Ethnic Differences in Prevalence of Post-stroke Depression

BACKGROUND: Little is known about ethnic differences in poststroke depression (PSD) in the United States. This study aims to estimate the prevalence of PSD at 90 days after first-ever stroke and to examine ethnic differences in the prevalence between Mexican Americans (MAs) and non-Hispanic whites (NHWs).

METHODS AND RESULTS: Stroke cases from 2011 to 2015 were identified from the BASIC project (Brain Attack Surveillance in Corpus Christi)—a population-based stroke surveillance study in south Texas. Participants were interviewed at the onset of stroke (baseline interview) and ≈90 days post-stroke (outcome interview). PSD was assessed by the Patient Health Questionnaire-8. Inverse probability weights were generated to account for differential attrition, and weighted logistic regression was used to investigate the association between ethnicity and PSD. The study sample consisted of 586 first-ever stroke patients who completed nonproxy baseline and outcome interviews and had depression assessment. Approximately, 60% of them were MAs, and 40% were NHWs. After accounting for attrition, the prevalence of depression at 90 days post-stroke was 30.4% for MAs (95% confidence interval, 25.0%–35.9%) and 20.7% for NHWs (95% confidence interval, 15.7%–25.7%). The crude odds of PSD in MAs was 1.69 times greater than that in NHWs (95% confidence interval, 1.13–2.51). The odds ratio decreased by 23.6% after adjustment for education (odds ratio, 1.29; 95% confidence interval, 0.82–2.02) and was further attenuated with additional adjustment for other covariates.

CONCLUSIONS: MAs had a higher prevalence of PSD at 90 days than NHWs. The ethnic difference was explained by sociodemographic and health factors, especially low educational attainment.

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WHAT IS KNOWN

- Depressive symptoms are prevalent among stroke survivors.
- Compared with whites, minority populations in the United States bear higher risks of unfavorable stroke outcomes, which might translate into a higher prevalence of poststroke depression, but population-based studies are lacking.

WHAT THE STUDY ADDS

- In this biethnic, population-based study, Mexican Americans had higher prevalence of poststroke depression at 90 days than non-Hispanic whites.
- Lower educational attainment contributed to the ethnic difference in prevalence of poststroke depression at 90 days.
- Selection bias because of differential attrition may lead to an underestimate of the association between ethnicity and poststroke depression in complete-case analysis.

Poststroke depression (PSD) is prevalent but undertreated among stroke survivors.[1,2] It was estimated by a recent meta-analysis that approximately one third of patients with stroke manifest depressive symptoms during the 5-year interval after stroke.[3] Depression after stroke is associated with additional morbidity and mortality risks and may interfere with stroke recovery.[2]

Notably, minority populations, including Hispanics, bear higher risks of stroke and more unfavorable stroke outcomes compared with whites[4–6]; however, few studies have investigated ethnic differences in the burden of PSD, and existing studies have varied in terms of measurement of PSD, study design, and data sources.[7–10] A study using health services utilization data from a national cohort of veteran patients showed that Hispanics had lower PSD diagnosis rates based on the *International Classification of Diseases–Ninth Revision* codes for depressive disorders and prescription records for antidepressants.[9] It is unclear whether this difference reflected a differential rate of diagnosis, which may be influenced by factors such as access to health care and health-seeking behaviors[11] or represented disparities in the true disease burden of PSD, given the nature of administrative data.[9,12] In addition, disease severity and some demographic characteristics, such as education and marital status, are not available in administrative data, which limits the ability to control for these potential confounders in analyses using this data source.[9]

More recent community-based clinical trials overcome some of the above noted limitations using self-report data for ascertainment of PSD. A post hoc analysis of the PRAISE study (Prevent Recurrent All-Inner City Stroke Through Education) found that the prevalence of depression on average 2 years after stroke was significantly higher among Hispanic stroke survivors than that of non-Hispanic survivors adjusted for sociodemographic and clinical risks.[7] In contrast, results of the SWIFT study (Stroke Warning Information and Faster Treatment) showed that Hispanic patients with stroke were less likely to have PSD at 1 month after stroke than non-Hispanic whites (NHW) adjusted for sociodemographic factors, stroke severity, and history of stroke; however, the difference diminished after 1 year.[8] Both of these studies were conducted in New York City, where the Hispanic population may not be representative of that in other regions of the country. As shown in the PRAISE study, more than half of the Hispanic participants were from Puerto Rico, and almost two thirds were not English speaking,[7] which limits the generalizability of the results to other Hispanic subgroups. Additionally, clinical trial participants are usually highly selective because of the inclusion and exclusion criteria for the trial, and individuals with depression may be less likely to enroll in trials resulting in an underestimation of PSD.

Selection bias and confounding are particular concerns for studies focused on the estimation of ethnic differences in PSD. Patients with severe poststroke cognitive impairment or aphasia are at a higher risk of depression; [13]however, this subgroup has typically been excluded from studies because of barriers communicating and lack of appropriate instruments for assessing PSD in these individuals.[7,14,15] Because minorities have a higher prevalence of such stroke sequelae,[5] excluding this subgroup may lead to an underestimation of ethnic differences in the prevalence of PSD. Moreover, because patients with stroke self-select to participate and drop out of research studies, using complete-case analysis may yield biased estimates when the selection process is influenced by both ethnicity and unmeasured determinants of PSD.[16] Additionally, limited data availability can result in unmeasured confounding from key variables, such as prestroke depression and functional and cognitive impairment, because these covariates are risk factors for PSD[1,2,17] and have significant ethnic differences.[5] Population-based studies, which aim to reduce selection bias and confounding, are needed to more thoroughly evaluate the presence and extent of ethnic differences in PSD.

The objectives of the present study were to (1) estimate the prevalence of PSD at 90 days after first-ever stroke, (2) examine ethnic differences in the prevalence of PSD, and (3) investigate factors that may explain the potential ethnic difference. We extend existing literature on the association of ethnicity and PSD in several critical ways including (1) the use of a large, population-based stroke study conducted in a biethnic population, focusing on Mexican Americans (MAs)—a subgroup with worse stroke outcomes that has been understudied; (2) accounting for potential differential attri-

tion because of aphasia and cognitive deficits; and (3) adjusting for important confounders of the ethnicity–PSD association.

METHODS

Study Setting

Data for the present study were obtained from the BASIC project (Brain Attack Surveillance in Corpus Christi), January 5, 2011, through December 31, 2015. BASIC is a population-based stroke surveillance study that captures stroke cases in the biethnic community of Nueces County, TX.[18] MAs composed approximately three fifths of the population in 2000, followed by NHW and other races. The MA community is nonimmigrant and representative of the broader MA population in the state.[18] Details of the study have been described elsewhere.[18,19] The data will not be made available to the public because of its restricted nature.

Study Participants

Stroke cases were identified among residents aged ≥45 years during the study period using active and passive surveillance methods. Active ascertainment includes the daily screening of admission logs for stroke-related symptoms at all hospitals, and passive ascertainment includes the review of all hospital discharges for *International Classification of Diseases–Ninth Revision* diagnoses in the range between 430 and 438.[19] Possible cases were validated by stroke fellowship trained physicians blinded to race/ethnicity. Patients with stroke were invited to participate in in-person interviews shortly after stroke occurrence (baseline interview) and ≈90 days after the index stroke (outcome interview). Proxy interviews were conducted if participants were unable to communicate.

In the present study, the analytic sample consisted of 586 first-ever stroke patients who (1) were either MA or NHW; (2) survived 90 days after stroke; (3) completed nonproxy baseline and outcome interviews, from which data on prestroke depression history and PSD data were collected, respectively; and (4) had assessment for depressive symptoms at the outcome interview. Figure 1 presents the sample construction process and sample attrition at different stages. Patients who survived 90 days after stroke but did not participate in the study (n=326), participated but did not have nonproxy baseline interview (n=233), or had nonproxy baseline interview but did not participate in the outcome interview (n=185) were excluded from the analytic sample but included in the analytic process to account for potential differential attrition (Figure 1). Patients who died before 90 days post-stroke did not contribute to the point prevalence estimates at 90 days and were, therefore, excluded from the study.

Measures

Outcome Measure: Depression at 90 Days After Stroke

The depression assessment was conducted among participants who completed the outcome interview in person. Depression at 90 days after stroke was assessed by the Patient Health Questionnaire (PHQ). The 9-item PHQ (PHQ-9) was used for participants interviewed between 2011 and 2013, and the 8-item PHQ (PHQ-8) was used for participants interviewed in 2014 and 2015 because of a protocol change. The PHQ-9 is a validated instrument based on the 9 diagnostic criteria for depressive disorder from the *Diagnostic and Statistical Manual of Mental Disorders–Fourth Edition*, including depressed mood, anhedonia, sleep problems, fatigue, appetite or weight changes, self-esteem, concentration, psychomotor retardation or agitation, and suicide ideation or self-injurious thoughts.[20] Participants were asked to rate the frequency of having each symptom in the past 2 weeks on a 4-point scale from "not at all" to "nearly every day".[21] A summative score was generated by calculating the total of the 9 questions. The score ranges from 0 to 27, with higher scores indicating more depressive symptoms. The PHQ-8, also a commonly used depression scale,[21] differs from PHQ-9 in that it does not include the item on thoughts about death and self-harm (item 9), which was used to assess suicide risk. The score, therefore, ranges from 0 to 24. Both PHQ-9 and PHQ-8 have been validated in English and Spanish.[22,23]

To make the depression measure consistent, we converted the summative scores of PHQ-9 for participants interviewed between 2011 and 2013 to PHQ-8 scores by subtracting the endorsed score of the item 9 from the total score. We dichotomized the continuous measure by classifying patients scoring ≥10 as having current depression versus no depression.

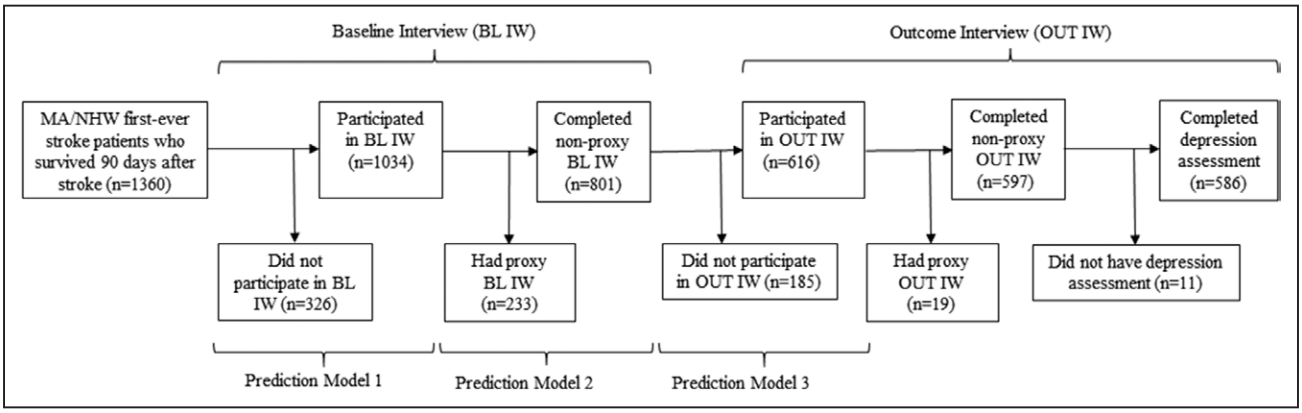

Figure 1. Study flowchart.
The BASIC study (Brain Attack Surveillance in Corpus Christi), United States, 2011 to 2015. BL IW indicates baseline interview; MA, Mexican Americans; NHW, non-Hispanic whites; and OUT IW, outcome interview.

This scoring threshold, shared by PHQ-9 and PHQ-8,[21,24] demonstrates high sensitivity and specificity for detecting depression among stroke survivors.[22]

Primary Independent Variable: Ethnicity

Information on race and ethnicity was ascertained from the baseline interview and medical records. Self-report data were considered as the primary data source, and medical records data were used only when self-report was not available. Among 1034 participants who completed the baseline interview, 99.1% self-reported race and ethnicity. Only MAs and NHWs were included in the present analysis. Other race/ethnic groups were excluded because of the small sample size.

Covariates

Three sets of variables were evaluated as potential confounders, including demographic characteristics, prestroke factors, and stroke characteristics. All covariates were assessed or ascertained at baseline.

Demographic characteristics included age, sex (men, women), educational attainment (less than high school, high school and above), marital status (married or living together, others including single, widow, and divorced/separated), and insurance status (insured, uninsured).

Prestroke factors at baseline included prestroke depression (none, depression history, current antidepressant use), cognitive function (normal, cognitive impairment no dementia, dementia), functional disability (none, mild/moderate, severe), number of medical conditions, health-risk behaviors (current smoking [yes, no] and excessive alcohol use [yes, no]), and obesity (yes, no). A participant was classified as having a depression history if he or she reported having ever been diagnosed with depression or taken antidepressants but not taking antidepressants at stroke onset. Cognition was measured by the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE), which was completed by someone who knew the patient well.[25] Participants were classified as having normal cognitive function (IQCODE≤3), cognitive impairment no dementia (3<IQCODE<3.44), or dementia (IQCODE≥3.44).[26] Prestroke disability was assessed by the modified Rankin scale (MRS),[27] which ranges from 0 to 5. We generated a 3-level ordinal variable by collapsing adjacent categories of the MRS: (1) no symptoms or disability (0–1), (2) slight or moderate disability (2–3), and (3) moderately severe or severe disability (4–5). Information on medical conditions and excessive alcohol use was ascertained from medical records (Data Supplement). Number of medical conditions was generated as a summative variable indicating the total number of comorbidities a patient had at the time of stroke occurrence (range, 0–12). Obesity was identified based on body mass index calculated using participants' weights and heights. Participants with body mass index ≥30 were classified as obese.

Stroke characteristics included stroke type (ischemic stroke, intracerebral hemorrhagic stroke) and stroke severity. Stroke severity measured using the National Institutes of Health Stroke scale (NIHSS), which ranges from 0 to 42 (higher scores indicating more severe impairment), was ascertained from medical records or calculated using previously validated methods.[28]

Statistical Analysis

We examined differences in baseline sample characteristics by ethnicity using χ^2 tests for categorical variables and Kruskal–Wallis tests for continuous variables and compared participants who remained in the study with those who did not. We explored missing data patterns and dealt with missing data using an approach combining multiple imputation and inverse probability weighting methods.[29] We used multiple imputation, specifically the fully conditional specification method, to fill in missing data from the baseline interview (Data Supplement). In the study sample, the percentage imputed was 13.1% for the IQCODE score (n=77), 4.4% for current smoking (n=26), 1.5% for prestroke depression (n=9), 1.4% for MRS (n=8), and <1.0% for NIHSS scores (n=3) and stroke type (n=1). For missing data because of loss to follow-up or inability to complete nonproxy interviews, we used an inverse probability weighting approach with bootstrapping to account for potential differential attrition. To reflect the entire stroke sample, we upweighted participants in the analytic sample who were similar to those not included in this sample for the various reasons outlined in Figure 1.[16] Weights were constructed as the reciprocal of the product of 3 probabilities: (1) probability of participating in the baseline interview, (2) probability of having a nonproxy baseline interview, and (3) probability of completing the 90-day outcome interview (Data Supplement). Stabilized weights were constructed by multiplying the nonstabilized weights by probabilities generated from a nested model with a subset of covariates (age, sex or ethnicity, depending on the prediction model).[16] Weights were trimmed at the 1st and 99th percentiles, resulting in overall weights ranging from 0.61 to 3.65.

We estimated the overall and ethnicity-specific 90-day prevalence of depression after first-ever stroke using cross-tabulations. To examine the ethnic difference in the prevalence of PSD, we first fit a weighted logistic regression model to examine the crude association. We then added each potential confounder to the crude model in separate models. The impact of each confounder on the ethnic difference was examined using the percentage change in the crude and adjusted odds ratios (ORs; calculated by subtracting the adjusted OR from the crude OR and then dividing by the crude OR). We compared the magnitude of the impact of the confounders on the association between ethnicity and PSD and selected variables that had >5% change or were associated with the outcome to fit a full model. Covariates selected for the full model included age, education, marital status, prestroke disability, prestroke depression, number of medical conditions, current smoking, and obesity at baseline. PROC SURVEYSELECT was used to perform 1000 bootstrap replications, and the bootstrap standard errors were used to compute 95% confidence intervals (CIs). PROC LOGISTIC was used to examine the racial/ethnic difference in prevalence of PSD, with a WEIGHT statement to apply the overall inverse probability weights.

To compare approaches with and without adjustment for attrition, we repeated the above steps in a complete-case analysis without application of multiple imputation and the inverse probability weighting. To examine the potential difference in using PHQ-9 and PHQ-8, we conducted a sensitivity analysis by repeating the main analysis among 2011 to 2013 participants using PHQ-9 and PHQ-8, respectively.

All statistical analyses were completed with SAS, version 9.4 (SAS Institute), and Stata, version 14.2 (StataCorp). The BASIC study was approved by the Institutional Review Boards at the University of Michigan and the 2 local hospital systems. Written informed consent was obtained from all patients.

RESULTS

Among 1360 MA or NHW first-ever stroke patients who survived 90 days after stroke, 1034 (76.0%) agreed to participate in the baseline interview, and 801 (77.5%) had a nonproxy interview. A total of 616 of 801 participants (76.9%) completed the outcome interview 3 months after stroke occurrence, with 597 (96.9%) interviewed in person. Eleven of the 597 participants (1.8%) did not have depression assessment, which yielded a sample of 586 participants who completed both baseline and outcome interviews in person (Figure 1).

Characteristics of eligible patients who refused to participate, participants who had proxy interview at baseline, and participants who did not complete the outcome interview at follow-up are presented in Tables I through III in the Data Supplement, respectively. Compared with patients who agreed to participate in the BASIC study, eligible patients who refused to participate were more likely to be NHW, have lower NIHSS scores, and have congestive heart failure (all $P<0.05$). Compared with participants who had nonproxy baseline interviews, those with proxy interviews were more likely to be older, MAs, and insured, have lower educational attainment, have more severe stroke (intracerebral hemorrhagic stroke, higher NIHSS scores, and higher scores of the MRS), have poor cognitive function (higher scores of the IQCODE, history of Alzheimer disease and dementia), and have more medical conditions (congestive heart failure, hypertension; all $P<0.05$). Compared with participants who completed the outcome interview, those lost to follow-up were more likely to be younger, men, and uninsured (all $P<0.05$).

Baseline characteristics of the study sample are presented in Table 1. The mean age was 65.9 years (standard deviation, 11.1 years). Approximately, 48.6% were women, 29.2% had educational attainment below high school, 51.2% were either married or living with a partner, and 11.4% were uninsured. In terms of stroke characteristics, 92.0% had ischemic stroke, and the mean NIHSS was 4.0 (standard deviation, 4.6). Approximately half of the sample was classified as no prestroke disability by the MRS (51.6%), and half was classified as having normal cognitive function by the IQCODE (51.9%). Compared with NHW, MAs were younger ($P<0.001$), had lower levels of education ($P<0.001$), had more medical conditions ($P=0.068$), and were more likely to have intracerebral hemorrhage ($P=0.033$), be uninsured ($P=0.069$) and obese ($P=0.002$). When asked about prestroke depression, 15.9% reported a depression history before onset of stroke but not on medication at the time of the baseline interview, and 17.5% were on antidepressants at stroke onset. There was no statistically significant ethnic difference in prestroke depression, in terms of self-reported diagnosis and medication use ($P=0.297$).

The mean score of PHQ-8 at 90 days was 7.16 for MAs and 5.54 for NHW ($P=0.009$). Without adjustment for attrition, the prevalence of depression (PHQ-8≥10) at 90 days after first-ever stroke was 26.5% in the biethnic sample (95% CI, 22.9%–30.2%), 21.3% among NHW (95% CI, 16.2%–27.1%), and 29.9% among MAs (95% CI, 25.2%–35.0%). The crude odds of PSD in MAs was 1.58 times greater than that in NHW (95% CI, 1.07–2.33). After adjustment for attrition, the ethnic difference in the prevalence estimates was widened slightly (NHW: prevalence rate, 20.7% [95% CI, 15.7%–25.7%]; MAs: prevalence rate, 30.4% [95% CI, 25.0%–35.9%]), and the crude OR of PSD increased to 1.69 (95% CI, 1.13–2.51).

In the models adjusted for each covariate individually, the OR of PSD for MAs compared with NHW decreased by 23.6%, 8.9%, and 5.3% after adjustment for education (OR for ethnicity, 1.29; 95% CI, 0.82–2.02), age (OR for ethnicity, 1.54; 95% CI, 1.02–2.31), and obesity (OR for ethnicity, 1.60; 95% CI, 1.07–2.39), respectively (Table 2; Figure 2). There was marginal change with adjustment for current smoking, prestroke disability, number of medical conditions, prestroke cognitive function, stroke type, marital status and insurance status, and almost no change after adjustment for excessive alcohol use, sex, stroke severity, and prestroke depression, respectively.

Results of the multivariable model adjusting for selected covariates and all covariates simultaneously are presented in Table 3 and Table V in the Data Supplement, respectively. The OR of PSD for MAs compared with NHW was attenuated and became nonsignificant after adjustment (selected covariates: OR, 1.14 [95% CI, 0.68–1.90]; all covariates: OR, 1.15 [95% CI, 0.68–1.95]). Factors associated with greater odds of PSD were younger age, prestroke depression, and current smoking at baseline (all $P<0.05$). The above results were in concordance with that from the complete-case analysis (Tables 2 and 3).

Among 301 participants interviewed with PHQ-9 between 2011 and 2013, MAs were more likely to have suicidal thoughts than NHW, but the difference was not statistically significant ($P=0.24$). In the sensitivity analysis comparing PHQ-9 and PHQ-8, after adjustment for attrition, the prevalence estimates were 30.7% for MAs (95% CI, 22.8%–38.5%) and 22.4% for NHW (95% CI, 15.6%–29.2%) using PHQ-9, and 29.2% for MAs (95% CI, 21.6%–36.8%) and 20.6% for NHW (95%

Table 1. Baseline Sample Characteristics by Ethnicity of 586 Participants From the Brain Attack Surveillance in Corpus Christi Study, United States, 2011 to 2015

	Total (n=586)	MA (n=351)	NHW (n=235)	*P* Value
Age, mean (SD)	65.9 (11.1)	64.6 (10.8)	67.9 (11.1)	<0.001
Sex				0.289
Men	301 (51.4)	174 (49.6)	127 (54.0)	
Women	285 (48.6)	177 (50.4)	108 (46.0)	
Education, n (%)				<0.001
Below high school	171 (29.2)	155 (44.2)	16 (6.8)	
High school	163 (27.8)	86 (24.5)	77 (32.8)	
Vocational/some college	167 (28.5)	87 (24.8)	80 (34.0)	
College or more	85 (14.5)	23 (6.6)	62 (26.4)	
Marital status, n (%)				0.697
Married/living together	300 (51.2)	182 (51.9)	118 (50.2)	
Single/separated/divorced	286 (48.8)	169 (48.1)	117 (49.8)	
Health insurance, n (%)				0.069
Insured	519 (88.6)	304 (86.6)	215 (91.5)	
Uninsured	67 (11.4)	47 (13.4)	20 (8.5)	
Stroke type,* n (%)				0.033
Ischemic stroke	538 (92.0)	315 (90.0)	223 (94.9)	
Intracerebral hemorrhagic stroke	47 (8.0)	35 (10.0)	12 (5.1)	
Stroke severity (NIHSS),* mean (SD)	4.0 (4.6)	4.0 (4.3)	3.9 (5.1)	0.297
Prestroke disability (MRS),* n (%)				0.159
No symptoms/disability (0–1)	298 (51.6)	172 (50.0)	126 (53.9)	
Slight/moderate disability (2–3)	254 (43.9)	152 (44.2)	102 (43.6)	
Moderately severe/severe disability (4–5)	26 (4.5)	20 (5.8)	6 (2.6)	
Cognitive function (IQCODE),* n (%)				0.104
Normal (0–3)	304 (51.9)	196 (55.8)	108 (46.0)	
CIND (3.01–3.43)	156 (26.6)	86 (24.5)	70 (29.8)	
Dementia (≥3.44)	49 (8.4)	29 (8.3)	20 (8.5)	
Missing	77 (13.1)	40 (11.4)	37 (15.7)	
Prestroke depression,* n (%)				0.297
None	384 (66.6)	231 (66.6)	153 (66.5)	
Depression history†	92 (15.9)	50 (14.4)	42 (18.3)	
Antidepressant use at stroke onset	101 (17.5)	66 (19.0)	35 (15.2)	
No. of medical conditions, mean (SD)	2.4 (1.5)	2.5 (1.5)	2.3 (1.5)	0.068
Health-risk behaviors, n (%)				
Current smoking*	143 (25.5)	85 (25.0)	58 (26.4)	0.718
Excessive alcohol use	49 (8.4)	26 (7.4)	23 (9.8)	0.308
Obesity				0.002
Yes	243 (41.5)	164 (46.7)	79 (33.6)	
No	343 (58.5)	187 (53.3)	156 (66.4)	

CIND indicates cognitive impairment no dementia; IQCODE, Informant Questionnaire on Cognitive Decline in the Elderly; MA, Mexican Americans; MRS, modified Rankin scale; NHW, non-Hispanic whites; and NIHSS, National Institutes of Health Stroke Scale.

*Variables with missing data. The numbers of missing values are 1 for stroke type, 3 for NIHSS, 8 for modified Rankin scale, 77 for IQCODE, 9 for history of depression and antidepressant use at baseline, and 26 for current smoking.

†A participant was classified as having a depression history if he or she reported having ever been diagnosed with depression or taken antidepressants but not taking antidepressants at stroke onset.

Table 2. Results From Logistic Regression Models of the Association Between Ethnicity and Prevalence of Poststroke Depression Adjusted for Each Covariate Individually (n=586), the Brain Attack Surveillance in Corpus Christi Study, United States, 2011 to 2015

	Adjusted for Attrition		Not Adjusted for Attrition	
	Ethnicity	Individual Covariate	Ethnicity	Individual Covariate
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Not adjusted for covariates				
Ethnicity (crude)	1.69 (1.13–2.51)	…	1.58 (1.07–2.33)	…
Ethnicity adjusted for each covariate individually				
Age	1.54 (1.02–2.31)	0.97 (0.95–0.98)	1.44 (0.97–2.14)	0.97 (0.95–0.99)
Sex	1.68 (1.13–2.51)		1.57 (1.06–2.31)	
Men		Reference		Reference
Women		1.19 (0.82–1.74)		1.24 (0.86–1.80)
Education	1.29 (0.82–2.02)		1.20 (0.78–1.85)	
Below high school		1.60 (0.96–2.68)		1.50 (0.91–2.47)
High school		Reference		Reference
Vocational/some college		0.99 (0.59–1.67)		1.00 (0.61–1.65)
College or more		0.60 (0.29–1.27)		0.51 (0.25–1.05)
Insurance status	1.67 (1.12–2.49)		1.56 (1.06–2.29)	
Insured		Reference		Reference
Uninsured		1.24 (0.71–2.14)		1.35 (0.78–2.35)
Marital status	1.70 (1.14–2.54)		1.59 (1.08–2.34)	
Married/living together		Reference		Reference
Single/separated/divorced		1.50 (1.02–2.19)		1.22 (0.84–1.76)
Stroke type	1.71 (1.14–2.56)		1.59 (1.08–2.34)	
Ischemic stroke		Reference		Reference
Intracerebral hemorrhagic stroke		0.81 (0.42–1.55)		0.99 (0.51–1.95)
Stroke severity (log-transformed NIHSS)*	1.69 (1.13–2.52)	1.13 (0.91–1.39)	1.53 (1.04–2.26)	1.25 (0.99–1.57)
Prestroke disability (MRS)*	1.63 (1.09–2.45)		1.51 (1.02–2.25)	
No symptoms/disability (0–1)		Reference		Reference
Slight/moderate disability (2–3)		1.86 (1.24–2.79)		1.90 (1.28–2.80)
Moderately severe/severe disability (4–5)		2.77 (1.27–6.07)		3.31 (1.45–7.58)
Cognitive function (IQCODE)*	1.72 (1.15–2.58)		1.85 (1.20–2.85)	
Normal (0–3)		Reference		Reference
CIND (3.01–3.43)		1.17 (0.74–1.85)		1.15 (0.74–1.80)
Dementia (≥3.44)		1.52 (0.81–2.86)		1.54 (0.80–2.97)
Prestroke depression*	1.69 (1.11–2.58)		1.57 (1.04–2.37)	
None		Reference		Reference
Depression history		2.64 (1.57–4.44)		2.53 (1.52–4.22)
Antidepressant use at stroke onset		5.56 (3.40–9.10)		5.73 (3.56–9.21)
No. of medical conditions	1.64 (1.10–2.45)	1.15 (1.02–1.29)	1.54 (1.04–2.27)	1.17 (1.04–1.32)
Current smoking*	1.75 (1.16–2.64)		1.57 (1.04–2.35)	
No		Reference		Reference
Yes		2.72 (1.80–4.13)		2.71 (1.80–4.08)
Excessive alcohol use	1.69 (1.13–2.52)		1.59 (1.08–2.34)	
No		Reference		Reference
Yes		1.22 (0.64–2.35)		1.16 (0.61–2.24)

(*Continued*)

Table 2. Continued

	Adjusted for Attrition		Not Adjusted for Attrition	
	Ethnicity	Individual Covariate	Ethnicity	Individual Covariate
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Obesity	1.60 (1.07–2.39)		1.49 (1.01–2.21)	
No		Reference		Reference
Yes		1.57 (1.07–2.31)		1.56 (1.07–2.26)

CI indicates confidence interval; CIND, cognitive impairment no dementia; IQCODE, Informant Questionnaire on Cognitive Decline in the Elderly; MRS, modified Rankin scale; NIHSS, National Institutes of Health Stroke Scale; and OR, odds ratio.

*Variables with missing data. The sample sizes of the models not adjusted for attrition are 585 for stroke type, 583 for stroke severity, 578 for prestroke disability, 509 for cognitive function, 577 for prestroke depression, and 560 for current smoking.

CI, 13.9%–27.3%) using PHQ-8. The ORs of PSD comparing MAs with NHW were 1.55 using PHQ-9 (95% CI, 0.89–2.70) and 1.61 using PHQ-8 (95% CI, 0.91–2.84).

DISCUSSION

This study examined prevalence of depression 90 days after first-ever stroke, and the association of ethnicity with the prevalence in a biethnic, population-based sample in Nueces County, TX, with adjustment for differential attrition. Among stroke survivors, MAs had a significantly higher prevalence of PSD at 90 days than NHW, with nearly a third reporting PSD. The ethnic difference was widened after accounting for attrition, and attenuated when controlling for covariates, especially educational attainment.

The overall prevalence of PSD at 90 days in the present study was in concordance with the pooled prevalence estimates of PSD at 1 to 6 months in a meta-analysis.[1] In terms of the ethnic difference in prevalence of PSD, we found that both the magnitude and significance of the association between ethnicity and PSD increased after adjustment for attrition. This result highlights the importance of accounting for selection bias and supported our hypothesis that using complete cases underestimates ethnic differences in PSD. MAs have poorer poststroke functional and cognitive outcomes than NHW and, therefore, were less likely to complete an in-person interview and have depression assessment.[5] Because there is an ethnic difference in remaining in the study sample, restricting the sample to complete cases may result in bias because of conditioning on continuation.[16] That is, when unmeasured factors associated with both continuation in the study and PSD exist, using a complete-case analysis may induce a spurious association between ethnicity and the unmea-

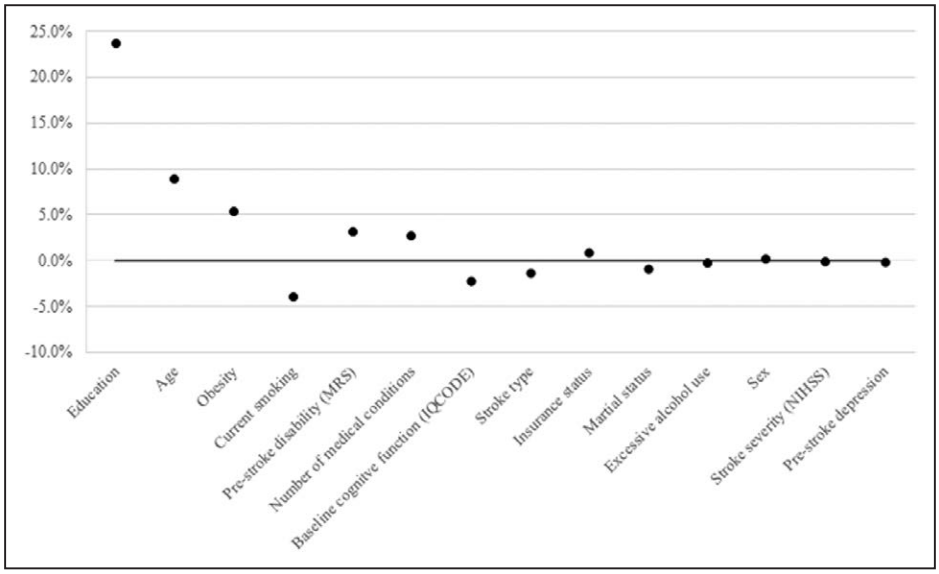

Figure 2. Effect of individual covariates on odds ratio of poststroke depression for Mexican Americans compared with non-Hispanic whites among 586 participants of the BASIC study (Brain Attack Surveillance in Corpus Christi), United States, 2011 to 2015.

Percentage change was calculated by subtracting the adjusted odds ratio from the crude odds ratio and then dividing by the crude odds ratio. IQCODE indicates Informant Questionnaire on Cognitive Decline in the Elderly; MRS, modified Rankin scale; and NIHSS, National Institutes of Health Stroke Scale.

Table 3. Results From Multivariable Logistic Regression of the Association Between Ethnicity and Prevalence of Poststroke Depression Adjusted for Selected Covariates, the Brain Attack Surveillance in Corpus Christi Study, United States, 2011 to 2015

	Adjusted for Attrition (n=586)	Not Adjusted for Attrition (n=551)
	OR (95% CI)	OR (95% CI)
Ethnicity		
Mexican Americans	1.14 (0.68–1.90)	1.12 (0.68–1.84)
Non-Hispanic whites	Reference	Reference
Age	0.97 (0.95–0.99)	0.98 (0.96–1.00)
Education		
Below high school	1.61 (0.89–2.89)	1.31 (0.74–2.32)
High school	Reference	Reference
Vocational/some college	0.94 (0.53–1.67)	0.97 (0.55–1.70)
College or more	0.62 (0.27–1.41)	0.54 (0.24–1.20)
Marital status		
Married/living together	Reference	Reference
Single/separated/divorced	1.23 (0.79–1.90)	0.99 (0.64–1.52)
Prestroke disability (MRS)		
No symptoms/disability (0–1)	Reference	Reference
Slight/moderate disability (2–3)	1.36 (0.84–2.19)	1.37 (0.87–2.17)
Moderately severe/severe disability (4–5)	1.97 (0.78–4.97)	2.04 (0.77–5.42)
Prestroke depression		
None	Reference	Reference
Depression history	2.25 (1.28–3.97)	2.03 (1.16–3.56)
Antidepressant use at stroke onset	4.61 (2.66–7.98)	4.54 (2.67–7.72)
No. of medical conditions	1.14 (0.99–1.31)	1.13 (0.98–1.31)
Current smoking		
No	Reference	Reference
Yes	2.32 (1.43–3.76)	2.51 (1.57–4.01)
Obesity		
No	Reference	Reference
Yes	1.35 (0.86–2.12)	1.21 (0.77–1.89)

CI indicates confidence interval; MRS, modified Rankin scale; and OR, odds ratio.

sured factors and result in a downward bias in association between ethnicity and PSD.[16] Although attrition because of death is common among patients with stroke, it is unlikely a threat to validity in the present study because findings from the same stroke population indicated that there were no significant differences in 30-day and 1-year mortality after ischemic stroke between MAs and NHW in 2011.[30]

Our results showed that the observed ethnic difference in prevalence of PSD at 90 days was largely explained by education. Education levels differed significantly between MAs and NHW in the study sample. The percentage of participants without high school education among MAs was six times greater than that among NHW. Evidence on the association between education and PSD is limited.[1] To the best of our knowledge, only 2 studies on ethnic differences in PSD or mental distress adjusted for educational attainment.[8,14] Our finding on the confounding influence of education is consistent with that from the National Health Interview Survey, which indicated that low levels of education partially accounted for the difference in prevalence of poststroke mental distress between Hispanics and NHW.[14]

Mechanisms of the association between education and PSD are unknown. We present 3 hypotheses. First, education is a proxy for socioeconomic status, which is associated with access to and quality of stroke treatment and poststroke rehabilitation. Patients with low socioeconomic status are more likely to have unmet health needs because of lack of economic resources and adequate insurance, which may lead to brain deficits or functional impairments and increase risks for PSD.[31] Second, education is also a proxy for cognitive reserve, which represents individuals' capacity to resist brain pathology.[32] Poststroke cognitive impairment is common among stroke survivors[33] and has been recognized as a predictor of PSD.[1] Patients with low educational attainment have less reserve to maintain cognitive function and, therefore, bear higher risk for depression. Third, because low education is associated with depression history in MAs but not in NHW,[34] future studies may investigate the interaction between ethnicity and education on PSD.

We also found that the ethnic difference in prevalence of PSD at 90 days between MAs and NHW was independent of prestroke depression history—a well-established risk factor for PSD.[2] Findings from the National Health and Nutrition Examination Survey III showed that among participants aged 15 to 40 years, MAs had a lower lifetime prevalence rate of major depressive disorder assessed by the Diagnostic Interview Schedule than whites.[34] In our study, the self-reported lifetime prevalence of prestroke depression did not differ significantly between MAs and NHW. When holding history of prestroke depression constant, MAs still had significantly higher odds of PSD than NHW. However, the results should be interpreted with caution because prevalence of depression history based on self-report can be influenced by recall bias, social disability bias, and ethnic differences in depression awareness and help-seeking behaviors.

Our finding of an ethnic difference in prevalence of PSD may not be comparable with the few existing studies for the following reasons. First, depressive symptoms were assessed at different time points after index stroke. Research on natural history of PSD has showed

that the prevalence rate changes over time, and it is not yet known whether the natural history varies by ethnicity. In the PRAISE study, time since last stroke varied across study participants and was ≈2 years on average.[7] In the SWIFT study, depressive symptoms were assessed at 1 and 12 months after stroke, respectively.[8] Second, because the prevalence of depression after first-ever stroke may differ from that after recurrent stroke, we focused on first-ever stroke patients to exclude the possibility that preexisting depression was because of previous stroke events, which is different from the existing studies. Third, our study sample is from a population-based surveillance study, which may differ from highly selected participants in clinical trials.

The study has several limitations. First, depressive symptoms of participants with stroke onset in later years were assessed using PHQ-8, which does not include the item on thoughts of death and self-harm from PHQ-9. However, endorsement of this item largely represents passive thoughts about mortality as a consequence of stroke events, instead of suicidal ideation.[22] Use of PHQ-8 is also supported by findings from the Heart and Soul Study that this item was not an accurate measure for suicide screening among patients with coronary artery disease.[35] Second, our measure of prestroke depression may classify subjects with undiagnosed prestroke depression as not having depression and thus is subject to measurement error. Third, there might be eligible patients not in the study sample that cannot be represented by the study participants, such as patients with stroke with severe aphasia and, therefore, cannot be accounted for by the inverse probability weighting approach. Fourth, because the MAs in the present study are nonimmigrants, the results may not be generalized to recent Mexican immigrants in the United States.

Despite the limitations, the study advances the literature by providing more valid estimates on the ethnic difference in prevalence of PSD using validated depression scales, applying the inverse probability weighting approach, and exploring the role of related factors in the ethnic difference. Our study suggests that low educational attainment accounts for a significant amount of the ethnic differences in PSD. In clinical settings, screening for PSD among stroke survivors should be a priority given the high prevalence in general and should particularly target patients with low education levels or low socioeconomic status, who bear a disproportionate burden of PSD. Research should further understand the mechanism through which education influences PSD. Future research with longitudinal data may also examine potential ethnic differences in the natural history of PSD, which could be helpful for planning depression prevention, allocating healthcare resources, and tailoring treatment for both stroke and depression.

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DISCLOSURES

None.

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FOOTNOTES

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Ethnic Differences in Prevalence of Post-stroke Depression

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SUPPLEMENTAL MATERIAL

Expanded Methods

1. Summative measure of medical conditions and health-risk behaviors

The medical conditions ascertained from medical records included Alzheimer's disease or dementia, coronary artery disease or myocardial infarction, atrial fibrillation, heart failure, cancer, chronic obstructive pulmonary disease, diabetes, end-stage renal disease, epilepsy, high cholesterol, hypertension, Parkinson's disease.

2. Multiple imputation

PROC MI was used to create imputed data sets. The FCS statement was used for fully conditional specification methods, because the missing data pattern was arbitrary and imputed variables include both categorical and continuous variables. More specifically, the logistic regression method was used for binary or ordinal variables (education, stroke type, the categorized Modified Rankin Scale (MRS), pre-stroke depression, current smoking, obesity). The predictive mean matching method was used for continuous variables (scores of the National Institutes of Health Stroke Scale (NIHSS), and scores of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE)). The number of imputations was set to ten, and the number of burn-in iterations before ach imputation was set to 100. Variables used for multiple imputation models included age, sex, race-ethnicity, education, marital status, insurance status, stroke type and stroke severity, medical conditions, health-risk behaviors, functional limitation, cognitive function and pre-stroke depression. PROC MIANALYZE was used to combine the results of the imputation-based analyses and make statistical inferences.

3. Inverse probability weighting

To determine predictors for generating the inverse probability weights, we fitted three prediction models using complete case analysis. Characteristics of the three samples are presented in Supplemental Tables S1-S3. Functional forms of continuous variables were determined using the LOWESS (locally weighted scatterplot smoothing) smoothed logit. Linear and squared terms of the same variable were grouped together in the backward-selection search (i.e. appeared or not appeared together). Predictors for

each model were selected based on backward stepwise logistic regression with a significance level of 0.20 for removal from the model (Supplemental Table S4).

In the first prediction model (Prediction Model 1), the probability of participating in the interview portion of the BASIC study among patients who survived 90 days after stroke was modeled as a function of race-ethnicity, insurance status, stroke severity (log-transformed NIHSS score and log-transformed NIHSS score squared) and history of congestive heart failure.

In the second prediction model (Prediction Model 2), the probability of having a non-proxy baseline interview (versus proxy interview) among participants who completed the baseline interview was modeled as a function of age, insurance status, stroke severity (log-transformed NIHSS score and log-transformed NIHSS score squared), stroke type, baseline functional limitations (MRS scores), pre-stroke cognitive function (IQCODE scores), medical conditions (Alzheimer's disease or dementia, congestive heart failure, atrial fibrillation and cancer) and excessive alcohol use.

In the third prediction model (Prediction Model 3), the probability of completing the outcome interview at 90 days among participants with non-proxy baseline interview was modeled as a function of age, sex, education, stroke severity (log-transformed NIHSS scores and log-transformed NIHSS score squared), and pre-stroke functional limitation.

Supplemental Table S1. Sample Characteristics of the Prediction Model 1

	Total (n=1360)	Patients who participated in the baseline interview (n=1034)	Patients who did not participate in the baseline interview (n=326)	*P* value
Age, mean (SD)	67.8 (12.3)	67.6 (12.1)	68.4 (12.9)	0.367
Sex, N (%)				0.709
Male	722 (53.1)	546 (52.8)	176 (54.0)	
Female	638 (46.9)	488 (47.2)	150 (46.0)	
Ethnicity, N (%)				0.008
Non-Hispanic Whites	545 (40.1)	394 (38.1)	151 (46.3)	
Mexican Americans	815 (59.9)	640 (61.9)	175 (53.7)	
Insurance status, N (%)				0.210
Uninsured	165 (12.1)	119 (11.5)	46 (14.1)	
Insured	1195 (87.9)	915 (88.5)	280 (85.9)	
Stroke type*, N (%)				0.271
Ischemic stroke	1190 (87.8)	900 (87.2)	290 (89.5)	
Intracerebral hemorrhage stroke	166 (12.2)	132 (12.8)	34 (10.5)	
Stroke severity (NIHSS)*, mean (SD)	5.5 (6.5)	5.6 (6.5)	5.1 (6.5)	<0.01
Medical conditions, N (column %)				
Dementia/Alzheimer's disease	85 (6.3)	67 (6.5)	18 (5.5)	0.533
Atrial fibrillation	163 (12.0)	121 (11.7)	42 (12.9)	0.567
Congestive heart failure	95 (7.0)	64 (6.2)	31 (9.5)	0.040
Coronary artery disease	334 (24.6)	255 (24.7)	79 (24.2)	0.875
Hypertension	1056 (77.7)	808 (78.1)	248 (76.1)	0.434
Diabetes	609 (44.8)	464 (44.9)	145 (44.5)	0.900
Cancer	156 (11.5)	120 (11.6)	36 (11.0)	0.781
COPD	116 (8.5)	84 (8.1)	32 (9.8)	0.340
Health-risk behaviors, N (column %)				
Current smoking*	316 (24.1)	236 (23.7)	80 (25.2)	0.588
Excessive alcohol use	127 (9.3)	95 (9.2)	32 (9.8)	0.734
Obesity*, N (column %)	513 (37.8)	397 (38.5)	116 (35.7)	0.362

Abbreviations: COPD, chronic obstructive pulmonary disease; NIHSS, the National Institutes of Health Stroke Scale; SD, standard deviation.
*Variables with missing data. The numbers of missing values are 4 for stroke type, 5 for NIHSS, 49 for current smoking, and 4 for obesity.

Supplemental Table S2. Sample Characteristics of the Prediction Model 2

	Total (n=1034)	Patients who had non-proxy baseline interview (n=801)	Patients who had proxy baseline interview (n=233)	*P* value
Age, mean (SD)	67.6 (12.1)	65.7 (11.2)	74.1 (12.7)	<0.001
Sex, N (%)				0.052
Male	546 (52.8)	436 (54.4)	110 (47.2)	
Female	488 (47.2)	365 (45.6)	123 (52.8)	
Ethnicity, N (%)				0.035
Non-Hispanic Whites	394 (38.1)	319 (39.8)	75 (32.2)	
Mexican Americans	640 (61.9)	482 (60.2)	158 (67.8)	
Education*, N (%)				<0.001
Below high school	346 (33.6)	243 (30.3)	103 (45.0)	
High school	288 (28.0)	235 (29.3)	53 (23.1)	
Vocational/some college	256 (24.9)	215 (26.8)	41 (17.9)	
College or more	140 (13.6)	108 (13.5)	32 (14.0)	
Marital status, N (%)				0.811
Married or living together	512 (49.6)	399 (49.8)	113 (48.9)	
Single/widowed/divorced /Separated	520 (50.4)	402 (50.2)	118 (51.1)	
Insurance status, N (%)				<0.001
Uninsured	119 (11.5)	108 (13.5)	11 (4.7)	
Insured	915 (88.5)	693 (86.5)	222 (95.3)	
Stroke type*, N (%)				<0.001
Ischemic stroke	900 (87.2)	727 (91.0)	173 (74.3)	
Intracerebral hemorrhage stroke	132 (12.8)	72 (9.0)	60 (25.7)	
Stroke severity (NIHSS)*, mean (SD)	5.6 (6.5)	4.2 (4.9)	10.5 (8.7)	<0.001
Cognitive function (IQCODE)*, mean (SD)	3.2 (0.4)	3.1 (0.3)	3.3 (0.5)	<0.001
Modified Rankin Scale*, N (%)				<0.001
0-1	472 (46.4)	408 (51.7)	64 (28.2)	
2-3	460 (45.2)	346 (43.8)	114 (50.2)	
4-5	85 (8.4)	36 (4.5)	49 (21.6)	
Medical conditions, N (column %)				
Dementia/Alzheimer’s disease	67 (6.5)	23 (2.9)	44 (18.9)	<0.001
Atrial fibrillation	121 (11.7)	88 (11.0)	33 (14.2)	0.184
Congestive heart failure	64 (6.2)	41 (5.1)	23 (9.8)	0.008
Coronary artery disease	255 (24.7)	188 (23.5)	67 (28.8)	0.100

Hypertension	808 (78.1)	615 (76.8)	193 (82.8)	0.049
Diabetes	464 (44.9)	365 (45.6)	99 (42.5)	0.406
Cancer	120 (11.6)	98 (12.2)	22 (9.4)	0.241
COPD	84 (8.1)	65 (8.1)	19 (8.2)	0.984
Health-risk behaviors, N (column %)				
Current smoking*	236 (23.7)	197 (25.6)	39 (17.5)	0.013
Excessive alcohol use	95 (9.2)	73 (9.1)	22 (9.4)	0.879
Obesity*, N (column %)	397 (38.5)	320 (40.0)	77 (33.3)	0.067

Abbreviations: COPD, chronic obstructive pulmonary disease; IQCODE, the Informant Questionnaire on Cognitive Decline in the Elderly; NIHSS, the National Institutes of Health Stroke Scale; SD, standard deviation.

*Variables with missing data. The numbers of missing values are 4 for education, 2 for stroke type, 5 for NIHSS, 17 for Modified Rankin Scale, 136 for IQCODE, 40 for current smoking, and 3 for obesity.

Supplemental Table S3. Sample Characteristics of the Prediction Model 3

	Total (n=801)	Patients who participate in the outcome interview (n=616)	Patients who did not participate in the outcome interview (n=185)	*P* value
Age, mean (SD)	65.7 (11.2)	66.2 (11.3)	63.9 (10.9)	0.015
Sex, N (%)				0.002
Male	436 (54.4)	317 (51.5)	119 (64.3)	
Female	365 (45.6)	299 (48.5)	66 (35.7)	
Ethnicity, N (%)				0.908
Non-Hispanic Whites	319 (39.8)	246 (39.9)	73 (39.5)	
Mexican Americans	482 (60.2)	370 (60.1)	112 (60.5)	
Education, N (%)				0.151
Below high school	243 (30.3)	179 (29.1)	64 (34.6)	
High school	235 (29.3)	173 (28.1)	62 (33.5)	
Vocational/some college	215 (26.8)	177 (28.7)	38 (20.5)	
College or more	108 (13.5)	87 (14.1)	21 (11.4)	
Marital status, N (%)				0.388
Married or living together	399 (49.8)	312 (50.7)	87 (47.0)	
Single/widowed/divorced or separated	402 (50.2)	304 (49.3)	98 (53.0)	
Insurance status, N (%)				0.048
Uninsured	108 (13.5)	75 (12.2)	33 (17.8)	
Insured	693 (86.5)	541 (87.8)	152 (82.2)	
Stroke type*, N (%)				0.316
Ischemic stroke	727 (91.0)	563 (91.5)	164 (89.1)	
Intracerebral hemorrhage stroke	72 (9.0)	52 (8.5)	20 (10.9)	
Stroke severity (NIHSS)*, mean (SD)	4.2 (4.9)	4.1 (4.7)	4.6 (5.6)	0.517
Cognitive function (IQCODE)*, mean (SD)	3.1 (0.3)	3.1 (0.3)	3.1 (0.3)	0.296
Functional limitation (MRS)*, N (%)				0.844
No symptoms or disability (0-1)	408 (51.7)	314 (51.7)	94 (51.4)	
Slight/moderate disability (2-3)	346 (43.8)	264 (43.5)	82 (44.8)	
Moderately severe/severe disability (4-5)	36 (4.5)	29 (4.8)	7 (3.8)	
Medical conditions, N (%)				
Dementia/Alzheimer's disease	23 (2.9)	21 (3.4)	2 (1.1)	0.096
Atrial fibrillation	88 (11.0)	69 (11.2)	19 (10.3)	0.723
Congestive heart failure	41 (5.1)	31 (5.0)	10 (5.4)	0.840
Coronary artery disease	188 (23.5)	153 (24.8)	35 (18.9)	0.096

Hypertension	615 (76.8)	476 (77.3)	139 (75.1)	0.546
Diabetes	365 (45.6)	275 (44.6)	90 (48.7)	0.337
Cancer	98 (12.2)	76 (12.3)	22 (11.9)	0.871
COPD				0.355
Health-risk behaviors, N (%)				
Current smoking*	197 (25.6)	148 (25.1)	49 (27.1)	0.592
Excessive alcohol use	73 (9.1)	51 (8.3)	22 (11.9)	0.134
Obesity*	320 (40.0)	252 (40.9)	68 (37.0)	0.337
Pre-stroke depression*, N (%)				0.395
None	532 (67.3)	403 (66.4)	129 (70.5)	
Past depression history	129 (16.3)	99 (16.3)	30 (16.4)	
Current antidepressant use	129 (16.3)	105 (17.3)	24 (13.1)	

Abbreviations: COPD, chronic obstructive pulmonary disease; IQCODE, the Informant Questionnaire on Cognitive Decline in the Elderly; MRS, modified Rankin scale; NIHSS, the National Institutes of Health Stroke Scale; SD, standard deviation.

*Variables with missing data. The numbers of missing values are 2 for stroke type, 3 for NIHSS, 11 for Modified Rankin Scale, 133 for IQCODE, 30 for current smoking, 1 for obesity, and 11 for history of depression and antidepressant use.

Supplemental Table S4. Prediction Models Based on Backward Stepwise Logistic Regression

	Prediction Model 1 (n=1298)	Prediction Model 2 (n=842)	Prediction Model 3 (n=623)
Age		0.95 (0.94, 0.97)	1.02 (1.00, 1.04)
Sex			
Male			Reference
Female			1.89 (1.24, 2.87)
Ethnicity			
Non-Hispanic Whites	Reference		
Mexican Americans	1.43 (1.10, 1.85)		
Insurance status			
Insured	Reference		
Uninsured	0.75 (0.52, 1.10)		
Stroke type			
Ischemic stroke		Reference	
Intracerebral hemorrhage stroke		0.38 (0.23, 0.62)	
Stroke severity (NIHSS)			
Log NIHSS	1.51 (1.01, 2.26)	1.55 (0.80, 2.98)	1.45 (0.76, 2.77)
Log NIHSS squared	0.91 (0.80, 1.04)	0.67 (0.55, 0.82)	0.81 (0.66, 1.01)
Cognitive function (IQCODE)			
Normal		Reference	
CIND		1.15 (0.74, 1.78)	
Dementia		0.57 (0.32, 1.03)	
Pre-stroke disability(MRS)			
No symptoms or disability (0-1)		Reference	
Slight/moderate disability (2-3)		0.62 (0.40, 0.94)	
Moderately severe/severe disability (4-5)		0.27 (0.14, 0.54)	
Medical conditions			
Dementia/Alzheimer's disease		0.29 (0.14, 0.62)	
Congestive heart failure	0.51 (0.32, 0.82)	0.57 (0.27, 1.20)	
Atrial fibrillation		1.80 (0.96, 3.40)	
Cancer		2.76 (1.39, 5.49)	
Excessive alcohol use		0.61 (0.32, 1.14)	
Obesity			1.33 (0.87, 2.04)

Abbreviations: CIND, cognitive impairment no dementia; IQCODE, the Informant Questionnaire on Cognitive Decline in the Elderly; MRS, modified Rankin scale; NIHSS, the National Institutes of Health Stroke Scale.

Supplemental Table S5. Results from the fully adjusted multivariable logistic regression of the association between ethnicity and prevalence of post-stroke depression adjusted for selected covariates, the Brain Attack Surveillance in Corpus Christi study, United States, 2011-2015.

	Adjusted for attrition (n=586) OR (95% CI)
Ethnicity	
Mexican Americans	1.15 (0.68, 1.95)
Non-Hispanic Whites	Reference
Age	0.97 (0.95, 0.99)
Sex	
Male	Reference
Female	0.99 (0.62, 1.59)
Education	
Below high school	1.55 (0.84, 2.85)
High school	Reference
Vocational/some college	0.94 (0.52, 1.70)
College or more	0.61 (0.26, 1.42)
Insurance status	
Insured	Reference
Uninsured	1.24 (0.63, 2.44)
Marital status	
Married or living together	Reference
Single/separated/divorced	1.20 (0.76, 1.90)
Stroke type	
Ischemic stroke	Reference
Intracerebral hemorrhage stroke	0.97 (0.45, 2.10)
Stroke severity (log-transformed NIHSS)	1.16 (0.90, 1.50)
Pre-stroke disability (MRS)	
No symptoms or disability (0-1)	Reference
Slight/moderate disability (2-3)	1.39 (0.85, 2.27)
Moderately severe/severe disability (4-5)	1.89 (0.72, 4.98)
Cognitive function (IQCODE)	
Normal (0-3)	Reference
CIND (3.01-3.43)	0.98 (0.56, 1.69)
Dementia (≥3.44)	1.16 (0.53, 2.49)
Pre-stroke depression	
None	Reference
Past depression history	2.33 (1.29, 4.22)
Antidepressant use at stroke onset	4.94 (2.74, 8.92)
Number of medical conditions	1.15 (0.99, 1.33)
Current smoking	
No	Reference
Yes	2.38 (1.43, 3.97)
Excessive alcohol use	
No	Reference
Yes	0.96 (0.43, 2.13)
Obesity	
No	Reference
Yes	1.34 (0.84, 2.13)