

# RACE/ETHNIC DIFFERENCES IN POST-STROKE DEPRESSION (PSD): FINDINGS FROM THE STROKE WARNING INFORMATION AND FASTER TREATMENT (SWIFT) STUDY

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**Objectives:** Post-stroke depression (PSD) is common and associated with poor stroke outcomes, but few studies have examined race/ethnic disparities in PSD. Given the paucity of work and inconsistent findings in this important area of research, our study aimed to examine race/ethnic differences in depression in a multi-ethnic cohort of stroke patients.

**Design:** Longitudinal.

**Setting:** Prospective trial of a post-stroke educational intervention.

**Patients or Participants:** 1,193 mild/moderate ischemic stroke/transient ischemic attack (TIA) patients.

**Main Outcome Measures:** We used the Center for Epidemiologic Studies Depression (CES-D) Scale to assess subthreshold (CES-D score 8-15) and full (CES-D score  $\geq 16$ ) depression at one month ("early") and 12 months ("late") following stroke. Multinomial logistic regression analyses examined the association between race/ethnicity and early and late PSD separately.

**Results:** The prevalence of subthreshold and full PSD was 22.5% and 32.6% in the early period and 22.0% and 27.4% in the late period, respectively. Hispanics had 60% lower odds of early full PSD compared with non-Hispanic Whites after adjusting for other covariates (OR=.4, 95% CI: .2, .8). Race/ethnicity was not significantly associated with late PSD.

**Conclusions:** Hispanic stroke patients had half the odds of PSD in early period compared with Whites, but no difference was found in the later period. Further studies comparing trajectories of PSD between race/ethnic groups may further our understanding of race/ethnic disparities in PSD and help

## INTRODUCTION

Stroke is one of the leading causes of death and disability, with almost 800,000 strokes and 137,000 stroke-related deaths occurring every year.<sup>1</sup> Stroke survivors suffer from various negative health outcomes, including vision and speech problems, paralysis, and other functional and cognitive impairment.<sup>1</sup> Psychiatric conditions may also develop in the aftermath of stroke. Post-stroke depression (PSD) is one of the most studied post-stroke mental health conditions and possibly one of the most common, affecting approximately one third of stroke survivors.<sup>2</sup> PSD is associated with several negative outcomes,<sup>3</sup> including: functional disability<sup>4</sup> and impaired recovery of activities of daily living;<sup>5</sup> reduced quality of life;<sup>6</sup> longer rehabilitation hospital stays;<sup>7</sup> less efficient use of rehabilitation services;<sup>7,8</sup> higher health care costs;<sup>9</sup> greater cog-

nitive impairment;<sup>10</sup> increased risk of recurrent stroke;<sup>11,12</sup> and mortality.<sup>13</sup>

Studies consistently report an elevated burden of stroke in some race/ethnic groups,<sup>14</sup> reflected in greater risk of ischemic stroke<sup>15-17</sup> and stroke mortality<sup>18</sup> among Hispanics and Blacks compared with Whites. Individuals from these two race/ethnic groups are also more likely to have more severe strokes and younger onset of stroke.<sup>14</sup> Additionally, Black and Hispanic stroke patients have greater odds of re-hospitalization after stroke, have longer hospital stays, are less ambulatory independent at discharge,<sup>14</sup> and have worse post-stroke rehabilitation functional outcomes compared with Whites.<sup>19</sup>

Studies have failed to find a consistent relationship between PSD and race/ethnicity,<sup>20-22</sup> and only one study has assessed race/ethnic differences in PSD in the United States. The lone US study,<sup>23</sup> conducted among Vet-

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**Keywords:** Stroke, Depression, Ethnicity, Disparities

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erans Affairs (VA) patients who received care for acute stroke, reported that non-Hispanic White patients were more likely to be diagnosed with PSD than non-Hispanic Blacks and Hispanics, even after controlling for other sociodemographic and clinical characteristics. Yet, these findings were based on diagnosis of depression listed in VA and Medicare records instead of assessments of patient symptoms. Results, therefore, may simply reflect race/ethnic differences in detection of PSD instead of differences in PSD itself<sup>23</sup> and may be insufficient to characterize the race/ethnic patterning of PSD in the United States.

Hispanics are the fastest-growing and largest subgroup in the United States.<sup>24</sup> In 2013, 53 million or 17% of the total US population were of Hispanic or Latino origin; by 2060, it is projected that Hispanics will constitute 31% of the total US population.<sup>25,26</sup> Given the changing demographic landscape in the United States, substantial race/ethnic disparities in stroke and stroke outcomes, and the high burden of PSD, understanding how PSD differs by race/ethnic group is particularly salient. Given the paucity of work and inconsistent findings in this important area of research, our study examined race/ethnic differences in depression in a multi-ethnic cohort of stroke patients.

## METHODS

### Study Sample

As part of the Stroke Warning Information and Faster Treatment (SWIFT) study, we prospectively enrolled a multi-ethnic cohort of mild/moderate ischemic stroke or transient

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ischemic attack (TIA) patients from a northern Manhattan (New York City) hospital into a study of an educational intervention aimed at action around acute stroke symptoms. Details of the study have been described elsewhere.<sup>27,28</sup> Eligible patients (aged >18 years, with a telephone, English or Spanish speaking) were administered a structured in-person survey to collect baseline information on demographic characteristics, medical history, vascular risk factors, family history of vascular or cardiac disease, psychosocial factors, cognition, and function. Patients were interviewed again at approximately one month (referred to here as the “early” period) and one year (“late” period) following the stroke/TIA to assess stroke knowledge, outcome events, and other psychosocial factors. SWIFT was approved by Columbia University Medical Center Institutional Review Board. Written informed consent was obtained from all participants.

### Measures

Depressive symptoms were assessed as part of a larger neurologi-

cal and psychosocial battery using the Center for Epidemiologic Studies Depression (CES-D) scale at baseline in reference to the 7-day period prior to the stroke and at one-month and 12-month follow up. The CES-D has 20 items related to the frequency of depression symptoms in the past week, from 0 (rarely/none of the time, less than one day) to 3 (most or all of the time, 5-7 days); scores can range from 0 to 60, with higher scores indicating greater frequency of symptoms. The CES-D has been widely used and found to be valid and reliable as a screening tool for depression in stroke patients.<sup>29</sup> Probable PSD was operationalized as a three-category variable: no or minimal depression (scores 0-7), subthreshold depression (scores 8-15), and full depression (scores  $\geq 16$ ), based on designations used in previous studies.<sup>30,31</sup> Both subthreshold and full depression were assessed given the older age of the study population and consistent evidence that older individuals experience impairing depressive symptoms that often do not meet full depression criteria.<sup>32</sup> PSD was identified among patients who were administered the CES-D one month following their stroke (“early PSD”) and among those who were administered the CES-D at 12 months (“late PSD”) separately. Not all patients were assessed at both follow ups and, therefore, do not have measures for both early and late PSD. Both early and late PSD were assessed because it has been hypothesized that depression occurring at various time points following stroke may be associated with different characteristics.<sup>33</sup>

Respondents were asked to report their race at baseline (based on

US Census categories) and ethnicity (Hispanic/Spanish origin: yes/no), which was subsequently categorized as: non-Hispanic White (NHW), non-Hispanic Black (NHB), Hispanic, and other. Results for the “other” race/ethnic group are not shown given the heterogeneity and small size of this group. Baseline age, educational attainment, sex, National Institutes of Health Stroke Scale (NIHSS; measures stroke-related neurological deficit), past week depression, household composition, and experience of another stroke/TIA since baseline were assessed as covariates. Household composition was categorized as: lives alone, lives with one non-spouse, lives with spouse, and lives with more than one person. Baseline fatalistic health beliefs were measured as agreeing, disagreeing, or having no opinion regarding the question, “Some people are fated to suffer strokes and there is nothing that can be done to prevent them.” Baseline stroke knowledge was assessed using the stroke knowledge (SK) survey,<sup>34</sup> a 29-item scale that asks about knowledge of stroke signs and symptoms, risk factors, treatment options, and actions taken in the event of a stroke (range 0-29). Scores were categorized as low (<23) or high (≥23), which reflects a cutpoint of 80% correct.<sup>28</sup>

### Statistics

Chi-square tests and analysis of variance (ANOVA) were used to assess bivariable associations between race/ethnicity, PSD, and all covariates described above. Unadjusted and adjusted multinomial logistic regressions examined the association between race/ethnicity and PSD

with “no or minimal” depression as the reference category. Models were adjusted for age, sex, educational attainment, household composition, baseline depression, NIHSS score, and experience of another stroke/TIA since baseline and prior to PSD assessment, as well as for number of days between baseline and follow-up assessments. Two additional models evaluated fatalistic health beliefs and stroke knowledge as potential explanatory factors. Analyses were completed for early and late PSD separately among patients who completed the CES-D for that follow-up assessment. Analyses were not restricted to only those patients who completed CES-D assessments in both follow-up interviews. All analyses were conducted using SAS Version 9.3 (Cary, NC).

### RESULTS

We enrolled 1,193 patients into the SWIFT study. At baseline, 25.7% of patients identified as NHW, 17.5% as NHB, 50.8% as Hispanic, and 6.0% as “other.” Almost three quarters of participants were aged >55 years (73.2%), 49.7% were female, 42.2% had less than a high school education, and 25.7% lived alone. Those evaluated at one month (n=685) and at 12 months (n=492) did not differ greatly from the baseline cohort in terms of the distribution of most characteristics. Women and those with more education were more likely to have been evaluated for early PSD than men and those with less education. Younger vs older participants were more likely to be evaluated for late PSD (not shown).

In the overall sample, the prevalence of subthreshold and full PSD was 22.5% and 32.6% in the early period and 22.0% and 27.4% in the late period, respectively. Table 1 reports the prevalence of early and late subthreshold and full PSD and other covariates by race/ethnicity. There was a marginally significant overall association between race/ethnicity and early PSD ( $P=.05$ ) but not between race/ethnicity and late PSD ( $P=.42$ ). The prevalence of early subthreshold and full PSD was lowest in Hispanics compared with NHWs and NHBs (subthreshold: 21.7%, 23.1%, and 26.4%, respectively; full: 27.7%, 37.9%, and 36.8%, respectively). This pattern was also present for late subthreshold PSD (18.4%, 26.6%, and 25.5% among Hispanics, NHWs, and NHBs, respectively), but not for late full PSD, where Hispanics had the highest prevalence (29.9% compared with 21.9% and 28.7% among NHWs and NHBs, respectively). NHB and Hispanic patients were younger, proportionally more female, and had lower educational attainment than NHW patients. Hispanic patients had higher prevalence of having no/mild depression and lower prevalence of full/subthreshold depression at baseline compared with NHWs and NHBs. A greater proportion of NHBs lived alone, a greater proportion of NHWs lived with a spouse only, and a greater proportion of Hispanics lived with more than one person compared with the other race/ethnic groups. NHBs had the highest mean NIHSS score at baseline; Hispanics had the lowest. Hispanic patients had the highest prevalence of having a low stroke knowledge score

**Table 1. Post-stroke depression (PSD) and baseline demographic and clinical characteristics by race/ethnicity**

	Non-Hispanic White		Non-Hispanic Black		Hispanic		P
	N	%	N	%	N	%	
Early PSD <sup>a</sup>							.05
No/mild	71	39.0	46	36.8	166	50.6	
Subthreshold	42	23.1	33	26.4	71	21.7	
Full	69	37.9	46	36.8	91	27.7	
Late PSD <sup>a</sup>							.42
No/mild	66	51.6	43	45.7	126	51.6	
Subthreshold	34	26.6	24	25.5	45	18.4	
Full	28	21.9	27	28.7	73	29.9	
Age, years							<.01
Less than 55	87	28.5	49	23.6	154	25.5	
55-64	49	16.1	52	25.0	164	27.2	
65-74	76	24.9	55	26.4	147	24.4	
75 or older	93	30.5	52	25.0	138	22.9	
Sex							.02
Female	134	43.9	119	57.2	306	50.8	
Male	171	56.1	89	42.8	297	49.3	
Educational attainment							<.01
Less than high school	21	7.0	61	29.5	400	66.8	
High school or greater	281	93.1	146	70.5	199	33.2	
Household composition							<.01
Lives alone	86	28.2	91	43.8	106	17.6	
Lives with one non-spouse	39	12.8	44	21.2	169	28.0	
Lives with spouse only	105	34.4	27	13.0	104	17.3	
Lives with more than one person	75	24.6	46	22.1	224	37.2	
Baseline PSD							<.01
No/mild	79	31.6	57	33.3	250	47.0	
Subthreshold	74	29.6	44	25.7	116	21.8	
Full	97	38.8	70	40.9	166	31.2	
Stroke knowledge score							<.01
Low	150	49.5	130	63.1	480	80.3	
High	153	50.5	76	36.9	118	19.7	
Some fated to have strokes							<.01
Agree	101	35.7	69	35.0	260	43.8	
Disagree	160	56.5	111	56.4	250	42.2	
No opinion	22	7.8	17	8.63	83	14.0	
NIHSS score, mean (SD)	3.2	(4.0)	4.1	(4.5)	2.8	(3.3)	<.01
Experienced another stroke between baseline and one-month follow up							.86
No	287	94.1	197	94.7	573	95.0	
Yes	18	5.9	11	5.3	30	5.0	
Experienced another stroke between baseline and 12-month follow up							.70
No	284	93.1	195	93.8	570	94.5	
Yes	21	6.9	13	6.3	33	5.5	

SD, standard deviation; NIHSS, National Institutes of Health Stroke Severity.

a. Early PSD assessed at one-month, late PSD at 12-month follow up.

compared with NHBs and NHWs and were more likely than NHWs and NHBs to have fatalistic health beliefs.

Results from adjusted multi-

nomial regression analysis of early and late PSD are shown in Table 2. Hispanics had less than half the odds of early full PSD compared

with NHWs (OR=.4, 95% CI: .2, .8). There was no significant difference between Hispanics and NHWs in early subthreshold PSD, and we

found no significant differences in early subthreshold or full PSD between NHBs and NHWs. Female gender, having baseline full vs no/mild depression, and higher NIHSS score were significantly associated with early subthreshold PSD in adjusted models. Having baseline subthreshold or full depression (vs no/mild depression) and higher NIHSS score were also associated with early full PSD in adjusted models.

Race/ethnicity was not significantly associated with late sub-

threshold or full PSD in adjusted models. Female gender, younger age, and higher NIHSS score were significantly associated with late subthreshold PSD. Meeting criteria for subthreshold or full depression compared with no/mild depression at baseline was also significantly associated with both late subthreshold and full PSD. Including fatalistic health beliefs and stroke knowledge into models for early full PSD (not shown) did not yield different results (Hispanic vs NHW patients: includ-

ing fatalistic health beliefs, OR=.4, 95% CI: .2-.8; including stroke knowledge, OR=.4, 95% CI: .2-.8).

## DISCUSSION

This study is, to our knowledge, the first to assess differences in self-reported PSD in a multi-ethnic cohort with an adequate representation of Hispanic patients. In the overall sample, more than half of stroke patients met criteria for subthreshold or

**Table 2. Multinomial logistic regression models of post-stroke depression (PSD)**

	Early PSD (n=685)				Late PSD (n=492)			
	Subthreshold PSD		Full PSD		Subthreshold PSD		Full PSD	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Race/ethnicity								
Non-Hispanic White	1.0		1.0		1.0		1.0	
Non-Hispanic Black	1.3	.6, 2.7	.7	.4, 1.5	1.2	.5, 3.2	1.3	.5, 3.3
Hispanic	1.0	.5, 1.9	.4	.2, .8	.9	.4, 2.2	1.0	.4, 2.4
Age, years								
Less than 55	1.0		1.0		1.0		1.0	
55-64	.6	.3, 1.1	.8	.4, 1.4	.4	.1, .9	.8	.3, 1.8
65-74	.6	.3, 1.1	.7	.4, 1.3	.8	.4, 1.9	1.0	.4, 2.3
75 or older	.6	.3, 1.2	.6	.3, 1.2	.8	.3, 2.2	1.3	.5, 3.4
Sex								
Female	1.0		1.0		1.0		1.0	
Male	.6	.3, .9	.8	.5, 1.3	.5	.3, .9	1.1	.6, 2.0
Educational attainment								
Less than high school	1.0		1.0		1.0		1.0	
High school or greater	1.2	.7, 2.1	.8	.4, 1.3	.9	.4, 1.8	.5	.3, 1.1
Baseline depression								
No/mild	1.0		1.0		1.0		1.0	
Subthreshold	1.6	.9, 2.8	3.9	2.2, 6.8	2.6	1.2, 5.7	4.2	1.9, 9.2
Full	4.0	2.3, 6.9	14.2	8.0, 25.2	2.9	1.4, 6.2	7.6	3.6, 16.1
Household composition								
Lives alone	1.0		1.0		1.0		1.0	
Lives with one non-spouse	.6	.3, 1.1	.7	.4, 1.4	2.5	.9, 6.5	1.3	.5, 3.1
Lives with spouse only	.9	.5, 1.8	.6	.3, 1.2	2.0	.8, 5.3	.4	.2, 1.1
Lives with more than one person	.7	.4, 1.3	.5	.3, 1.0	2.0	.8, 5.0	1.0	.4, 2.3
NIHSS score	1.1	1.0, 1.1	1.0	.9, 1.1	1.0	1.0, 1.2	1.1	1.0, 1.2
Experienced another stroke since baseline and prior to PSD assessment								
No	1.0		1.0		1.0		1.0	
Yes	1.0	.5, 2.3	1.9	.9, 3.8	.7	.2, 2.1	1.5	.5, 4.0

Models are adjusted for all variables shown, as well as for days from the initial stroke to the PSD assessment. Early PSD assessed at one-month; late PSD at 12-month follow up.

NIHSS, National Institutes of Health Stroke Severity.

full PSD in the early period following the stroke, and almost half met these criteria in the later period, consistent with a recent meta-analysis of PSD.<sup>2</sup> Hispanic stroke patients had less than half the odds of full PSD in the early period following a stroke compared with NHWs, but no significant difference in PSD between Hispanics and NHWs was found in the later period. Our results are, in part, consistent with the Jia et al (2010) study of race/ethnic differences in PSD that also reported lower odds of PSD among Hispanic patients compared with NHW patients (although not statistically significant). That study, however, also reported lower odds of PSD among NHB patients compared with NHW patients,<sup>23</sup> while our study found no significant difference in odds of PSD between NHBs and NHWs. However, Jia et al (2010) identified depression at any point in the 12 months following stroke based on diagnosis and antidepressant prescriptions and did not indicate when the diagnosis occurred, making comparison of results less feasible. The increased odds of PSD among women compared with men, younger vs older patients, patients with greater stroke severity, and patients with pre-stroke depression are consistent with previous studies of PSD.<sup>35</sup>

Although Hispanics had lower odds of full PSD in the early period following stroke, they appear to have “caught up” to the other race/ethnic groups in terms of PSD at 12 months. We tested potential explanations for the lower prevalence of early full PSD among Hispanics compared with NHW patients, including differences in household composition, baseline

depression, fatalistic health beliefs and stroke knowledge, and did not find that any of these factors played an explanatory role. Nevertheless, the protective role of Hispanic ethnicity may be related to greater perceived *functional* social support experienced by Hispanic patients directly following a stroke, which may not have been adequately captured by household composition. Galanti (2003) describes Hispanic family units as be-

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*Hispanic stroke patients had less than half the odds of full PSD in the early period following a stroke compared with NHWs, but no significant difference in PSD between Hispanics and NHWs was found in the later period.*

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ing larger than the “typical American family unit,” with all members expecting to visit their loved one in the hospital.<sup>36</sup> It is possible that strong support from family and friends, who reside inside and outside of their household, while the patient is still in the hospital confers protection against PSD in the early period following a stroke. Yet, once the patient has been released from the hospital, completes rehabilitation if needed, and has to cope with any disability or life changes due to the stroke, this

support may have waned and/or may no longer be enough to prevent depressive symptoms in the longer term. Additionally, early needs of Hispanic acute stroke patients may be satisfied by family and friend support,<sup>37</sup> but needs later on may include other individuals or resources not provided by family and friends. Additional studies that probe potential explanations for these findings are warranted.

The results of this study should be interpreted in light of several limitations. First, there was attrition over the follow-up period. Yet, there do not appear to be substantial differences in race/ethnicity or in the distribution of other key demographic characteristics between assessment periods, and those characteristics whose distribution differed significantly between assessments were controlled for in regression models. Second, race/ethnic differences in PSD prevalence may reflect differential reporting of self-reported depression symptoms in the CES-D instead of true differences in the burden of depression. Although CES-D has been validated in Hispanic populations,<sup>38</sup> differences in cultural expression of depression may have limited our ability to accurately compare PSD across groups. Studies that use culturally adapted screening instruments would be useful in confirming these results. Third, the study population comprised only mild or moderate stroke/TIA patients and may, therefore, not be generalizable to all stroke victims. By excluding severe stroke patients, who may be more likely to be Hispanic or NHB and may be at greater risk of PSD, we may have underestimated the burden of depression in stroke patients

and the association between race/ethnicity and PSD. Fourth, because Hispanics in New York City tend to differ in origin from Hispanics in the rest of the country,<sup>24</sup> our findings may not be generalizable to all US Hispanics. Fifth, baseline depression was assessed just after the stroke based on patient report of depression symptoms in the past week, not prior to the stroke occurrence, introducing potential for recall bias. However, the study only included mild/moderate strokes, mitigating the concern that cognitive issues influenced recall of symptoms somewhat. Finally, a portion of participants did not have both early and late PSD assessments. It is possible, then, that the differing PSD results in the early vs late period are due to differences in the cohorts assessed, not any change in depression status among Hispanics over time. Yet, among those patients with PSD assessments in both periods and no or minor depression in the early period, the odds of having full PSD by the late period was almost three times greater for Hispanic patients compared with NHW patients (unadjusted OR=2.8, 95% CI: .8-10.3,  $P=.12$ ). There is some evidence, then, that Hispanic patients without PSD in the early period had greater odds of developing full PSD by the late period. Future studies with larger sample sizes may be helpful in confirming these results.

## CONCLUSIONS

The marked racial/ethnic demographic shift of the US population combined with the high burden of stroke and stroke-related outcomes

among some race/ethnic groups warrants additional studies that assess race/ethnic differences in PSD. In particular, studies that compare the longitudinal course of PSD between race/ethnic groups have the potential to further our understanding of race/ethnic disparities in PSD. Specifically, trajectory analysis using novel statistical methods such as latent growth mixture modeling, which considers assessments of depression at several time points (ideally, both before and after stroke) and identifies distinct symptom trajectories of PSD,<sup>39,40</sup> have the potential to substantially contribute to our knowledge of PSD and race/ethnic differences in PSD course. Elucidating race/ethnic disparities in PSD course may also have important implications for understanding race/ethnic differences in stroke recovery, given evidence that PSD can negatively impact post-stroke functioning and outcomes.<sup>11,12,33</sup> Should further research confirm this study's findings, understanding the factors that account for the potentially protective effect of Hispanic ethnicity on early PSD would be the essential next step in helping to identify effective interventions for reducing PSD in the short- and long-term.

## ACKNOWLEDGMENTS

### CONFLICT OF INTEREST

No conflicts of interest to report.

### HUMAN SUBJECTS

This study involved research with human subjects and was approved by Columbia University Institutional Review Board. All participants provided informed consent prior to enrollment in the study.

## AUTHOR CONTRIBUTIONS

Research concept and design: Goldmann, Lord, Boden-Albala. Acquisition of data: Boden-Albala. Data analysis and interpretation: Goldmann, Roberts, Parikh, Lord. Manuscript draft: Goldmann, Roberts, Parikh, Lord, Boden-Albala. Statistical expertise: Goldmann, Roberts. Acquisition of funding: Boden-Albala. Administrative: Goldmann, Parikh, Lord. Supervision: Goldmann, Boden-Albala.

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