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Quality of life after stroke: a prospective longitudinal study

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Abstract

Purpose—To measure the impact of stroke on quality of life (QOL), and analyze whether race, gender, age, income, or living alone moderated those changes, using prospective longitudinal methods.

Methods—Participants in the REasons for Geographic and Racial Differences in Stroke study without history of stroke completed baseline SF-12 Mental (MCS) and Physical Component Summary (PCS) measures and a depression scale. Measures were repeated ($M = 1231$ days later) by 136 participants after an incident medically documented stroke and by 136 demographically matched stroke-free controls.

Results—Stroke participants showed significant worsening than controls in all three QOL measures. Controls also declined significantly in PCS. Standardized effect sizes for stroke versus control participants after adjusting for covariates were similar across the three measures and ranged from .366 to .465 standard deviation units. Stroke survivors who lived alone were at greater risk for increases in depressive symptoms.

Conclusions—Multiple declines in QOL occur after stroke, and social isolation heightens risk for increasing depression after stroke. Our prospective design and use of a population-based sample with matched controls suggests similar effects in both physical health and mental health QOL domains and offers unique strengths in understanding the impact of stroke on QOL.

Keywords

Stroke; Population-based studies; Quality of life

There are numerous studies focused on quality of life (QOL) in the aftermath of stroke. Stroke survivors experience a variety of long-term problems with quality of life after strokes [1,2]. Studies of stroke and QOL typically recruit participants after the stroke has occurred, and use clinical/convenience samples, such as stroke registries. Participants recruited from clinical settings are likely to undersample stroke survivors who have relatively mild impairments and minimal changes in quality of life. This is a key concern because stroke survivors identified through stroke registries or clinical sources may have different impairments than those obtained from population-based samples [3]. Most longitudinal studies of QOL and stroke do not have control groups who are similar in demographic characteristics who are also followed longitudinally while not having strokes. This is important because there may be changes in QOL over time even without a stroke due to other conditions and aging.

The prediction of individual differences in QOL after stroke is also very important. While many factors affect long-term stroke recovery, two demographic factors—race and gender—appear to be particularly important, although the mechanisms behind these differences are poorly understood. Women [4–7] and African Americans [8] tend to have poorer QOL outcomes after stroke than men and Whites. Social support is also a promising variable in predicting post-stroke outcome and explaining racial and gender differences [5,6,9]. Lack of a caregiver to enhance access to care may explain worse outcomes observed for women and African American stroke survivors and merits study. One recent review [10] concluded that social factors (i.e., living alone, social support, social isolation) were consistently associated with post-stroke QOL.

Understanding the extent and magnitude of the effects of stroke on quality of life has important implications for public health. QOL outcomes are increasingly seen as reflecting clinically significant indicators that are important to patients and families [2]. Conducting such research in the context of a prospective population-based study allows for a relatively unbiased estimate of the magnitude of stroke on QOL and of the predictors of changes in QOL.

We have identified one paper that has attempted to estimate the magnitude of QOL changes before and after stroke [11]. In this research, patients experiencing TIAs or strokes who reported to an emergency room were asked to retrospectively estimate their QOL before the stroke (using the SF-12) and then either the stroke survivor or their proxy completed a SF-12 1 year later. The paper reported on standardized response means (SRMs) or the mean change in SF 12 score divided by the standard deviation of the change score. This paper supported the ability of the SF-12 to detect change in QOL after stroke, and reported effect sizes after stroke of .49 for PCS, and .52 for MCS. However, limitations of this project include the use of retrospective recall to estimate pre-stroke SF-12, the lack of a non-stroke control group and use of an emergency room sample. In addition, the use of SRM instead of other measures of effect size is controversial since different approaches can lead to very different estimates [12,13].

One reason that it has been difficult to study these issues is that there have been few large, prospective studies of stroke that included pre- and post-stroke measures of QOL in samples that are diverse in race, gender, and other factors. The REasons for Geographic and Racial Differences in Stroke (REGARDS) study is an ongoing epidemiologic study of stroke and coronary heart disease incidence and mortality using a large national sample of African American and White adults over 45 years of age. The REGARDS baseline telephone interview included measures of QOL, as well as important factors that should be examined as covariates. While REGARDS has collected quality-of-life data (SF-12, depression) from its participants at the baseline interviews, REGARDS does not collect follow-up data on

QOL after stroke. The Caring for Adults Recovering from the Effects of Stroke (CARES) project, an ancillary study of REGARDS examining the long-term psychosocial impact of stroke on stroke survivors and their family caregivers [3], routinely gathers post-stroke data on QOL from surviving patients and from matched stroke-free controls. In particular, CARES collects data on the SF-12 and the short form CES-D at the baseline CARES telephone interview, which is collected between 9 and 12 months after the stroke. The CARES data collected from a sample of stroke-free REGARDS participants who are matched with the REGARDS stroke survivors allow for longitudinal comparisons of changes in QOL either with or without stroke. Thus, we have the ability to compare changes in QOL over time among individuals who do or do not have strokes and to gauge to what extent QOL changes are attributable to stroke, versus to changes that might have occurred anyway over time.

In this report, our primary aim was to estimate the magnitude of effects of first-time strokes on SF-12 Mental and Physical Health component summary scores, and on depressive symptoms as measured by the 4-item short form CES-D. We predicted that there would be significantly greater negative effects on QOL in stroke cases versus control cases. We also hypothesized that females, African Americans, and individuals with a relative lack of social support (as measured by living alone) would show a greater negative QOL impact of stroke. In addition, we explored whether other predictor variables, including age, type of stroke (hemorrhagic or ischemic), and the hemispheric location of the stroke (left, right, or bilateral) predicted extent of change in QOL after stroke. Finally, because there are alternative approaches to standardizing the effect sizes for comparative purposes [13], we calculated standardized effect size estimates via four different approaches to facilitate interpretations and comparisons with the literature.

Materials and methods

Participants

Potential participants for the REGARDS study were randomly selected from a commercially available nationwide list, using a stratified random sampling design. Approximately half of the sample was obtained from “stroke belt” region (the states of AL, AR, GA, LA, MS, NC, SC, and TN) and the remaining half from other areas throughout the 48 contiguous states, with an effort to include about half African American and half White, as well as half male and half female. After mail contact, a subsequent telephone contact was attempted. Respondents were briefly screened for eligibility and then invited to participate and provided verbal informed consent. Exclusion criteria included age less than 45, self-identified race other than African American or White, previous diagnosis of cancer requiring chemotherapy, inability to communicate in English, or residence in or on a waiting list for a nursing home. These criteria were intended to allow for a focus on Whites and African Americans and ability to participate in a longitudinal study largely conducted by telephone assessments. Anyone not excluded by these criteria was eligible for enrollment. The cooperation rate (the proportion of known eligible participants who agreed to be interviewed) was over 60% [14]. All recruitment, interview, and informed consent procedures were reviewed and approved by the Institutional Review Boards of each involved REGARDS organizational unit. The sampling, recruitment, and telephone interviewing procedures for REGARDS have been described in more detail elsewhere [14].

Enrollment began in January of 2003 and ended in October of 2007. A total of 30,183 participants completed the initial telephone interview and home visit and provided valid race, sex, and age data. The present analyses focus on stroke survivors, who self-reported a first stroke during a follow-up call, which was subsequently confirmed by review of medical records, and a group of demographically matched non-stroke controls. For stroke survivors,

index hospitalization event medical records were obtained and were reviewed and adjudicated by two trained physician adjudicators (including at least one neurologist) with expertise in stroke. Stroke subtype was confirmed by the same adjudicators using imaging and other diagnostic data abstracted from the index stroke event hospitalization record.

REGARDS participants who were determined to have had a stroke as described earlier were potentially eligible to participate in CARES. Because of the focus of CARES on family caregiving, each stroke survivor had to be a community-dwelling resident 9 months after the stroke event and needed to have a family member or close friend who either was serving as an informal caregiver or had served in this capacity at some point after the stroke event, and who was also willing to participate in the project.

Through the CARES project, we also recruited a control participant for each stroke survivor from within the REGARDS cohort, matched on age of the stroke survivor/stroke-free comparison participant (± 5 years), gender, race, whether or not they lived with their primary family caregiver (or perceived available caregiver) and their relationship with that person. Both the stroke and control participants completed the QOL measures both at the baseline, and at a time interval either 9–12 months after the stroke (Stroke cases) or at a similar follow-up interval (Controls). Stroke participants completed the QOL measures an average of 275.46 days after their strokes, and 1231.40 days after the initial REGARDS baseline assessment, while control participants completed the QOL measures an average of 1176.91 days after the initial REGARDS assessment.

Procedures

Trained interviewers contacted potential participants and established eligibility for participation and obtained verbal informed consent. A computer-assisted telephone interview was then administered that obtained baseline information on a variety of topics. Education was included as a measure of socioeconomic status and was coded into four ordinal categories (less than high school graduate, high school graduate, some college, college graduate, or more).

Instruments

Depressive symptoms—The 4-item short form of the Center for Epidemiological Studies-Depression scale (CESD-4) was used to assess depressive symptoms [15]. Participants indicated how many days during the past week they felt depressed, lonely, sad, or had crying spells. Response options included less than 1 day, 1–2 days, 3–4 days, or 5 or more days. Total scores ranged from 0 to 12, with a score of 4 or more suggestive of significant psychological distress. The reliability and validity of the CESD-4 have been shown to be sufficient in comparison with the full 20-item CESD [15].

Health-related quality of life—The SF-12 was used to assess general mental and physical health functioning [16]. The Mental Component Summary (MCS) and Physical Component Summary (PCS) scores were calculated using weighted item composites. These scores were standardized to have population means of 50 and standard deviations of 10, with higher scores reflecting better functioning. The MCS and PCS scores were designed to be uncorrelated with each other and have been shown to be reliable and valid independent indicators of health-related QOL [16].

Statistical analyses

Simple changes on each QOL measure were calculated by subtracting the baseline REGARDS observation from the second CARES observation. These change scores were then compared between the two groups using multiple linear regression analyses. The

baseline REGARDS score was included as a covariate in these analyses. The primary predictor variable was an indicator of whether the participant was a stroke survivor (1) or a matched control participant (0). Additional covariates included race (African American or White), gender, age, whether the participant lived alone or with at least one other person, and income as measured during the REGARDS baseline interview. Income was coded as a categorical predictor with 5 levels (<\$20,000; \$20,000 to \$34,999; \$35,000 to \$74,999; ≥ \$75,000; refused to answer).

Three steps were completed in the analyses. First, in order to determine the overall differences in effect size between those with and without stroke, primary models examined covariate-adjusted main effects for stroke status (stroke versus control) on the change scores after adjusting for the baseline score and other covariates. Next, additional supplemental regression analyses were conducted that examined whether age, gender, race, income, living alone, or number of days between the REGARDS and CARES assessments predicted differential rates of change in QOL for stroke and control cases. In these models, we included interaction terms (stroke status*covariate) to determine whether the covariates predicted significant differential change in QOL. Finally, for stroke cases only, we also examined whether the type of stroke or the hemispheric location of stroke predicted the degree of change in QOL. For cases with missing data on any of the QOL measure, the stroke participant and stroke-free matched control were both deleted for the regression analyses for that particular measure.

Standardized effect sizes were calculated in four different ways to compare effects across the different measures and to facilitate comparisons with previous studies [17]. These methods included two different standard deviations used in the denominator (baseline versus change) and analyses with and without covariate adjustments. For simple within-group changes, we divided the raw within-group change score mean (1) by the standard deviation of the *change score* to calculate a standardized response mean (SRM) [13] and (2) by the standard deviation of the *baseline score* to calculate Cohen's standardized effect size (CSES) [18]. We then calculated differences between the groups on the standardized effect size measures. Similarly, from the multiple regression analyses of group differences, we calculated the difference between the covariate-adjusted change scores for stroke participants and controls and divided this (1) by the square root of the mean square error from the multiple regression analysis to obtain an adjusted standardized response mean (ASRM) and (2) by the overall standard deviation of the measure from the REGARDS baseline to obtain an adjusted Cohen's standardized effect size (ACSES). This resulted in covariate-adjusted differences between the groups in standard deviation units based on the standard deviation of change and the standard deviation at baseline, respectively.

Results

Table 1 summarizes the descriptive information for the 272 participants included in our analyses. This sample ranged from 46 to 90 years of age ($M = 70.18$) and included high percentages of women (51%) and African Americans (40%). The stroke and control participants were individually matched on age (within 5 years), race, gender, and whether or not they lived with their primary family caregiver (or perceived available caregiver). Confirming the effectiveness of this matching strategy, the stroke and control groups did not differ on race, gender, or whether they lived alone. The two groups were also found to not differ significantly on income or education. Despite matching participants within a 5-year range on age, there was a small but statistically significant difference between the two groups in age with stroke cases being 2.19 years older on average than controls ($P = .02$). Among the individuals who had experienced a stroke, 9% had hemorrhagic and 91% had

ischemic strokes. In terms of hemispheric location of the stroke, 52% had left, 40% right, and 2% bilateral strokes, with 6% undetermined.

Group differences in QOL changes

The results of the multiple linear regression analyses predicting changes in QOL as a function of stroke survivor versus control participant status, with covariates of baseline level, age, gender, race, income, and whether or not the participant lived alone, revealed statistically significant effects for stroke versus control status on all three measures. On the CES-D, stroke participants showed a covariate-adjusted increase that was .91 points higher than the increase shown by controls ($M_s = 1.06$ and $.15$, respectively; $F(1,255) = 10.10$, $P = .002$). For the MCS, stroke participants showed a covariate-adjusted decrease of 1.97 points, which was significantly different from the covariate-adjusted increase of 1.01 points for the stroke-free controls ($F(1,241) = 8.18$, $P = .005$). Similarly, for the PCS, stroke participants showed a covariate-adjusted decrease of 6.43 points, which was statistically greater than the 2.18 covariate-adjusted decline observed for the controls ($F(1,241) = 12.87$, $P = .0004$). Of particular interest is that even stroke-free controls showed a significant decrease over time on the PCS ($P = .001$).

For all three QOL measures, the baseline observation was a significant predictor of the change scores, with higher baseline scores associated with lower increases or greater decreases ($P < .0001$). Age was also a statistically significant predictor of CES-D change after accounting for the effects of the other covariates, with younger participants reporting slightly greater increases in depression across both stroke and control groups ($F(1,255) = 4.61$, $P = .03$). None of the other covariate effects were statistically significant (all $P > .30$).

Other predictors of QOL changes

The supplemental regression analyses that examined whether age, gender, race, income, or living alone moderated the stroke versus control effects on change in QOL revealed no statistically significant interaction effects for MCS or PCS. For the 4-item CES-D, living alone ($F(1,254) = 5.33$, $P = .02$) was found to significantly modify the stroke versus control difference, with stroke survivors who lived alone showing greater increases on the CES-D than stroke survivors who co-resided with their caregivers or other family members (adjusted $M_s = 1.74$ and $.70$, respectively). The stroke versus control moderation effect for race on the CES-D closely approached statistical significance ($F(1,254) = 3.82$, $P = .052$), with African American stroke survivors tending to report greater increases on the CES-D than White stroke survivors (adjusted $M_s = 1.32$ and $.92$, respectively). Type of stroke (hemorrhagic or ischemic) and the hemispheric location of the stroke (left, right, or bilateral) were not found to be significant predictors of the changes in QOL on any measure.

Magnitude of changes in QOL in stroke and control participants

Table 2 shows the estimates of the standardized change scores within each group separately as well as differences between the two groups both before and after accounting for the effects of the covariates. Overall, the group difference effects are between Cohen's [18] definition of a "small" (.20) and a "medium" (.50) effect size. The largest standardized decline was observed within the stroke group on the PCS, but some of this decline can be attributed to the aging of the cohort as indicated by the more modest, but significant, decline on the PCS observed for the controls. The group differences more directly estimate the effects of stroke on QOL over and above the passage of time, and these effects suggested similar effect sizes across the multiple QOL measures.

Discussion

To the best of our knowledge, our project is the first study to prospectively measure the impact of stroke on QOL in a population-based sample, using both stroke and non-stroke control cases. As expected, even with the inclusion of many individuals who experienced mild strokes or recovery [19], we found that incident stroke has a negative impact on changes over time in depression and mental health- and physical health-related QOL compared to control individuals. The magnitude of these effects, comparing the extent of change in those with and without stroke after adjusting for covariates, ranged from .366 to .465 standard deviation units. According to the usual descriptors of magnitude of effects presented by Cohen [18], these effect sizes can be considered small to medium in size. However, certainly these effects are important from a public health perspective. Even with the inclusion of relatively mild strokes as in our study, stroke has an important overall impact on physical and mental QOL.

A previous study of the REGARDS data indicated that the PCS is approximately twice as sensitive as the MCS to differences between participants who did and did not report a history of stroke prior to the baseline interview [20]. This retrospective analysis suggested that the physical health effects of stroke may be stronger than the more psychological effects, but our prospective analyses and the use of a population-based sample with a matched group of non-stroke controls suggests similar effects in both QOL domains. Of interest is the fact that, even among individuals not experiencing a stroke, there was a significant decline in physical health-related QOL over the nearly 3-year period of follow-up. Thus, when estimating the impact of stroke on QOL, use of a non-stroke control group allowed us to take into account changes that occur even without stroke, likely due to the effects of aging and age-related conditions other than stroke.

Also of interest was the finding that younger age, both in the stroke and control groups, was associated with greater increases in depression scores over time. This finding is consistent with a large body of evidence showing that more recently born cohorts in the United States have higher rates of depressive disorders than older cohorts [21]. The finding also points out the value of having a non-stroke control group. Without this control group, the findings might have been misinterpreted to suggest that stroke has greater effects on depression in younger persons, but our findings show that this effect was not different in stroke and non-stroke groups.

Consistent with our prediction, we also found evidence that stroke survivors living alone reported larger increases in depressive symptoms after stroke than stroke survivors with a coresident family member or friend. Social isolation is known to be a risk factor for depression, but our study adds to this literature by demonstrating that living alone is a risk for worsening quality of life after stroke.

With regard to race, we did find a trend ($P = .052$) for African American stroke survivors to experience larger increases in depressive symptoms after stroke than White stroke survivors, a finding that is consistent with previous evidence of poorer outcomes after stroke for African Americans [8]. However, no race differences were evident on the QOL measures obtained from the SF-12, and more research is needed to better characterize the nature and extent of possible racial differences in functional outcomes following stroke.

Contrary to our prediction, we found no differences by gender in the magnitude of these changes related to stroke. This finding is discrepant from the previous literature [4–7] and may be because the present sample from the CARES study only includes stroke participants who had a family caregiver who was also willing to participate in the study. Women are less likely than men to say that they have an informal family caregiver available to them [22].

Our results may support the contention that gender differences in post-stroke outcome may be partially explained by the relative lack of availability of caregivers for women stroke survivors [4]. Thus, when we in essence controlled for availability of a family caregiver by making it a requirement to be in the CARES study, we found that gender differences in the amount of QOL change after stroke were not statistically significant.

Standardized effect sizes were estimated in multiple ways to facilitate comparisons across measures and with previous studies. The within-stroke group effect sizes are most directly comparable to previous studies of stroke survivors only, and these effects do suggest stronger declines in physical health than mental health. However, the comparisons with the stroke-free controls indicate that part of this decline in physical health is simply due to aging. The adjusted effect sizes from the regression analyses detect stroke minus control differences after adjusting for covariates, and these suggest similar stroke-related declines across physical and mental health domains. Perhaps the most straightforward effect sizes for interpretation of group differences are the adjusted Cohen standardized effect sizes, which simply quantifies change relative to the original standard deviation of the measure.

This project has a number of major methodological strengths, including the use of a population-based sample that is culturally diverse, the careful ascertainment of stroke cases, the prospective design, and the use of non-stroke controls. However, the study also has several limitations. Because the CARES project focuses on family caregiving in the aftermath of stroke, individuals who had a stroke and who did not have a family caregiver were not included in our sample. In addition, individuals who died or were placed in nursing homes were not included.

Our findings support the conclusion that stroke has important effects on QOL, even when including the mild range of strokes and allowing for considerable time (about 9 months on average) of recovery to occur. Future projects examining QOL outcomes of diverse conditions should use such prospective population-based methods, with appropriate controls, to more accurately estimate the magnitude of illness and disability on QOL.

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Abbreviations

QOL	Quality of life
MCS	Mental Component Summary
PCS	Physical Component Summary
CES-D	Center for Epidemiological Studies-Depression
SRMs	Standardized response means
REGARDS	The REasons for Geographic and Racial Differences in Stroke

CARES	Caring for Adults Recovering from the Effects of Stroke
CSES	Cohen's standardized effect size
ASRM	Adjusted standardized response mean
ACSES	Adjusted Cohen's standardized effect size

References

1. Christensen M, Mayer S, Ferran J, Kissela B. Depressed mood after intracerebral hemorrhage: The FAST trial. *Cerebrovascular Disease*. 2009; 27:353–360.
2. Kissela B. The value of quality of life research in stroke. *Stroke*. 2006; 37:1958–1959. [PubMed: 16809553]
3. Haley WE, Allen JY, Grant JS, Clay OJ, Perkins M, Roth DL. Problems and benefits reported by stroke family caregivers: Results from a prospective epidemiological study. *Stroke*. 2009; 40:2129–2133. [PubMed: 19407230]
4. Gargano JW, Reeves MJ. for the Paul Coverdell National Acute Stroke Registry Michigan Prototype Investigators. Sex differences in stroke recovery and stroke-specific quality of life: Results from a statewide stroke registry. *Stroke*. 2007; 38:2541–2548. [PubMed: 17673706]
5. Patel MD, McKevitt C, Lawrence E, Rudd AG, Wolfe CDA. Clinical determinants of long-term quality of life after stroke. *Age and Ageing*. 2007; 36:316–322. [PubMed: 17374601]
6. Petrea RE, Beiser AS, Seshadri S, Kelly-Hayes M, Kase CS, Wolf PA. Gender differences in stroke incidence and poststroke disability in the Framingham Heart Study. *Stroke*. 2009; 40:1032–1037. [PubMed: 19211484]
7. Reeves MJ, Bushnell CD, Howard G, Gargano JW, Duncan PW, Lynch G, et al. Sex differences in stroke: Epidemiology, clinical presentation, medical care, and outcomes. *Lancet Neurology*. 2008; 7:915–926. [PubMed: 18722812]
8. Stansbury JP, Jia H, Williams LS, Vogel WB, Duncan PW. Ethnic disparities in stroke: Epidemiology, acute care, and postacute outcomes. *Stroke*. 2005; 36:374–386. [PubMed: 15637317]
9. Hinojosa MS, Rittman M, Hinojosa R. Informal caregivers and racial/ethnic variation in health service use of stroke survivors. *Journal of Rehabilitation Research and Development*. 2009; 46:233–241. [PubMed: 19533537]
10. Hackett M, Anderson C. Predictors of depression after stroke: A systematic review of observational studies. *Stroke*. 2005; 36:2296–2301. [PubMed: 16179565]
11. Müller-Nordhorn J, Nolte CH, Rosnagel K, Jungehülsing GJ, Reich A, Roll S, et al. The use of the 12-item short-form health status instrument in a longitudinal study of patients with stroke and transient ischaemic attack. *Neuroepidemiology*. 2005; 24:196–202. [PubMed: 15802924]
12. Gummesson C, Atroshi I, Ekdahl C. The disabilities of the arm, shoulder and hand (DASH) outcome questionnaire: Longitudinal construct validity and measuring self-rated health change after surgery. *BMC Musculoskeletal Disorders*. 2003; 4:11–16. [PubMed: 12809562]
13. Husted JA, Cook RJ, Farewell VT, Gladman DD. Methods for assessing responsiveness: A critical review and recommendations. *Journal of Clinical Epidemiology*. 2000; 53:459–468. [PubMed: 10812317]
14. Howard VJ, Cushman M, Pulley L, Gomez CR, Go RC, Prineas RJ, et al. The REasons for Geographic and Racial Differences in Stroke study: Objectives and design. *Neuroepidemiology*. 2005; 25:135–143. [PubMed: 15990444]
15. Melchior LA, Huba GJ, Brown VB, Reback CJ. A short depression index for women. *Educational and Psychological Measurement*. 1993; 53:1117–1125.
16. Ware JE, Kosinski M, Keller SD. A 12-item short-form health survey: Construction of scales and preliminary tests of reliability and validity. *Medical Care*. 1996; 34:220–233. [PubMed: 8628042]
17. Streiner, DL.; Norman, GR. *Health measurement scales: A practical guide to their development and use*. New York: Oxford University Press; 2008.

18. Cohen, J. Statistical power analysis for the behavioral sciences. 2. Hillsdale, NJ: Lawrence Erlbaum Associates; 1988.
19. Howard G, Safford MM, Meschia JF, Moy C, Howard VJ, Pulley L, et al. Stroke symptoms in individuals reporting no stroke or transient ischemic attack are associated with a decrease in indices of mental and physical functioning. *Stroke*. 2007; 38:2446–2452. [PubMed: 17673720]
20. Okonkwo OC, Roth DL, Pulley L, Howard G. Confirmatory factor analysis of the validity of the SF-12 for persons with and without a history of stroke. *Quality of Life Research*. 2010; 19(9): 1323–1331. [PubMed: 20567914]
21. Kessler RC, Berglund PA, Demler O, Jin R, Merikangas KR, Walters EE. Lifetime prevalence and age-of-onset distributions of DSM IV disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry*. 2005; 62:593–602. [PubMed: 15939837]
22. Roth DL, Haley WE, Wadley VG, Clay OJ, Howard G. Race and gender differences in perceived caregiver availability for community-dwelling middle-aged and older adults. *The Gerontologist*. 2007; 47:721–729. [PubMed: 18192626]

Table 1

Baseline and follow-up data for participants with and without stroke

	Stroke (<i>N</i> = 136)	Non-stroke controls (<i>N</i> = 136)
Baseline age		
<i>M</i>	71.27	69.08
SD	7.91	7.86
Gender (percent female)	69 (51%)	69 (51%)
Race (percent African American)	55 (40%)	55 (40%)
Education		
Less than high school graduate	21 (15%)	15 (11%)
High school graduate	31 (23%)	37 (27%)
Some college	37 (27%)	29 (21%)
College graduate and above	47 (35%)	55 (40%)
Living alone	37 (27%)	35 (26%)
Income		
Refused	19 (14%)	16 (12%)
Less than \$20,000	29 (21%)	26 (19%)
\$20,000–\$34,999	40 (29%)	32 (24%)
\$35,000–\$74,999	35 (26%)	48 (35%)
\$75,000 and more	13 (10%)	14 (10%)
Duration of follow-up (days)		
<i>M</i>	1231.40	1176.91
SD	519.72	785.13
Baseline CESD-4		
<i>M</i>	0.95 ^a	1.11 ^a
SD	1.82	2.08
Follow-up CESD-4		
<i>M</i>	1.88 ^a	1.16 ^a
SD	2.89	2.13
Baseline SF-12 MCS		
<i>M</i>	54.75 ^b	54.72 ^b
SD	7.73	7.13
Follow-up SF-12 MCS		
<i>M</i>	53.26 ^b	56.02 ^b
SD	10.25	7.34
Baseline SF-12 PCS		
<i>M</i>	46.49 ^b	47.54 ^b
SD	9.60	9.99
Follow-up SF-12 PCS		
<i>M</i>	40.29 ^b	45.45 ^b
SD	10.42	11.60

CESD-4 4 item Center for Epidemiological Studies Depression, *MCS* Mental Component Summary, *PCS* Physical Component Summary

^a $N = 133$,

^b $N = 126$

Table 2

Effect sizes for changes in quality of life for participants with and without stroke

	Stroke	Stroke-free controls	Group difference
CES-D			
SRM	.377	.018	.359
CSES	.513	.022	.491
ASRM	–	–	.396
ACSES	–	–	.465
MCS			
SRM	–.156	.158	–.314
CSES	–.193	.182	–.375
ASRM	–	–	–.366
ACSES	–	–	–.403
PCS			
SRM	–.587	–.228	–.359
CSES	–.647	–.208	–.438
ASRM	–	–	–.460
ACSES	–	–	–.434

SRM standardized response mean, *CSES* Cohen's standardized effect size, *ASRM* adjusted standardized response mean, *ACSES* adjusted Cohen's standardized effect size