Fatalism, Optimism, Spirituality, Depressive Symptoms, and Stroke Outcome
A Population-Based Analysis

Lewis B. Morgenstern, MD; Brisa N. Sánchez, PhD; Lesli E. Skolarus, MD, MS; Nelda Garcia, BS; Jan M.H. Risser, PhD; Jeffrey J. Wing, MPH; Melinda A. Smith, DrPh; Darin B. Zahuranec, MD, MS; Lynda D. Lisabeth, PhD

Background and Purpose—We sought to describe the association of spirituality, optimism, fatalism, and depressive symptoms with initial stroke severity, stroke recurrence, and poststroke mortality.

Methods—Stroke cases from June 2004 to December 2008 were ascertained in Nueces County, TX. Patients without aphasia were queried on their recall of depressive symptoms, fatalism, optimism, and nonorganizational spirituality before stroke using validated scales. The association between scales and stroke outcomes was studied using multiple linear regression with log-transformed National Institutes of Health Stroke Scale and Cox proportional hazards regression for recurrence and mortality.

Results—Six hundred sixty-nine patients participated; 48.7% were women. In fully adjusted models, an increase in fatalism from the first to third quartile was associated with all-cause mortality (hazard ratio, 1.41; 95% CI, 1.06–1.88) and marginally associated with risk of recurrence (hazard ratio, 1.35; 95% CI, 0.97–1.88), but not stroke severity. Similarly, an increase in depressive symptoms was associated with increased mortality (hazard ratio, 1.32; 95% CI, 1.02–1.72), marginally associated with stroke recurrence (HR, 1.22; 95% CI, 0.93–1.62), and with a 9.0% increase in stroke severity (95% CI, 0.01–18.0). Depressive symptoms altered the fatalism–mortality association such that the association of fatalism and mortality was more pronounced for patients reporting no depressive symptoms. Neither spirituality nor optimism conferred a significant effect on stroke severity, recurrence, or mortality.

Conclusions—Among patients who have already had a stroke, self-described prestroke depressive symptoms and fatalism, but not optimism or spirituality, are associated with increased risk of stroke recurrence and mortality. Unconventional risk factors may explain some of the variability in stroke outcomes observed in populations and may be novel targets for intervention.

Key Words: depression ■ fatalism ■ optimism ■ outcome ■ religion ■ spirituality ■ stroke

Fatalism, optimism, and spirituality are important psychological factors that are associated with health.1–4 Little attention has been paid to the role of these factors in stroke outcome. Potential mechanisms whereby these factors may influence stroke outcome include influencing medication adherence and behavioral strategies (eg, diet and exercise) to prevent recurrence and assertiveness in seeking acute medical care. Depression may influence the association of these psychological factors with stroke outcome because depression is clearly associated with stroke outcome5 and is also associated with these psychological factors.6–8 Depression has also been linked to vascular disease pathophysiology.9

In a population-based study, we asked subjects who had recently had a stroke to provide information on prestroke fatalism, optimism, and spirituality and examined associations with stroke outcome, including initial stroke severity, stroke recurrence, and all-cause mortality after stroke. We further wished to explore the role of prestroke depressive symptoms in the potential association of these psychological factors and the stroke outcome measures. We interviewed subjects soon after stroke and asked them to self-report their levels of prestroke fatalism, optimism, spirituality, and depressive symptoms and then estimated associations between their responses to these measures with stroke outcome.

Methods
This was a primary, prespecified analysis of the Brain Attack Surveillance in Corpus Christi (BASIC) project.
Subjects and Setting
This project was approved by the University of Michigan and both Corpus Christi Health Systems’ Institutional Review Boards. Informed consent was obtained from all subjects. Stroke cases presenting between June 2004 and December 2008 were ascertained in Nueces County, TX. The details of the BASIC methods were previously published.10 Briefly, through active and passive surveillance, BASIC ascertains all cases of acute cerebrovascular disease presenting to the emergency department or directly admitted to any of the 7 hospitals in Nueces County. Trained and certified abstractors verify stroke diagnoses based on rigorous criteria. Stroke cases are validated by neurologists using source documentation following international clinical criteria. Abstractors obtain demographic and clinical information from the medical chart.

Interview Methods
At the time of their stroke hospital admission, patients were approached and asked to participate in an in-person, structured interview. Patients unable to answer a series of orientation questions asked before the interview were excluded from this study as were patients with aphasia. Patients were queried on prestroke fatalism, optimism, spirituality, and depressive symptoms using validated scales. Bilingual abstractors conducted the interview in English or Spanish depending on patient preferences. Subjects were eligible only with their first BASIC stroke.

Scales
A description of the scales used to measure fatalism, optimism, spirituality, and depressive symptoms was previously reported.11 For each scale, an overall score was determined by summing responses to individual items. A modified version of the Mental Adjustment for Stroke Scale and the Pearlin scale was used to assess Fatalism,7,12,13 Each item in the scale was scored with a Likert scale ranging from 1, strongly agree, to 5, strongly disagree (Cronbach α=0.66). Scores can range from 8 to 40 with higher scores indicating more fatalism. Optimism was assessed with the revised Life Orientation Test.14 A Likert scale was used here as well. Items were reverse-coded such that higher scores corresponded to more optimism with possible scores ranging from 6 to 24 (Cronbach α=0.72). The nonorganizational religious items from the Strawbridge’s religiosity scale were used to assess spirituality.15 These 2 items asked about the role of religion in one’s daily activities. A Likert scale ranging from 1 (very important) to 4 (not at all important) was used. The responses were reverse-coded and summed to obtain a scale ranging from 2 to 8 with higher values indicating higher importance of spirituality. The Patient Health Questionnaire was used to evaluate depressive symptoms, a scale validated in patients with stroke and Spanish-speaking patients admitted to the hospital.16,17 Scores range from 0, no depressive symptoms, to 27, all 9 symptoms occurring daily (Cronbach α=0.82).

Identification of Initial Stroke Severity, Recurrent Stroke, and Mortality
Initial stroke severity was measured by chart abstracted presenting National Institutes of Health Stroke Scale, a previously validated measure.18 Recurrent ischemic stroke, intracerebral hemorrhage (ICH), or subarachnoid hemorrhage (SAH) was determined from BASIC surveillance. All-cause mortality was determined from the medical record for in-hospital mortality or through Texas Department of Health databases or the Social Security Death Index. All-cause mortality and recurrence were ascertained through December 31, 2009.

Statistical Analysis
Descriptive statistics were computed for demographic and clinical characteristics using means and SDs for continuous measures or frequencies and percents for categorical variables. The correlation among the fatalism, optimism, spirituality, and depressive symptoms scales was calculated as well as the skewness of the scales’ distributions.

The time until mortality was calculated by subtracting the date of the stroke from either the date of death or December 31, 2009. A similar procedure was done for time until recurrence; however, if a patient died without a recurrent stroke, then the time until recurrence was censored as of the date of death. Kaplan-Meier curves for recurrence and mortality were estimated.

The associations between individual fatalism, optimism, spirituality, and depressive symptoms scales and stroke outcome were investigated using multiple linear regression with log-transformed National Institutes of Health Stroke Scale as the dependent variable and Cox proportional hazards regression for time to recurrence or mortality. All scales were treated as continuous predictors. Measures of association, that is, percent increase in National Institutes of Health Stroke Scale or hazard ratios (HRs), were expressed as the comparison of the 75th with the 25th percentile of the continuous scale. Models were estimated without adjustment, adjusted for demographics (continuous age, sex, and ethnicity), and “fully” adjusted for demographics and clinically important outcome predictors. Clinical factors were chosen on the basis of being associated with both psychological factor (spirituality, optimism, spirituality) and the stroke outcomes as informed on the basis of exploratory bivariate analyses. Clinical factors in the models were: history of hypertension, National Institutes of Health Stroke Scale, history of stroke/transient ischemic attack (TIA), coronary artery disease, and diabetes; models of recurrence: history of stroke/TIA and diabetes; stroke severity model was smoking status. To evaluate the role of depressive symptoms on the psychological factor–outcome associations, models were estimated with additional adjustment for the depressive symptom scale as well as models to evaluate effect modification (interaction) of the psychological factor effects by depressive symptoms. Because the models included both psychological factors and depression scales as continuous predictors (and their interaction), the psychological factor effect estimates were computed among those with zero depressive symptoms and among those with a depression score of 15, the 90th percentile of the depression scores in this sample for interpretation. Influence and residual diagnostics were used to check model assumptions and fit, and cumulative sums of residuals were used to examine any potential lack of linearity between stroke outcome and the scales and continuous predictors. No violations from model assumptions were found. We conducted sensitivity analyses by adjusting models for comorbidity (operation-alized as the count of the following conditions present in the patient: hypertension, diabetes, coronary artery disease, atrial fibrillation, high cholesterol, excessive alcohol, smoker, history of stroke, congestive heart failure, end-stage renal disease, any cancer, dementia, and chronic obstructive pulmonary disease).

Results
A total of 3053 cerebrovascular patients were identified during the timeframe: 2040 ischemic stroke, 335 ICH, 57 SAH, 11 unknown, and 610 TIA. Of the events, 2439 were the first stroke captured by BASIC and eligible for this study (1623 ischemic stroke, 285 ICH, 56 SAH, 469 TIA, 6 unknown). Of these, a random sample of 1944 subjects was asked to participate in the structured interview and 1380 participated (970 ischemic stroke, 153 ICH, 28 SAH, 2 unknown, 227 TIA). Participants (13.9%) versus nonparticipants (9.5%) had significantly (P=0.04) higher rates of atrial fibrillation, but no other risk factor differences were found. After exclusions due to inability to answer orientation questions or aphasia, 795 patient interviews were available (562 ischemic stroke, 48 ICH, 11 SAH, 174 TIA). Of these, 759 patient interviews had information on the psychological factor and depressive symptom scales, but 44 patients answered questions 6 months after their stroke and were
excluded by predefined criteria, leaving 715 subjects. Because very few patients reported other ethnicities, only data from Mexican Americans or non-Hispanic whites were included for a study sample comprised of 669 patients (476 ischemic strokes, 42 ICH, 7 SAH, 144 TIA). The median (quartiles) time from stroke to interview for participants was 13.4 days (3.6–52.6). Table 1 presents the demographic and clinical characteristics of the study subjects. Excluded (N = 1380–669) participants had higher rates ($P < 0.01$) of atrial fibrillation (17.8%), high cholesterol (33.8%), and a history of stroke (28.2%) as well as being older (mean age, 73.1 years) and having a higher severity ($41.5\%$ had National Institutes of Health Stroke Scale $7$) compared with included participants. Median (interquartile range) length for follow-up for recurrence and mortality were 1128 (719–1505) and 1094 (708–1491) days, respectively. Kaplan-Meier estimates of 2-year cumulative mortality and stroke recurrence were 10.7% and 9.1%, respectively (Figure 1).

Median (interquartile range) scores for the depressive symptoms and fatalism and optimism were: depression: 4 (1–8); fatalism: 17 (13–21); and optimism: 19 (16–22). The derived spirituality scale was strongly positively skewed because $67.5\%$ of subjects obtained the highest score due to reporting strong agreement with both questions that religious or spiritual beliefs provide meaning in their life and their daily activities; scale median (interquartile range) was 8 (7–8; Figure 2).

Responses to questions about fatalism and optimism were highly but not perfectly negatively correlated ($r = -0.55$) suggesting they provide distinct information. As expected,
depression and optimism were also negatively correlated ($r = -0.31$). Depression was only moderately correlated with fatalism ($r = 0.35$).

In fully adjusted models (Table 2), an increase from the first to third quartile, that is, an interquartile range increase, of depressive symptom scores was associated with increased mortality (HR, 1.32; 95% CI, 1.02–1.72), marginally associated with risk of stroke recurrence (HR, 1.22; 95% CI, 0.93–1.62), and with a 9.0% increase in stroke severity (95% CI, 1.0%–18.0%). An interquartile range increase in fatalism was associated with increased mortality (HR, 1.41; 95% CI, 1.06–1.88) and marginally associated with increased risk of recurrence (HR, 1.35; 95% CI, 0.97–1.88; Table 2). The association between fatalism and severity was not significant. Depression may, at least in part, explain the relationship of fatalism with stroke mortality and recurrence because after adjustment for depressive symptoms, the fatalism–mortality and the fatalism–recurrence associations were attenuated and no longer significant (mortality: HR, 1.17; 95% CI, 0.85–1.62; recurrence:

<table>
<thead>
<tr>
<th>Scale</th>
<th>Mortality</th>
<th>Recurrence</th>
<th>Stroke Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crude</td>
<td>1.19 (0.94, 1.51)</td>
<td>1.32 (1.01, 1.72)</td>
<td>1.09 (1.01, 1.18)</td>
</tr>
<tr>
<td>Adjusted demographics†</td>
<td>1.45 (1.13, 1.89)</td>
<td>1.31 (0.99, 1.72)</td>
<td>1.08 (0.99, 1.17)</td>
</tr>
<tr>
<td>Fully adjusted‡</td>
<td>1.32 (1.02, 1.72)</td>
<td>1.22 (0.93, 1.62)</td>
<td>1.09 (1.00, 1.18)</td>
</tr>
<tr>
<td>Fatalism</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crude</td>
<td>1.57 (1.19, 2.09)</td>
<td>1.42 (1.02, 1.98)</td>
<td>1.05 (0.96, 1.15)</td>
</tr>
<tr>
<td>Adjusted demographics†</td>
<td>1.52 (1.15, 2.02)</td>
<td>1.43 (1.02, 1.98)</td>
<td>1.06 (0.96, 1.16)</td>
</tr>
<tr>
<td>Fully adjusted‡</td>
<td>1.41 (1.06, 1.88)</td>
<td>1.35 (0.97, 1.88)</td>
<td>1.06 (0.97, 1.17)</td>
</tr>
<tr>
<td>Fully adjusted‡ + depression</td>
<td>1.17 (0.85, 1.62)</td>
<td>1.30 (0.90, 1.87)</td>
<td>1.02 (0.93, 1.14)</td>
</tr>
<tr>
<td>Fatalism effect modification at 2 levels of depression</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression score = 0</td>
<td>1.48 (0.92, 2.37)</td>
<td>1.16 (0.69, 1.95)</td>
<td>1.02 (0.88, 1.17)</td>
</tr>
<tr>
<td>Depression score = 15</td>
<td>0.84 (0.46, 1.52)</td>
<td>1.49 (0.81, 2.75)</td>
<td>1.05 (0.87, 1.27)</td>
</tr>
</tbody>
</table>

HR indicates hazard ratio; CI, confidence interval.
*Effect estimates represent relative change in outcome per interquartile range increase in depression or fatalism.
†Demographics include: age (continuous), sex, and race–ethnicity.
‡In addition to demographics, stroke severity models included: smoking status; recurrence models included: history of stroke and diabetes; mortality models included: history of hypertension, National Institutes of Health Stroke Scale, history of stroke, coronary artery disease, and diabetes.
HR, 1.30; 95% CI, 0.90–0.87). However, the role of depression in the fatalism–stroke outcome association may be more complex, because the effect of fatalism among patients reporting zero depressive symptoms was strong and marginally significant (HR, 1.48; 95% CI, 0.92–2.37) but not significant among patients with high depression scores.

Spiritual attitude did not confer a significant effect on stroke severity, recurrence, or mortality (Table 3). Optimism was not associated with any of the stroke outcome measures, although the direction of the observed associations was toward protective effects of increased optimism on both recurrence and mortality.

The sensitivity analysis including an index of comorbidity in the models, based on N = 555, detected only a change in the association of depression and initial stroke severity, which was attenuated to a 6% increase in severity (95% CI, −5% to 16%) versus 9% in the full sample.

**Discussion**

Unconventional risk factors may explain some of the variability in stroke outcome observed in populations and may be novel targets for intervention. In this study, prestroke depressive symptoms and fatalism, but not optimism or spirituality, were associated with increased risk of stroke recurrence and mortality. The association of depressive symptoms with a 32% increase in mortality after stroke is modestly lower than that observed in populations. Whether fatalism and depression change or are modifiable through the life course remains to be determined and could impact the usefulness of these variables as targets for intervention.

Although the direction of the association of optimism with stroke outcome events was in the expected direction (ie, protective effects of optimism), our findings were neutral. Optimism has not been evaluated in stroke studies in the past but has been shown to be independently associated with reduced coronary heart disease risk. We also did not detect an association of spirituality with stroke outcome. The scale we used asked subjects about the role that spirituality had in their daily lives. We found that the overwhelming majority of subjects reported high spirituality (Figure 2). It may be difficult for patients facing an uncertain future to communicate negative feelings on spirituality even when asked about pre-stroke beliefs. In the future, studies that examine frequency of religious practice (praying or attending services) may be measures with greater variability and thus allow investigation of the association of religiosity with stroke severity.

<table>
<thead>
<tr>
<th>Table 3. The Association of Spirituality and Optimism With Initial Mortality, Stroke Recurrence, and Stroke Severity*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Spirituality</strong></td>
</tr>
<tr>
<td>Crude</td>
</tr>
<tr>
<td>Adjusted demographics†</td>
</tr>
<tr>
<td>Fully adjusted‡</td>
</tr>
<tr>
<td>Fully adjusted‡ + depression</td>
</tr>
<tr>
<td><strong>Optimism</strong></td>
</tr>
<tr>
<td>Crude</td>
</tr>
<tr>
<td>Adjusted demographics†</td>
</tr>
<tr>
<td>Fully adjusted‡</td>
</tr>
<tr>
<td>Fully adjusted‡ + depression</td>
</tr>
</tbody>
</table>

HR indicates hazard ratio; CI, confidence interval. *Effect estimates represent relative change in outcome per interquartile range increase in spirituality or optimism. †Demographics include: age (continuous), sex, and race–ethnicity. ‡In addition to demographics, mortality models included: history of hypertension, National Institutes of Health Stroke Scale, history of stroke, coronary artery disease, and diabetes; recurrence models included: history of stroke and diabetes; stroke severity models included: smoking status.
outcome. Studies examining the association of stroke and spirituality have shown mixed results. One study of 112 subjects in stroke rehabilitation found no association of spirituality with any measure of stroke recovery. 24 One study found an association of spirituality with reduced emotional distress after stroke. 25 That study suggests that spirituality may reduce depression, which has been associated with poor stroke functional recovery. 26

This article has important limitations. We asked participants to recall prestroke beliefs soon after stroke. This is subject to recall bias because the stroke event may alter one’s recall of their feelings. An alternative explanation for our findings is that poststroke rather than prestroke depression and fatalism are associated with stroke outcome. We excluded subjects with severe deficits because we previously demonstrated that proxy reports for psychological measures correlated only fairly with subject responses. 27 This means our current work speaks only to subjects with mild or moderate stroke and without aphasia. This study, although population-based, is from a single community of specific Hispanic whites: the Brain Attack Surveillance in Corpus Christi project. 28

Conclusions
This study suggests that reported prestroke fatalism and depression are associated with stroke outcome measures. Further research is needed to better clarify this relationship. Using measures of religious practice rather than spirituality to detect a possible association with stroke outcome should also be studied.

Sources of Funding
This study was funded by the National Institute of Neurological Disorders and Stroke/National Institutes of Health (R01NS38916).

Disclosures
None.

References
Fatalism, Optimism, Spirituality, Depressive Symptoms, and Stroke Outcome: A Population-Based Analysis
Lewis B. Morgenstern, Brisa N. Sánchez, Lesli E. Skolarus, Nelda Garcia, Jan M.H. Risser, Jeffrey J. Wing, Melinda A. Smith, Darin B. Zahuranec and Lynda D. Lisabeth

Stroke. published online September 22, 2011;
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2011 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/early/2011/09/22/STROKEAHA.111.625491

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Stroke can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Stroke is online at:
http://stroke.ahajournals.org/subscriptions/