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Prevalence and correlates of depression among Black and Latino stroke survivors with uncontrolled hypertension

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Prevalence and correlates of depression among Black and Latino stroke survivors with uncontrolled hypertension

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ABSTRACT

Objective: To examine the prevalence and correlates of depression in a cohort of Black and Hispanic stroke survivors with uncontrolled hypertension.

Setting: Baseline survey data from ten stroke centers across New York City

Participants: Black and Hispanic stroke survivors with initially uncontrolled hypertension (n=450).

Outcome Measures: Depressive symptoms were assessed with the 8-item Patient Reported Outcomes Measurement Information System (PROMIS) measure. Other data collected included clinical factors, health-related quality of life (EQ-5D), functional independence (Barthel Index, BI) etc.

Results: Depressive symptoms were assessed with the 8-item Patient Reported Outcomes Measurement Information System (PROMIS) measure. Other data collected included clinical factors, health-related quality of life (EQ-5D), functional independence (Barthel Index, BI) etc. Patients with depression were more likely to have a PROMIS physical function score (36.9± 8.32 vs. 43.4± 10.19, p<0.001), BI of (79.9±19.2 vs. 88.1±15.1, p<0.001); and poorer EQ-5D score (0.66±0.24 vs. 0.83±0.17, p<0.001) compared to those without depression. Correlates of depression included high comorbidity (≥3 comorbid conditions, OR=1.49, 95% CI=1.00, 2.23); lower SBP; being unmarried (p<0.05); and foreign-born status (OR=3.34, 95% CI=1.4, 7.97).

Conclusions

Post-stroke depression is common among Black and Hispanic stroke survivors with higher rates noted among foreign-born patients and those with high comorbidity.

Trail Registration: http://www.clinicaltrials.gov. Unique identifier: NCT01070056.

Strengths and limitations of this study

- This is the first study to specifically examine post stroke depression among community dwelling minority stroke survivors' groups
- The definition of depression was based on patient self-report using interview administered validated screening tool, allowing the inclusion of undiagnosed depression
- Data was only assessed in select cohort that survived the stroke event and recovered sufficiently to be discharged to the community
- Findings can only be generalized to only Black and Hispanic community dwelling stroke survivors with uncontrolled hypertension as it did not consist of other racial groups

Introduction

Post-stroke depression (PSD) affects approximately one third of stroke survivors, either in the early or in the late stages after stroke.[1, 2] Depression among stroke survivors is often associated with long-term physical disability[3], cognitive impairments[4], and increased mortality risk.[5] At the same time, PSD remains under-diagnosed, particularly in minority populations[6]. Most studies that have evaluated PSD among community-dwelling minorities have either focused mainly on Hispanics or included very few (<25%) Black patients. [3, 7] There is a gap in the literature on the correlates of PSD in community-dwelling minorities. Early identification of this vulnerable cohort is essential to optimize post-stroke recovery and decreasing the high morbidity and mortality that is especially prevalent in minority populations post-stroke. Our study addresses this critical knowledge gap by examining the prevalence and correlates of depression among community-dwelling Black and Hispanic stroke survivors with uncontrolled hypertension.

Methods

For this analysis, we used baseline data from a clinical trial of hypertension control strategies among 450 Blacks and Hispanics with recent stroke (≈7 months after index stroke) recruited from ten stroke centers in New York City; the study design is discussed in detail elsewhere.[8] Participants were interviewed at baseline to assess depressive symptoms over the past 7 days using the validated 8-item Patient Reported Outcomes Measurement Information System (PROMIS) Depression Short Form. [9] Depression was defined as a PROMIS score ≥55, which indicates at least mild depression according to the American Psychiatric Association classification.[10] Other data collected included socio-

demographics, Charlson Comorbidity Index,[11] health-related quality of life (EQ-5D),[12] functional independence (Barthel Index),[13] physical function (PROMIS Physical Function Short Form), smoking and alcohol use was defined by self-reported current use, stroke-related disability [14] and executive functioning.[15] Variables were summarized as mean ± standard deviation (SD) for continuous variables and percentage for categorical variables. Bivariate analyses were conducted using student t-tests and chi-squared tests for continuous and categorical variables, respectively. Multivariate logistic regression was performed to assess correlates of depression by adjusting for independent risk factors significantly associated with depression in addition to potential confounders in bivariate analyses; variables not included in the adjusted models were removed because of collinearity. Statistical analyses were conducted using IBM SPSS Statistics version 25. A 2-sided $P< 0.05$ was considered statistically significant. The Institutional Review Boards (IRB) of NYU School of Medicine, Columbia University Medical Center, and Biomedical Research Alliance of New York approved this study.

Results

Participant characteristics are shown in Table 1. The 445 participants included in the study had an average age of 61.7±11.1 years, 44% were women and about half self-identified as Black. Over two thirds had low socioeconomic status with annual household income <$25,000 and half had less than high school education and majority were foreign-born (72.5%), with average length of stay in the US of 31.4 years. Thirty-two percent of the participants had PSD. In bivariate analyses, depressed patients were more likely than non-depressed patients to be female, had higher disability, lower household income, lower

systolic BP and higher comorbidity. Furthermore, patients with PSD had worse scores on executive function and on all measures of physical function including stroke-related functional disability, PROMIS physical function, functional independence and health-related quality of life (Table1)

As shown in Table 2, after adjusting for all demographics, clinical, and lifestyle variables; patients who were foreign-born (odds ratio [OR] =3.34; 95% CI: 1.40-7.97); those with three or more comorbid conditions (OR=1.49; 95%CI: 1.00 – 2.23); and older age (OR= 0.94; CI: 0.91 – 0.97) had higher odds of having depression. There was a lower odds of being depressed if participants endorsed being married or having a domestic partner (OR= 0.46; CI: 0.24 – 0.89) or reported higher quality of life (OR= 0.02; CI: 0.00 – 0.12).

Discussion

In this cohort of Black and Hispanic stroke survivors with uncontrolled hypertension, the prevalence of self-reported PSD was similar in range to the rate of post-stroke depression reported in previous studies of minority populations (20.7 – 39.3%).[7, 16] In comparison to community dwelling cohorts consisting predominantly of white stroke survivors, our cohort has a similar prevalence of PSD. Correlates of PSD included being unmarried/not living with a partner, older age, lower quality of life and higher medical comorbidity.[17]

Disparities in PSD rates are difficult to assess because of possible racial/ethnic differences in symptom endorsement and physician assessment and recognition. These factors may account for the Jia *et al.* study that showed Black and Hispanics were less likely to have a PSD diagnosis compared to their non-Hispanic white (NHW) counterparts.[6] A novel finding from our present study is that foreign-born survivors were

~3 times more likely to have PSD than their US-born counterparts. This is in contrast to prior studies that have found that foreign-born adults are less likely to suffer from depressive symptoms compared to US born participants.[18-20] For example, Sala-Wright *et al.* [28] evaluated the prevalence and co-morbidity of mental disorders, including depression, among immigrants to the US. They found that immigrants were significantly less likely than US-born individuals to meet criteria for a lifetime disorder (AOR = 0.63, 95% CI = 0.57–0.71) or to report parental history of psychiatric problems.[20] This may be because the rates of depression among this group are underdiagnosed or under-reported due to differences in health care access and utilization or cultural factors (e.g., stigma related to mental health disorders). Alternatively, lower rates of depression may reflect protective factors related to one's native country and culture. Foreign-born participants in our study had been in the U.S. for a mean of 31 years, so it is possible that acculturation to the U.S. reduced any such protective factors. This is a finding that needs to be evaluated because PSD would be expected to be associated with the burden that immigrants suffer from including; social isolation, difficulty navigating the health system leading to lack of access to care.

There were several limitations to this study. The diagnosis of PSD is most appropriately based on a structured mental state exam and DSM-IV criteria; however, this is difficult to perform in most clinical trials. We did not collect data on history of depression prior to the index stroke or on depression treatment. We only assessed data in the select cohort that survived the stroke event and recovered sufficiently to be discharged to the community. Finally, the findings cannot be generalized to other racial/ethnic groups

because this cohort consisted exclusively of Black and Hispanic community dwelling stroke survivors with uncontrolled hypertension.

Our study also had several important strengths. In previous studies that have evaluated PSD among minorities, Blacks were usually under-represented despite being most at risk for poor stroke outcomes.[6, 7] Unlike these studies, we included a large cohort of Black and Hispanic community-dwelling stroke survivors, and the majority of participants were foreign-born. The definition of depression was based on patient self-report using interview administered validated screening tool, not clinical reporting, allowing us to include undiagnosed depression.

Conclusions

PSD is common among Black and Hispanic stroke survivors with potential for dire post-stroke outcomes, including mortality. Such high rate of depression mandates screening of minority stroke survivors for depressive symptoms in order to capture the full burden of the disease in this vulnerable community. Early intervention on PSD should improve recovery and reduce morbidity and mortality related to stroke. The finding of a higher odds for PSD in foreign-born survivors is novel and warrants further research to replicate the findings, assess long-term effects of PSD in this population, and ascertain whether specific tailored depression interventions should be tested.

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Patient and Public Involvement

No patients or the public were involved in the study protocol design, the specific aims or research questions development, or in developing plans for recruitment, design, or implementation

Disclosures

None

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Tables

Table 1 Cohort characteristics

Variables	Total (n= 445)	Without Depression (n= 301, 67.6%)	With Depression (n= 144, 32.4%)	*P* Value
Socio-demographics				
Age, mean (SD)	61.7 (11.1)	61.8 (11.4)	61.4 (10.4)	0.731
Female, n, (%)	196 (44.0)	118 (39.2)	78 (54.2)	0.003
Race, n (%)				0.169
Black, non-Hispanic	228 (51.2)	161 (53.5)	67 (46.5)	
Hispanic	217 (48.8)	140 (46.5)	77 (53.5)	
Married/domestic partnership, n (%)	187 (42.1)	137 (45.7)	50 (34.7)	0.174
Less than high school education, n (%)	208 (49.3)	136 (47.7)	72 (52.6)	0.458
Annual household income <$25,000, n (%)	233 (72.6)	149 (68.3)	84 (81.6)	0.011
Foreign-born, n (%)	321 (72.5)	209 (69.9)	112 (77.8)	0.078
Length of stay in the US, n (%)	31.4 (15.0)	30.2 (14.7)	33.4 (15.6)	0.130
Clinical and lifestyle				
Systolic blood pressure, mean (SD)	149.18 (14.82)	150.43 (15.87)	146.58 (11.79)	0.005
Diastolic blood pressure, mean (SD)	87.91 (12.54)	88.28 (12.89)	87.14 (11.79)	0.370
Charlson Comorbidity index, n (%)				0.014
0 comorbid conditions	88 (19.8)	66 (22.0)	22 (15.3)	
1-2 comorbid conditions	220 (49.5)	155 (51.7)	65 (45.1)	
≥3 comorbid conditions	136 (30.6)	79 (26.3)	57 (39.6)	
EuroQol (EQ-5D), mean (SD)	0.77 (0.21)	0.83 (0.17)	0.66 (0.24)	<0.001
Barthel Index, mean (SD)	85.43 (16.96)	88.06 (15.14)	79.93 (19.15)	<0.001
PROMIS Physical Function, mean (SD)	41.30 (10.09)	43.42 (10.19)	36.89 (8.32)	<0.001
Modified Rankin Score, mean (SD)	1.67 (1.05)	1.46 (1.01)	2.10 (1.00)	<0.001
Frontal Assessment Battery, mean (SD)	13.37 (3.54)	13.69 (3.37)	12.68 (3.81)	0.010
Smoking, n (%)	63 (14.5)	41 (14.0)	22 (15.6)	0.807
Alcohol use, n (%)	129 (29.7)	99 (33.9)	30 (21.1)	0.006

Table 2. Cross-sectional predictors of depression among Blacks and Hispanics stroke survivors with uncontrolled hypertension[1]*

		Unadjusted Model			Adjusted for Demographics (n=307)			Adjusted for Demographics, Clinical, and Lifestyle Factors (n=296)	
	N	OR	95% CI		OR	95% CI		OR	95% CI
Age	445	1.00	(0.98,	1.01)	0.96	(0.94,	0.99)	0.94	(0.91, 0.97)
Female	445	1.83	(1.23,	2.74)	1.36	(0.79,	2.36)	1.37	(0.72, 2.64)
Black, non-Hispanic	445	0.76	(0.51,	1.13)					
Hispanic	445	1.32	(0.89,	1.97)	1.27	(0.69,	2.36)	0.65	(0.31, 1.36)
Systolic blood pressure	445	0.98	(0.97,	.99)				0.98	(0.96, 1.00)
Diastolic blood pressure	445	0.99	(0.98,	1.01)					
Married / Domestic partnership	444	0.63	(0.42,	0.96)	0.51	(0.20	0.89)	0.46	(0.24, 0.89)
Less than HS education	422	1.21	(0.81,	1.83)					
High school diploma / GED	422	0.99	(0.64,	1.54)					
Employed / Self-employed	438	0.28	(0.14,	.55)	0.18	(0.07,	0.50)	0.44	(0.15, 1.35)
Unemployed / Not working	438	1.10	(0.56,	2.17)					
Stroke type: Ischemic	424	1.25	(0.77,	2.03)				0.79	(0.38, 1.64)
EuroQol Index (EQ-5D)	445	0.02	(0.01,	0.06)				0.02	(0.00, 0.12)
Barthel Index	445	0.97	(0.96,	0.98)					
Foreign born	443	1.51	(0.95,	2.40)	2.29	(1.11,	4.70)	3.34	(1.40, 7.97)
Modified Rankin Score	444	1.39	(1.22,	1.58)					
PROMIS Physical Function	444	0.93	(0.91,	0.95)				0.97	(0.93, 1.01)
Categorized Charlson Comobidity	444	1.51	(1.13,	2.03)				1.49	(1.00, 2.23)
Frontal Assessment Battery	418	0.92	(0.87,	0.98)				0.94	(0.84, 1.05)

[1] Odds Ratio with 95% Confidence Interval in predicting PSD

* Variables not included in the adjusted models were removed because of collinearity

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ABSTRACT

Objective: To examine the prevalence and correlates of depression in a cohort of Black and Hispanic stroke survivors with uncontrolled hypertension.

Setting: Baseline survey data from ten stroke centers across New York City.

Participants: Black and Hispanic stroke survivors with uncontrolled hypertension (n=450).

Outcome Measures: Depressive symptoms were assessed with the 8-item Patient Reported Outcomes Measurement Information System (PROMIS) measure. Depression was defined as a PROMIS score ≥55. Other data collected included clinical factors, health-related quality of life (EQ-5D), functional independence (Barthel Index, BI), stroke-related disability (Modified Rankin Score), physical function (PROMIS Physical Function), and executive functioning (Frontal Assessment Battery).

Results: The mean age was 61.7±11.1 years, 44% of participants were women and 51% were Black. Post-stroke depression was noted in 32% of the cohort. Examining bivariate relationships, patients with depression were observed to have poorer function and quality of life as evidenced by significantly lower PROMIS physical function scores (36.9± 8.32 vs. 43.4± 10.19, p<0.001); BI scores (79.9±19.2 vs. 88.1±15.1, p<0.001); EQ-5D scores (0.66±0.24 vs. 0.83±0.17, p<0.001) and higher Rankin scores (2.10±1.00 vs. 1.46±1.01, p<0.001) compared to those without depression. Multivariate (model-adjusted) significant correlates of depression included lower self-reported quality of life (OR=0.02 (CI=0.004, 0.12) being younger (OR=0.94; 95% CI=0.91, 0.97); not married (OR=0.46; CI=0.24, 0.89)); and foreign-born (OR=3.34, 95% CI=1.4, 7.97). There was a trend for higher

comorbidity to be uniquely associated with depression (≥3 comorbid conditions, OR=1.49, 95% CI=1.00, 2.23).

Conclusions: Post-stroke depression is common among Black and Hispanic stroke survivors with higher rates noted among foreign-born patients and those with high comorbidity. These findings highlight the importance of screening for depression in minority stroke survivors.

Trial Registration: http://www.clinicaltrials.gov. Unique identifier: NCT01070056.

Strengths and limitations of this study

- This is the first study to specifically examine post stroke depression among community dwelling minority stroke survivors.
- The definition of depression was based on patient self-report using an interview administered validated screening tool, allowing the inclusion of undiagnosed depression.
- Data was only assessed in select cohort that survived the stroke event and recovered sufficiently to be discharged to the community.
- Findings can only be generalized to Black and Hispanic stroke survivors as it did not consist of other minority groups.

Introduction

Post-stroke depression (PSD) affects approximately one third of stroke survivors, either in the early or in the late stages after stroke.[1, 2] Depression among stroke survivors is associated with long-term physical disability[3], cognitive impairments[4], and increased mortality risk.[5] At the same time, PSD remains under-diagnosed, particularly in minority populations[6] and little is known about correlates of PSD in community-dwelling minorities. Most studies that have evaluated PSD among minorities have either focused mainly on Hispanics or included very few (<25%) Black patients. [3, 7] Early identification of depression in this vulnerable cohort is essential to optimize post-stroke recovery and decrease the high morbidity and mortality that is especially prevalent in minority populations post-stroke. Our study addresses this critical knowledge gap by examining the prevalence and correlates of depression among community-dwelling Black and Hispanic stroke survivors with uncontrolled hypertension.

Methods

Sample: For these analyses, we used baseline data from a clinical trial of hypertension control strategies among 450 Blacks and Hispanics with recent stroke (≈7 months after index stroke) recruited from ten stroke centers in New York City; the study design is discussed in detail elsewhere.[8] The Institutional Review Boards (IRB) of NYU Grossman School of Medicine, Columbia University Medical Center, and Biomedical Research Alliance of New York approved this study. All participants provided informed consent before inclusion in the study.

Measures: Participants were interviewed at baseline to assess depressive symptoms over the past 7 days using the 8-item Patient Reported Outcomes Measurement Information System (PROMIS) Depression Short Form. [9] This measure has been found to perform well among ethnically diverse groups, evidencing little differential item functioning of high magnitude.[10] Internal consistency and unidimensionality estimates for the continuous PROMIS Depression scale for the current sample were high (ordinal alpha = 0.949; McDonald's Omega total = 0.949; Explained Common Variance = 84.199). Depression was defined as a PROMIS score ≥55, which indicates at least mild depression according to the American Psychiatric Association classification.[11] Other data collected included sociodemographic factors, current smoking and alcohol use, Charlson Comorbidity Index,[12] health-related quality of life (EQ-5D),[13] functional independence (Barthel Index),[14] physical function (PROMIS Physical Function Short Form)[15], stroke-related disability (Modified Rankin Score)[16] and executive functioning (Frontal Assessment Battery).[17]

Statistical Approach: Variables were summarized as mean ± standard deviation (SD) for continuous variables and percentage for categorical variables. Bivariate analyses were conducted using student t-tests and chi-squared tests for continuous and categorical variables, respectively. Multivariate logistic regression was performed to assess correlates of depression by adjusting for independent risk factors significantly associated with depression in addition to potential confounders in bivariate analyses; variables not included in the adjusted models were removed because of collinearity.

The primary analyses were performed examining blood pressure using 10 mm Hg units. Logistic regression analyses were performed using generalized estimating equations assuming a binomial distribution with a logit link and robust estimates for variance. The motivation was to produce odds ratios as measures of association. These are appropriate summary statistics if they are not interpreted as relative risks [18].

The assumption of linearity between the logit and the continuous predictor was examined using the Box-Tidwell Test.[19] This test was performed by obtaining the natural log of the continuous predictor and adding an interaction between the continuous predictor and its natural log variable to the logistic model. A significant interaction term is indicative of a violation of this assumption (non-linearity). The only predictor found to violate this assumption at the univariate level was the Modified Rankin Scale. This scale was previously removed from further analysis because of collinearity with other predictors. No violations were observed in the other two models.

Several sensitivity analyses were performed. The first was to treat depression as continuous and perform a linear regression predicting PROMIS Depression. Additionally, prevalence ratio statistics were estimated using several methods described in the text. Prevalence ratios were computed directly using three different methods as described by Barros and Hirakata[20]; and Coutinho *et al.*[21] The first method used was the log-binomial method (assumes a binomial distribution with a log link). The second method was interval censored survival analysis using a binomial distribution with a complementary log-log link (used in place of Cox Proportional Hazards). The third method was to use Poisson

regression with a log link. Robust estimates for the variances were used in all of the analysis.

Sensitivity analyses was also performed examining the possible influence of missing data on the results. The EM algorithm was used to impute missing data in the covariates, with the imputed data entered into the linear and logistic regressions. Statistical analyses were conducted using IBM SPSS Statistics version 25. A 2-sided P< 0.05 was considered statistically significant.

Patient and Public Involvement: No patients or the public were involved in the study protocol design, the specific aims or research questions development, or in developing plans for recruitment, design, or implementation

Results

Participant characteristics are shown in Table 1. The 445 participants included in the study had an average age of 61.7±11.1 years, 44% were women and about half self-identified as Black. Socioeconomic status was low, with over two-thirds reporting annual household income <$25,000 and half completing less than high school education. Majority were foreign-born (72.5%), with average length of US residence of 31.4 years.

Thirty-two percent of participants had PSD. In bivariate analyses, a significantly larger proportion of patients classified as depressed patients as contrasted with those classified as non-depressed were female, and reported lower annual household income. Those

classified as depressed reported a significantly lower quality-of-life, and higher levels of disability as measured by the Barthel Index, the PROMIS physical function scale and the modified Rankin, which measured stroke-related functional disability. Those classified as depressed evidenced lower systolic BP and higher comorbidity. Furthermore, patients with PSD had worse scores on the Frontal Assessment Battery measuring executive function (Table1).

As shown in Table 2, after adjusting for all demographics, clinical, and lifestyle variables; patients who were foreign-born (odds ratio [OR] =3.34; 95% CI: 1.40-7.97) evidenced higher odds of depression than those who were born in the United States those who were married or reported having a domestic partner (OR = 0.46; 95% CI: 0.24, 0.89) and those who were older (OR= 0.94; CI: 0.91 – 0.97) had lower odds of depression than their unmarried and younger counterparts. There was a lower odds of being depressed if participants reported higher quality of life (OR= 0.02; CI: 0.004 – 0.12). There was a trend for higher comorbidity to be uniquely associated with depression (≥3 comorbid conditions, OR=1.49, 95% CI=1.00, 2.23). Sensitivity analyses treating missing data using mean imputation for the logistic regression yielded consistent results with the main analysis with the exception of PROMIS physical function, which evidenced a significant association with depression with the imputed data, but not in the main analysis (results not shown). For example, the OR estimate for foreign born in the sensitivity analyses treating missing data was 2.79, 95% CI=1.50, 6.34; p<0.002.

Sensitivity analyses with a continuous depression outcome identified similar results (Table 3). The only difference was that being married was not a predictor of depression in the linear regression, but was in the logistic regression (see Table 3). Additionally, there was a trend (p=0.054) for Hispanics to evidence lower depression. Using mean imputation for the linear regression yielded consistent results with the linear regression above.

Tables 4 and 5 show the prevalence ratios for the bivariate associations using three methods (Table 4) and the multivariate results using only two methods (Table 5) due to lack of convergence for the log-binomial approach. Again, results were similar to those of the primary analyses, with age, marital status, foreign born status and quality-of-life emerging as the significantly, uniquely associated with the post-stroke depression classification.

Discussion

In this cohort of Black and Hispanic stroke survivors with uncontrolled hypertension, the prevalence of self-reported PSD was 32%. This is similar to the rate of PSD reported in cohorts of predominantly white stroke survivors and in previous studies of minority populations (20.7 – 39.3%), including those in sub-Saharan Africa.[7, 22, 23] Independent correlates of PSD included being foreign-born, being unmarried/not living with a partner, older age and lower health-related quality of life.[24]

Disparities in PSD rates are difficult to assess because of possible racial/ethnic differences in symptom endorsement and physician assessment and recognition. These factors may account for the Jia *et al.* study that showed Black and Hispanics were less likely to have a PSD diagnosis compared to their non-Hispanic white (NHW)

counterparts.[6] A novel finding from our present study is that the multivariate analyses identified a significant association of foreign-born status and self-reported PSD. This is in contrast to prior studies that have found that foreign-born adults are less likely to suffer from depressive symptoms compared to US born participants.[25-27] For example, Sala-Wright *et al.* [27] evaluated the prevalence and co-morbidity of mental disorders, including depression, among immigrants to the US. They found that immigrants were significantly less likely than US-born individuals to meet criteria for a lifetime disorder (AOR = 0.63, 95% CI = 0.57–0.71) or to report parental history of psychiatric problems.[27] This may be because the rates of depression among this group are underdiagnosed or under-reported due to differences in health care access and utilization or cultural factors (e.g., stigma related to mental health disorders). Alternatively, lower rates of depression may reflect protective factors related to one's native country and culture. Foreign-born participants in our study had been in the U.S. for a mean of 31 years, so it is possible that acculturation to the U.S. reduced any such protective factors. This is a finding that needs to be evaluated because many of the challenges immigrants experience, including social isolation and difficulty navigating the healthcare system, would be expected to be associated with PSD.

There were several limitations to this study. The diagnosis of PSD is most appropriately based on a structured exam and DSM-IV criteria; however, this is difficult to perform in most clinical trials. We did not collect data on history of depression prior to the index stroke or on depression treatment. We only assessed data in the select cohort that survived the stroke event and recovered sufficiently to be discharged to the community. The cross-sectional design limits interpretations about causality. In particular, the direction of the association between PSD and health-related quality of life cannot be determined.

Finally, the findings cannot be generalized to other racial/ethnic groups or to the population of stroke survivors in general because this cohort consisted exclusively of Black and Hispanic community dwelling stroke survivors with uncontrolled hypertension recruited from one geographic area.

Our study also had several important strengths. In previous studies that have evaluated PSD among minorities, Blacks were usually under-represented despite being most at risk for poor stroke outcomes.[6, 7] Unlike these studies, we included a large cohort of Black and Hispanic community-dwelling stroke survivors, and the majority of participants were foreign-born. The definition of depression was based on patient self-report using interview administered validated screening tool, not clinical reporting, allowing us to include undiagnosed depression.

Conclusions

PSD is common among Black and Hispanic stroke survivors with potential for dire post-stroke outcomes, including mortality. Such high rates of depression mandate screening of minority stroke survivors for depressive symptoms in order to capture the full burden of the disease in this vulnerable community. Early intervention on PSD could improve recovery and reduce morbidity and mortality related to stroke. The finding of a higher odds for PSD in foreign-born survivors is novel and warrants further research to replicate the findings, assess long-term effects of PSD in this population, and ascertain whether specific tailored depression interventions should be tested. Such efforts could improve disparities in post-stroke health outcomes affecting understudied and underserved minority populations.

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Contributors

AOO, SKW, JAT, OW, GO and TMS were involved in the conception and design of the study, interpreted the data and drafted the manuscript. JPE and JAT analyzed the data and prepared the tables. AOO, SKW, JJ, DO were involved in data collection and reviewed the literature. All authors critically reviewed and approved the final version of the manuscript for publication.

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Competing interests

None declared

Data availability statement

All data relevant to the study are included in the article or uploaded as supplementary information.

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Tables

Table 1 Cohort characteristics

Variables	Total (n= 445)	Without Depression (n= 301, 67.6%)	With Depression (n= 144, 32.4%)	*P* Value
Socio-demographics				
Age, mean (SD)	61.7 (11.1)	61.8 (11.4)	61.4 (10.4)	0.731
Female, n, (%)	196 (44.0)	118 (39.2)	78 (54.2)	0.003
Race, n (%)				0.169
Black, non-Hispanic	228 (51.2)	161 (53.5)	67 (46.5)	
Hispanic	217 (48.8)	140 (46.5)	77 (53.5)	
Married/domestic partnership, n (%)	187 (42.1)	137 (45.7)	50 (34.7)	0.174
Less than high school education, n (%)	208 (49.3)	136 (47.7)	72 (52.6)	0.458
Annual household income <$25,000, n (%)	233 (72.6)	149 (68.3)	84 (81.6)	0.011
Foreign-born, n (%)	321 (72.5)	209 (69.9)	112 (77.8)	0.078
Length of stay in the US, n (%)	31.4 (15.0)	30.2 (14.7)	33.4 (15.6)	0.130
Clinical and lifestyle				
Systolic blood pressure, mean (SD)	149.18 (14.82)	150.43 (15.87)	146.58 (11.79)	0.005
Diastolic blood pressure, mean (SD)	87.91 (12.54)	88.28 (12.89)	87.14 (11.79)	0.370
Charlson Comorbidity index, n (%)				0.014
0 comorbid conditions	88 (19.8)	66 (22.0)	22 (15.3)	
1-2 comorbid conditions	220 (49.5)	155 (51.7)	65 (45.1)	
≥3 comorbid conditions	136 (30.6)	79 (26.3)	57 (39.6)	
EuroQol (EQ-5D)(higher score indicates best health), mean (SD)	0.77 (0.21)	0.83 (0.17)	0.66 (0.24)	<0.001
Barthel Index (higher score indicates greater independence), mean (SD)	85.43 (16.96)	88.06 (15.14)	79.93 (19.15)	<0.001
PROMIS Physical Function (higher score indicates greater functional ability), mean (SD)	41.30 (10.09)	43.42 (10.19)	36.89 (8.32)	<0.001
Modified Rankin Score (higher score indicates greater disability), mean (SD)	1.67 (1.05)	1.46 (1.01)	2.10 (1.00)	<0.001
Frontal Assessment Battery (higher score indicates better performance), mean (SD)	13.37 (3.54)	13.69 (3.37)	12.68 (3.81)	0.010
Smoking, n (%)	63 (14.5)	41 (14.0)	22 (15.6)	0.807
Alcohol use, n (%)	129 (29.7)	99 (33.9)	30 (21.1)	0.006

Table 2. Cross-sectional predictors of depression among Blacks and Hispanics stroke survivors with uncontrolled hypertension[1]*

	Unadjusted Model			Adjusted for Demographics (n=307)		Adjusted for Demographics, Clinical, and Lifestyle Factors (n=278)	
	N	OR	95% CI	OR	95% CI	OR	95% CI
Age	445	1.00	(0.98, 1.01)	**0.96**	**(0.94, 0.99)**	**0.94**	**(0.91, 0.97)**
Female	445	**1.83**	**(1.23, 2.74)**	1.36	(0.79, 2.36)	1.37	(0.72, 2.64)
Black, non-Hispanic	445	0.76	(0.51, 1.13)				
Hispanic	445	1.32	(0.89, 1.97)	1.27	(0.69, 2.36)	0.65	(0.31, 1.36)
Systolic blood pressure (per 10 mm Hg unit rise)	445	**0.82**	**(0.71, 0.95)**			0.83	(0.68, 1.01)
Diastolic blood pressure (per 10 mm Hg unit rise)	445	0.93	(0.80, 1.09)				
Married / Domestic partnership	444	**0.63**	**(0.42, 0.96)**	**0.51**	**(0.20 0.89)**	**0.46**	**(0.24, 0.89)**
Less than HS education	422	1.21	(0.81, 1.83)				
High school diploma / GED	422	0.99	(0.64, 1.54)				
Employed / Self-employed	438	**0.28**	**(0.14, .55)**	**0.18**	**(0.07, 0.50)**	0.44	(0.15, 1.35)
Unemployed / Not working	438	1.10	(0.56, 2.17)				
Stroke type: Ischemic	424	1.25	(0.77, 2.03)			0.79	(0.38, 1.64)
EuroQol Index (EQ-5D) (higher score indicates best health)	445	**0.02**	**(0.01, 0.06)**			**0.02**	**(0.004, 0.12)**
Barthel Index (higher score indicates greater independence)	445	**0.97**	**(0.96, 0.98)**				
Foreign born	443	1.51	(0.95, 2.40)	**2.29**	**(1.11, 4.70)**	**3.34**	**(1.40, 7.97)**
Modified Rankin Score (higher score indicates greater disability)	444	**1.39**	**(1.22, 1.58)**				
PROMIS Physical Function (higher score indicates greater functional ability)	444	**0.93**	**(0.91, 0.95)**			0.97	(0.93, 1.01)
Categorized Charlson Comobidity	444	**1.51**	**(1.13, 2.03)**			1.49	(1.00, 2.23)
Frontal Assessment Battery (higher score indicates better performance)	418	**0.92**	**(0.87, 0.98)**			0.94	(0.84, 1.05)

[1] Odds Ratio with 95% Confidence Interval in predicting PSD

* Variables not included in the adjusted models were removed because of collinearity

Significant relationships are bolded.

Table 3. Sensitivity analysis using linear regression predicting continuous PROMIS depression (n=278)

	Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
	B	Std. Error	Beta	t	p-value	Lower Bound	Upper Bound
(Constant)	82.624	7.315		11.295	<0.001	68.220	97.028
Age	**-0.143**	**0.051**	**-0.167**	**-2.781**	**0.006**	**-0.244**	**-0.042**
Female	0.682	1.140	0.035	0.598	0.550	-1.562	2.926
Hispanic	-2.336	1.209	-0.120	-1.932	0.054	-4.717	0.044
Systolic blood pressure (per 10 mm Hg unit rise)	-0.279	0.329	-0.044	-0.847	0.398	-0.927	0.370
Married / Domestic partnership	-1.051	1.124	-0.054	-0.934	0.351	-3.264	1.163
Employed / Self-employed	-1.802	1.397	-0.077	-1.290	0.198	-4.553	0.948
Stroke type: Ischemic	1.144	1.213	0.051	0.944	0.346	-1.244	3.532
EuroQol Index (EQ-5D) (higher score indicates best health)	**-18.974**	**2.969**	**-0.418**	**-6.391**	**<0.001**	**-24.820**	**-13.128**
Foreign born	**3.466**	**1.345**	**0.159**	**2.578**	**0.010**	**0.818**	**6.113**
PROMIS Physical Function (higher score indicates greater functional ability)	-0.115	0.068	-0.120	-1.682	0.094	-0.249	0.020
Categorized Charlson Comobidity	0.522	0.763	0.039	0.684	0.495	-0.981	2.024
Frontal Assessment Battery (higher score indicates better performance)	-0.037	0.177	-0.013	-0.208	0.836	-0.386	0.312

Table 4. Cross-sectional predictors of depression among Blacks and Hispanics stroke survivors with uncontrolled hypertension [Bivariate results]

	Logistic Regression (binomial distribution with logit link)				Log-binomial (Binomial distribution with log link)			Interval censored survival (binomial distribution with Complementary Log-log link)			Poisson distribution with log link		
	N	OR[1]	95% CI		PR[2]	95% CI		PR[2]	95% CI		PR[2]	95% CI	
Age	445	1.00	(0.98,	1.01)	1.00	(0.99,	1.01)	1.00	(0.98,	1.01)	1.00	(0.99,	1.01)
Female	445	**1.83**	**(1.23,**	**2.74)**	**1.50**	**(1.15,**	**1.97)**	**1.65**	**(1.18,**	**2.29)**	**1.50**	**(1.15,**	**1.97)**
Black, non-Hispanic	445	0.76	(0.51,	1.13)	0.83	(0.63,	1.08)	0.79	(0.57,	1.10)	0.83	(0.63,	1.08)
Hispanic	445	1.32	(0.89,	1.97)	1.21	(0.92,	1.58)	1.26	(0.91,	1.75)	1.21	(0.92,	1.58)
Systolic blood pressure (per 10 mm Hg unit rise)	445	**0.82**	**(0.71,**	**0.95)**	**0.88**	**(0.79,**	**0.97)**	**0.85**	**(0.75,**	**0.96)**	**0.87**	**(0.79,**	**0.97)**
Diastolic blood pressure (per 10 mm Hg unit rise)	445	0.93	(0.80,	1.09)	0.95	(0.86,	1.06)	0.94	(0.83,	1.07)	0.95	(0.86,	1.06)
Married / Domestic partnership	444	**0.63**	**(0.42,**	**0.96)**	**0.73**	**(0.55,**	**0.97)**	**0.68**	**(0.48,**	**0.96)**	**0.73**	**(0.55,**	**0.97)**
Less than HS education	422	1.21	(0.81,	1.83)	1.14	(0.87,	1.50)	1.17	(0.84,	1.64)	1.14	(0.87,	1.50)
High school diploma / GED	422	0.99	(0.64,	1.54)	0.99	(0.74,	1.34)	0.99	(0.69,	1.43)	0.99	(0.74,	1.34)
Employed / Self-employed	438	**0.28**	**(0.14,**	**.55)**	**0.38**	**(0.22,**	**0.67)**	**0.33**	**(0.18,**	**0.61)**	**0.38**	**(0.22,**	**0.67)**
Unemployed / Not working	438	1.10	(0.56,	2.17)	1.07	(0.68,	1.67)	1.08	(0.62,	1.89)	1.07	(0.68,	1.67)
Stroke type: Ischemic	424	1.25	(0.77,	2.03)	1.17	(0.83,	1.63)	1.21	(0.80,	1.81)	1.17	(0.83,	1.63)
EuroQol Index (EQ-5D) (higher score indicates best health)	445	**0.02**	**(0.01,**	**0.06)**	--	--	--	**0.05**	**(0.03,**	**0.10)**	**0.13**	**(0.09,**	**0.19)**
Barthel Index (higher score indicates greater independence)	445	**0.97**	**(0.96,**	**0.98)**	**0.99**	**(0.98,**	**0.99)**	**0.98**	**(0.97,**	**0.99)**	**0.98**	**(0.98,**	**0.99)**
Foreign born	443	1.51	(0.95,	2.40)	1.33	(0.95,	1.86)	1.41	(0.95,	2.09)	1.33	(0.95,	1.86)
Modified Rankin Score (higher score indicates greater disability)	444	**1.39**	**(1.22,**	**1.58)**	**1.23**	**(1.14,**	**1.34)**	**1.30**	**(1.18,**	**1.45)**	**1.24**	**(1.15,**	**1.35)**
PROMIS Physical Function (higher score indicates greater functional ability)	444	**0.93**	**(0.91,**	**0.95)**	**0.96**	**(0.95,**	**0.97)**	**0.95**	**(0.93,**	**0.96)**	**0.95**	**(0.94,**	**0.97)**
Categorized Charlson Comobidity	444	**1.51**	**(1.13,**	**2.03)**	**1.33**	**(1.09,**	**1.62)**	**1.41**	**(1.11,**	**1.80)**	**1.32**	**(1.08,**	**1.61)**
Frontal Assessment Battery (higher score indicates better performance)	418	**0.92**	**(0.87,**	**0.98)**	**0.95**	**(0.92,**	**0.99)**	**0.94**	**(0.89,**	**0.98)**	**0.95**	**(0.92,**	**0.98)**

[1] Odds Ratio with 95% Confidence Interval in predicting PSD
[2] Prevalence Ratio with 95% Confidence Interval in predicting PSD

Table 5. Cross-sectional predictors of depression among Blacks and Hispanics stroke survivors with uncontrolled hypertension [Adjusted for Demographics, Clinical, and Lifestyle Factors (n=278)]

	Logistic Regression (binomial distribution with logit link)		Interval censored survival (binomial distribution with Complementary Log-log link)		Poisson distribution with log link	
	OR[1]	**95% CI**	**PR[2]**	**95% CI**	**PR[2]**	**95% CI**
Age	**0.94**	**(0.91, 0.97)**	**0.95**	**(0.93, 0.98)**	**0.97**	**(0.96, 0.99)**
Female	1.37	(0.72, 2.64)	1.29	(0.78, 2.13)	1.26	(0.89, 1.78)
Hispanic	0.65	(0.31, 1.36)	0.75	(0.43, 1.31)	0.76	(0.51, 1.12)
Systolic blood pressure (per 10 mm Hg unit rise)	0.83	(0.68, 1.01)	0.87	(0.75, 1.02)	0.90	(0.81, 1.02)
Married / Domestic partnership	**0.46**	**(0.24, 0.89)**	**0.59**	**(0.35, 0.98)**	**0.68**	**(0.48, 0.97)**
Employed / Self-employed	0.44	(0.15, 1.35)	0.46	(0.18, 1.16)	0.51	(0.22, 1.17)
Stroke type: Ischemic	0.79	(0.38, 1.64)	0.82	(0.47, 1.41)	0.87	(0.61, 1.25)
EuroQol Index (EQ-5D) (higher score indicates best health)	**0.02**	**(0.00, 0.12)**	**0.06**	**(0.02, 0.20)**	**0.19**	**(0.10, 0.38)**
Foreign born	**3.34**	**(1.40, 7.97)**	**2.49**	**(1.28, 4.84)**	**1.95**	**(1.20, 3.17)**
PROMIS Physical Function (higher score indicates greater functional ability)	0.97	(0.93, 1.01)	0.98	(0.95, 1.00)	0.98	(0.96, 1.00)
Categorized Charlson Comobidity	1.49	(1.00, 2.23)	1.30	(0.96, 1.75)	1.19	(0.97, 1.46)
Frontal Assessment Battery (higher score indicates better performance)	0.94	(0.84, 1.05)	0.94	(0.87, 1.03)	0.97	(0.92, 1.03)

[1] Odds Ratio with 95% Confidence Interval in predicting PSD
[2] Prevalence Ratio with 95% Confidence Interval in predicting PSD
Significant relationships are bolded.

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	4-5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5-7
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5-7
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	7
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(*e*) Describe any sensitivity analyses	6-7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	8
Outcome data	15*	Report numbers of outcome events or summary measures	8-9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8, 9, 16,19

		(*b*) Report category boundaries when continuous variables were categorized	8-9
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-9
Discussion			
Key results	18	Summarise key results with reference to study objectives	9-10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	10-11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.