 (0.3)	0.72 (0.01)	0.82 (0.00)	62.8 (1.8)	76.1 (0.4)
75–84	48.9 (0.7)	51.8 (0.3)	34.1 (0.8)	39.4 (0.3)	0.70 (0.01)	0.78 (0.01)	62.6 (1.4)	71.1 (0.6)
≥85	46.5 (1.5)	51.8 (0.5)	29.9 (1.0)	35.5 (0.5)	0.60 (0.03)	0.73 (0.01)	58.2 (3.3)	66.0 (1.0)
Gender								
Male	49.1 (0.6)	52.2 (0.1)	37.0 (0.7)	50.4 (0.1)	0.72 (0.01)	0.88 (0.00)	62.5 (1.3)	81.5 (0.2)
Female	45.0 (0.7)	50.4 (0.1)	34.3 (0.5)	48.8 (0.1)	0.67 (0.01)	0.86 (0.00)	60.9 (0.9)	79.5 (0.2)
Race								
White	47.9 (0.5)	51.3 (0.1)	35.5 (0.1)	49.6 (0.1)	0.70 (0.01)	0.87 (0.00)	61.9 (0.9)	80.6 (0.2)
Black	45.4 (1.0)	51.1 (0.2)	35.3 (1.1)	49.3 (0.2)	0.67 (0.02)	0.86 (0.00)	60.5 (2.2)	79.9 (0.4)
Others	43.3 (3.4)	51.2 (0.3)	37.8 (2.7)	50.1 (0.3)	0.64 (0.07)	0.89 (0.01)	58.8 (4.1)	80.1 (0.6)
Hispanic								
Yes	44.6 (1.4)	50.9 (0.2)	33.6 (1.4)	50.3 (0.2)	0.59 (0.04)	0.88 (0.00)	53.9 (3.0)	80.4 (0.4)
No	47.5 (0.5)	51.3 (0.1)	35.7 (0.5)	49.5 (0.1)	0.70 (0.01)	0.87 (0.00)	62.1 (0.8)	80.5 (0.2)
Region								
Northeast	46.7(1.0)	51.2 (0.2)	34.4 (1.1)	50.1 (0.2)	0.67 (0.02)	0.88 (0.00)	59.9 (2.3)	81.0 (0.3)
Midwest	48.3 (0.9)	51.6 (0.2)	35.8 (1.0)	50.0 (0.2)	0.71 (0.01)	0.87 (0.00)	63.3 (1.4)	81.1 (0.3)
South	47.0(0.7)	51.2 (0.1)	34.8 (0.9)	48.9 (0.2)	0.69 (0.01)	0.86 (0.00)	59.9 (1.4)	80.1 (0.3)
West	47.4(1.0)	51.3 (0.1)	37.4 (0.7)	49.9 (0.1)	0.71 (0.02)	0.88 (0.00)	63.7 (1.6)	80.0 (0.3)
Hypertension								
Yes	47.4 (0.5)	50.3 (0.2)	34.1 (0.5)	43.3 (0.2)	0.68 (0.01)	0.80 (0.00)	59.7 (0.9)	72.5 (0.3)
No	47.4 (0.9)	51.5 (0.1)	38.5 (0.8)	50.1 (0.1)	0.72 (0.01)	0.89 (0.00)	65.8 (1.4)	82.4 (0.2)
Diabetes								
Yes	46.1 (0.9)	49.2 (0.3)	31.3 (0.7)	40.9 (0.3)	0.62 (0.02)	0.77 (0.01)	55.4 (1.8)	67.3 (0.5)
No	47.8 (0.5)	51.4 (0.1)	36.9 (0.5)	50.1 (0.1)	0.72 (0.01)	0.88 (0.00)	63.9 (0.9)	81.3 (0.2)
Coronary artery disease								
Yes	46.2 (0.8)	49.4 (0.3)	31.9 (0.8)	37.8 (0.4)	0.65 (0.04)	0.74 (0.01)	55.5 (1.4)	64.7 (0.6)
No	48.0 (0.5)	51.4 (0.1)	37.4 (0.5)	50.2 (0.1)	0.71 (0.01)	0.88 (0.00)	66.7 (0.9)	81.3 (0.1)
Smoking								
Yes	45.4 (1.0)	49.2 (0.2)	36.7 (1.0)	48.9 (0.2)	0.71 (0.01)	0.84 (0.00)	59.1 (1.9)	77.2 (0.3)
No	48.0 (0.5)	51.9 (0.1)	35.1 (0.5)	49.8 (0.1)	0.69 (0.01)	0.88 (0.00)	62.5 (0.9)	81.4 (0.2)

Note: The sample included 1040 stroke and 38 640 nonstroke participants. All were significant between stroke and nonstroke populations based on *Z* tests ($P<0.05$).

Statistical Analysis

Data were first analyzed using a stratified matching method,[32] in which each HRQoL measure among stroke survivors was compared with the corresponding adjusted score among nonstroke individuals. More specifically, the population estimates of the HRQoL measures were calculated directly using MEPS individual sample weights for stroke survivors. To obtain the means and variances for the matching nonstroke adults, the population means of these variables were first calculated within each stratum defined by the unique combination of age (18–64 and ≥65 years), gender (male and female), race (white, black, and others), and geographic region (Northeast, Midwest, South, and West) for the nonstroke group. Overall, 48 strata were constructed. Based on these stratum-specific means, a weighted average for the matching nonstroke group was then estimated with weights being the percentages of the stroke population within each stratum. A weighted variance was likewise calculated. Differences between the population estimates for the stroke survivors and the matching nonstroke adults were then obtained. Following the law of large numbers, the estimated mean HRQoL scores should follow a normal distribution. Therefore, z scores were calculated to test the significance of the difference in HRQoL between stroke survivors and the matching nonstroke group.[33] The stratified matching method was used because it adjusted for factors that may affect HRQoL between stroke survivors and the nonstroke population without making arbitrary assumptions of the specific functional forms of HRQoL measures. It also allowed stroke effects to vary across the 48 strata, which is essentially equivalent to including all the interactions

TABLE 3. Unadjusted and Adjusted Differences and 95% CIs in HRQoL Measures Between Stroke and Nonstroke Populations, MEPS 2000 and 2002

Model	Mental Health Score (MSC-12)	Physical Health Score (PCS-12)	Health Utility Score (EQ-5D Index, US)	Self-Rating of Health (EQ VAS)
Unadjusted	−3.9 (−4.8 to −3.0)	−14.0 (−14.9 to −13.1)	−0.18 (−0.19 to −0.16)	−18.9 (−20.4 to −17.3)
Stratified matching methods*	−4.4 (−5.3 to −3.5)	−9.6 (−10.5 to −8.6)	−0.14 (−0.15 to −0.12)	−14.6 (−16.2 to −13.0)
OLS regressions†	−2.1 (−3.0 to −1.3)	−3.9 (−4.7 to −3.0)	−0.06 (−0.07 to −0.04)	−5.8 (−7.4 to −4.1)

*Adjusted for age, gender, race, and geographic region.
†Adjusted for sociodemographic variables, risk factors of stroke, and comorbidities.
All differences were significant ($P<0.05$).

among these demographic variables. However, for some strata, because of small numbers, other variables such as ethnicity and comorbidity had to be excluded from the adjustment. Finer classification of the adjusted variables, eg age, was not feasible in this method.

To control for potential confounders, multivariate ordinary least square (OLS) regressions were used to further examine the differences in each HRQoL score (the dependent variable) between stroke survivors and nonstroke individuals. The base model included independent variables such as stroke, age, gender, race, ethnicity, education, risk factors of stroke, other heart disease, number of other noncardiovascular medical conditions, and proxy report. Survey year was not included in the regression models because the coefficients remained the same when it was added. In addition, a separate model was estimated, which included two-way interaction terms between stroke and demographic characteristics (ie age, gender, race, and ethnicity) to detect any differential impact of stroke on HRQoL among these subgroups. Furthermore, to make the results easier to interpret, relative differences based on the basic OLS models were calculated. More specifically, the differences in HRQoL measures between stroke survivors and the nonstroke population were taken from the OLS models and then divided by the respective mean HRQoL score of the nonstroke population. The differences were interpreted as percentages of HRQoL scores of the nonstroke population. All the analyses were conducted using Stata 8.2 and incorporated the complex survey design in MEPS to calculate standard errors of population estimates. Statistical significance was determined based on $\alpha=0.05$.

Results

Of the 39 680 individuals in our sample, 1040 were stroke survivors, representing 2.5% of the US adult population. Stroke survivors were generally older than the nonstroke population and were disproportionately black; they were also less likely to be Hispanic, more likely to live in the Midwest, and less likely to live in the West (Table 1). They had a much higher prevalence of hypertension, diabetes, coronary artery disease, other heart disease, and noncardiovascular conditions. In addition, proxy report was used more frequently to gather information on HRQoL in the stroke sample.

The average scores on all of the HRQoL measures were lower among stroke survivors than the nonstroke population overall as well as in each population subgroup (Table 2). The population means of MCS-12, PCS-12, EQ-5D index, and EQ VAS among stroke survivors were 47.4 (SE=0.4), 35.6 (SE=0.5), 0.69 (SE=0.01), and 61.6 (SE=0.8), respectively. For the nonstroke population, the respective scores were 51.3 (SE=0.1), 49.6 (SE=0.1), 0.87 (SE=0.00), and 80.5 (SE=0.2) (Table 2). Although the differences in HRQoL narrowed after adjusting for age, gender, race, and geographic region, the association between stroke and HRQoL scores remained statistically significant for each measure (all $P<0.01$) (Table 3). The differences were further attenuated after controlling for risk factors and comorbidities (all $P<0.05$). Based on the results from OLS, on average, stroke survivors had 4.1% lower mental health score, 7.9% lower physical health score, 6.9% lower health utility, and 7.2% lower self-rating of health than the nonstroke population.

Further analysis of interactions showed that stroke exacerbated disparities in HRQoL among some demographic subgroups compared with the nonstroke population. In general, stroke did not have a statistically significant impact on either age or gender disparities in HRQoL or on the disparities between whites and people of "other" races. However, although being black was associated with significantly lower scores in every measure in the nonstroke population, these disparities were even greater among stroke survivors (Figure 1). Both SF-12 mental score and the EQ-5D index (health utility) showed a significantly greater gap between black and white stroke survivors ($P<0.05$). In addition, among stroke survivors, the differences in HRQoL measures between Hispanics and non-Hispanics were higher than in nonstroke respondents, although this impact was only significant for the EQ-5D index and EQ VAS (Figure 2).

Discussion

To our knowledge, this analysis is among the first to quantify HRQoL of noninstitutionalized stroke survivors at the national level. It provides important information to assess the impact of stroke in the United States from a new perspective: quality of life. The findings reveal that in addition to mortality and morbidity, stroke leads to significant reductions in quality of life. The study encompasses a rather complete

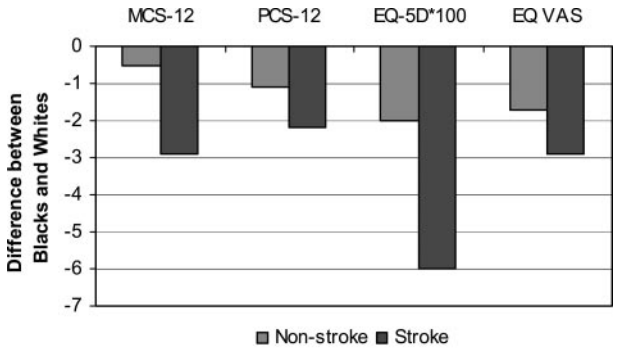

Figure 1. Mean differences between blacks and whites in HRQoL, by stroke status, MEPS 2000 and 2002.

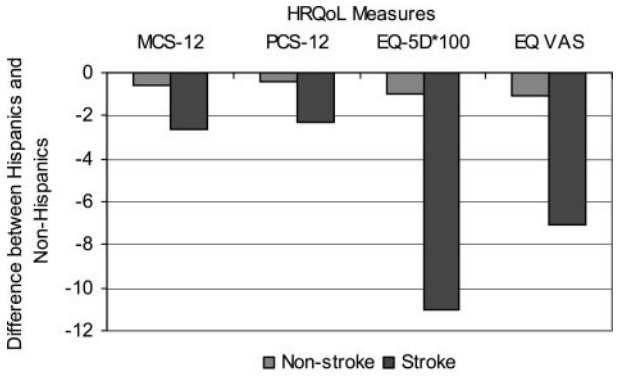

Figure 2. Mean differences between Hispanics and non-Hispanics in HRQoL, by stroke status, MEPS 2000 and 2002.

spectrum of HRQoL measures, including physical and mental capacity (SF-12), health utility (EQ-5D index), and self-rating of health (EQ VAS). These four measures are among the most commonly used in disease outcomes and cost-effectiveness research.

Using a nationally representative survey, this study showed that the HRQoL of noninstitutionalized stroke survivors was lower than that of the nonstroke population. Stroke significantly impaired HRQoL in the US population in every measure, but the impact on physical health status, health utility, and self-rating score was greater than on mental health status. The estimated MCS-12 and PCS-12 and the EQ-5D index in our study fall within the range of values identified by other studies with convenience samples.[34–37]

Previous studies have found some demographic disparities in HRQoL among stroke survivors, although no studies have compared such disparities between the stroke and the nonstroke populations.[10,12,13,19] Our study confirmed the findings that nonwhite stroke survivors had a lower physical HRQoL score compared with whites.[12,19]

The reasons for racial and ethnic disparities in stroke outcomes are not fully understood but may be associated with the frequently reported racial and ethnic disparities in quality of care and access to care.[38] Several previous studies have shown, for example, that nonwhites are less likely than whites to be enrolled in rehabilitation programs and have less functional improvement at discharge.[39–42] Moreover, the receipt of secondary prevention such as warfarin is lower among nonwhite stroke survivors.[43] Further studies are needed to explore issues related to access to care and quality of care of stroke survivors in different racial and ethnic groups.

This study has several limitations. First, all disease conditions were self- or proxy-reported, which may have introduced measurement errors into the variables of stroke, risk factors, and other comorbidities. Self- or proxy-reported prevalence is generally lower than prevalence based on medical examination. Nevertheless, the point prevalence of stroke derived from this sample matches the estimates from other sources quite well.[6,44] In addition, the estimates obtained in this study do not represent the HRQoL of all stroke patients in the United States because the study population excludes institutionalized stroke survivors, who are more likely to have cognitive impairment and disabilities than their noninstitutionalized counterparts. Because stroke survivors with cognitive impairment and disabilities tend to have lower HRQoL and noninstitutionalized survivors underrepresent this group, the impact of stroke is presumably underestimated in this study. In addition, the questionnaire used in MEPS does not distinguish among different types of stroke, stroke severity, or recurrent events. It should be noted that stroke survivors in this study include stroke of different types, different stages, and different prognoses. These stroke cases also include transient ischemic attack, which may have little effect on HRQoL after recovery. Finally, MEPS does not include certain measures[45–49] that are more responsive to HRQoL among patients with stroke (such as Stroke Impact Scales).

Future studies may include the institutionalized population and other outcome measures such as quality-adjusted life-years, which combines the traditional outcome of patient survival with preference-based quality of life to provide a more comprehensive picture of impact of stroke in the United States.

This study used the best available dataset to estimate the national impact of stroke on HRQoL and on racial and ethnic disparities in HRQoL among noninstitutionalized stroke survivors in the United States. These findings support the importance of preventing stroke and minimizing its impact on survivors, especially among racial and ethnic minority populations. Because stroke impairs HRQoL to a greater degree among blacks and Hispanics, future public health interventions should focus on developing culturally appropriate interventions for these populations.

Disclosures

None.

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