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Stroke Outcomes Among English- and Spanish-Speaking Mexican Americans

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Abstract

Objectives:

We examined whether language preference was associated with 90-day post stroke outcomes among Mexican Americans (MAs).

Methods:

Ischemic stroke and intracerebral hemorrhage (ICH) patients from the population-based Brain Attack Surveillance in Corpus Christi (BASIC) project (2009-2018) were compared by language preference in 90-day neurological, functional and cognitive outcomes using weighted Tobit regression. Models were adjusted for demographics, initial NIHSS, medical history, stroke characteristics, and insurance status.

Results:

Of 1,096 stroke patients, 926 were English-speaking and 170 were Spanish only speaking. Spanish speakers were older ($p < 0.01$), received less education ($p < 0.01$), had higher initial NIHSS values ($p = 0.02$), had higher prevalence of atrial fibrillation ($p < 0.01$), and had lower prevalence of smoking ($p = 0.01$) than English speakers. In fully adjusted models, Spanish only speakers had worse neurological outcome (NIHSS, range 0–44 [higher worse], mean difference: 1.93, $p < 0.01$), but no difference in functional outcome measured by activities of daily living/instrumental activities of daily living or cognitive outcome compared with English speakers.

Conclusions:

This population-based study found worse neurologic but similar functional and cognitive stroke outcomes among Spanish only speaking MAs compared with English speaking MAs.

Non-standard Abbreviations and Acronyms

MA-Mexican American

NHW-Non Hispanic white

ADL-Activities of daily living

IADL-Instrumental activities of daily living

MSE-Mini-Mental status examination

NIHSS-National Institutes of Health Stroke Scale

Introduction

Mexican Americans (MAs) have worse neurological, functional, and cognitive stroke outcomes compared with non-Hispanic Whites (NHWs) [1]. The data on preferred language use and stroke outcome is rare and unclear. A systematic review of limited English proficiency and stroke noted the limited data available, and inconsistently equitable outcomes [2]. We examined whether language preference was associated with 90-day post stroke outcomes among Mexican Americans (MAs).

Methods

We included MA patients with ischemic or hemorrhagic stroke who survived 90 days and completed the baseline and outcome interviews from the Brain Attack Surveillance in Corpus Christi (BASIC) project, a population-based stroke study conducted in South Texas. Detailed methods were previously published [3]. Patients diagnosed with ischemic or hemorrhagic stroke between 2009 and 2018 were identified. Outcomes examined were: National Institutes of Health Stroke Scale (NIHSS, range 0–44, higher worse), activities of daily living/instrumental activities of daily living (ADL/IADL, range 1–4, higher worse), and the modified Mini-Mental State

Examination (MSE, range 0–90, lower worse). Interviews and NIHSS examinations were performed by bilingual and NIHSS certified coordinators. We classified patients as Spanish only speakers compared to others (English only or bilingual). Differences in the stroke outcomes comparing English and Spanish speakers were examined using weighted Tobit regression. Inverse probability of participation weights were created by logistic regression to account for attrition at the baseline and outcome interviews, with baseline (and outcome) interview participation as the outcome, and age, sex, initial NIHSS score, hypertension, diabetes, atrial fibrillation, smoking status, comorbidities, body mass index (BMI), stroke type, history of stroke, and insurance status as candidate predictors. In logistic regression models, these candidate predictors were further selected by a backward selection procedure with threshold $p = 0.20$. For each of the three outcomes, we fitted four sequential models with increasing numbers of the covariates mentioned above. We conducted sensitivity analyses including weighted Tobit regression using complete-case data, unweighted Tobit regression using complete-case and imputed data, weighted Tobit regression further adjusting for immigration status as an additional covariate using complete-case and imputed data, and weighted Tobit regression with inverse probability weights further accounting for survival at 90 days using complete-case and imputed data. Additional detailed methods and statistical analysis are available in the eMethods.

Standard Protocol Approvals, Registrations, and Patient Consents

This project was approved by the University of Michigan and both participating hospitals IRBs. Interviewed subjects or proxies provided informed consent.

Data Availability

Reasonable data requests should be submitted to the corresponding author who will consider them based on existing IRB approvals and data sharing agreements.

Results

Of 1,096 MA patients with first-ever stroke who survived 90 days and completed the baseline and outcome interviews, 926 were English speakers and 170 were Spanish speakers. Table 1 presents their demographic and clinical information. Overall, Spanish speakers were older (median age 77 versus 64 years; $p < 0.01$), received less education ($p < 0.01$), had higher initial NIHSS values ($p = 0.02$), had higher prevalence of atrial fibrillation ($p < 0.01$), and had lower prevalence of smoking ($p = 0.01$) than English speakers. No significant differences in sex, hypertension, diabetes, comorbidity score, stroke type, history of stroke, and insurance status between English and Spanish speakers were found.

In fully adjusted models, Spanish speakers had worse neurological outcome (mean difference: 1.93, $p < 0.01$), but no significant difference in functional outcome (mean difference: 0.05, $p = 0.53$), or cognitive outcome (mean difference: -1.28, $p = 0.30$) (Table 2 and Figure). The sensitivity analyses with weighted Tobit regression using complete-case data, unweighted Tobit regression using complete-case and imputed data, and weighted Tobit regression with inverse probability weights further accounting for survival at 90 days using complete-case and imputed data yielded similar results. Analysis with further adjustment for immigration status also yielded similar results to the main results, with only significant differences in neurological outcome (mean difference: 2.13, $p < 0.01$). Considering that immigration status is highly correlated with

interview language (Chi-squared test $p < 0.01$), we checked multicollinearity in the models with immigration status, language preference, and level of education and found that there were no multicollinearity concerns.

To determine if the NIHSS was driven, at least in part, by more dominant hemisphere strokes in Spanish-only speakers, in a post-hoc analysis we found that Spanish-only speakers scored higher on the NIHSS language question ($p<0.01$).

Discussion

Our results demonstrate worse 90-day post stroke neurological outcomes among Spanish-only speaking MA compared to MA who spoke English. We found no difference in 90-day post stroke cognitive or functional outcomes. Within this same population cohort between 2000-2006, language was not associated with hospital arrival delay and emergency medical services use among MA and non-Hispanic White ischemic stroke patients [4].

A recent comparison of this same BASIC cohort noted long-term MA immigrants demonstrated better stroke functional outcomes than non-immigrant MAs and had comparable scores among neurological and cognitive outcomes [5]. Our current study did consider the interplay of language, level of education, and immigration status, and when models were further adjusted we found similar results. Improving the report of language preference and immigration status in stroke studies could help better characterize what is driving differences and disparities among populations.

Some factors could influence the reported data from Spanish speakers within our cohort. Cognitive screening tools may be biased or non-equivalent across language preference or degree of bilingualism [6, 7]. Reports suggest that bilingualism leads to better post-stroke outcome [8]. It is possible there is increased resilience or cognitive reserve in these individuals, or that any communication in English, however limited, reduces possible negative effects of language discordance between patient and provider on stroke outcomes. Our data set did not analyze the bilingual group separately as the degree of bilingualism may vary subject to subject. Spanish speakers in the Secondary stroke prevention by Uniting Community and Chronic care model teams Early to End Disparities (SUCCEED) trial noted low stroke literacy, low self-efficacy, and negative perception of healthcare delivery [9]. We know, from the Reasons for Geographic and Racial Differences in Stroke (REGARDS) Study, that incremental increases in the number of social determinants of health in adults < 75 years of age were independently associated with increases in incident stroke risk [10]. A strong consideration of limited English proficiency and language barriers as a social determinant of health should be investigated further.

The post-hoc analysis found worse language function among Spanish-only speakers suggesting the possibility of more dominant hemisphere strokes in Spanish-only speakers which has an important effect on the NIHSS. Our study provides novel information on Spanish speakers and neurological, functional, and cognitive outcomes following stroke. Some limitations include that the overwhelming majority of the MA population in Corpus Christi are US born, and there was a low number of Spanish only speakers. Language could be a proxy for socioeconomic status, our only adjustment was for education and no income information was available for further adjustment. The data was also self-reported, and no information was available for language used

by providers to examine the role of patient-provider language discordance. A 2 point difference on the NIHSS may not translate to clinical differences at a glance, though it has been reported that each point increase on the NIHSS may lead to decreased likelihood of excellent outcomes at 3 months by 17% [11].

In conclusion, we found evidence of worse neurological stroke outcomes among MA Spanish only speakers. These data suggest the need for further research into what factors and barriers may influence the observed worse outcomes among Spanish only speakers.

http://links.lww.com/WNL/C724

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Table 1: Baseline characteristics using complete and imputed data.

Variables	Complete data Median (IQR)* or %					Imputed data Median (IQR)* or %			
	n	English (N=926)	Spanish (N=170)	Total (N=1096)	p-value	English (N=926)	Spanish (N=170)	Total (N=1096)	p-value
Age	1096	64.00 (56.00,73.00)	77.00 (65.25, 83.75)	65.00 (57.00, 76.00)	< 0.01	64.00 (56.00,73.00)	77.00 (65.25, 83.75)	65.00 (57.00, 76.00)	< 0.01
Sex	1096				0.11				0.11
Male	546	50.86%	44.12%	49.82%		50.86%	44.12%	49.82%	
Female	550	49.14%	55.88%	50.18%		49.14%	55.88%	50.18%	
Education	1091				< 0.01				< 0.01
Less than High School	515	40.35%	84.62%	47.20%		40.50%	84.71%	47.35%	
High School	285	29.39%	8.28%	26.12%		29.27%	8.24%	26.00%	
Beyond High School	291	30.26%	7.10%	26.67%		30.24%	7.06%	26.64%	
Initial NIHSS	1093	3.00 (1.00, 7.00)	4.50 (2.00, 9.00)	4.00 (1.00, 8.00)	0.02	3.00 (1.00, 7.00)	4.50 (2.00, 9.00)	4.00 (1.00, 8.00)	0.02
Hypertension	1096	85.75%	84.71%	85.58%	0.72	85.75%	84.71%	85.58%	0.72
Diabetes	1094	56.06%	48.82%	54.94%	0.08	56.05%	48.82%	54.93%	0.08
Atrial Fibrillation	1094	7.90%	15.88%	9.14%	< 0.01	7.99%	15.88%	9.22%	< 0.01
Smoking Status	1096				0.01				0.01
Never	939	84.34%	92.94%	85.68%		84.34%	92.94%	85.68%	
Current	89	8.96%	3.53%	8.12%		8.96%	3.53%	8.12%	
Former	68	6.70%	3.53%	6.20%		6.70%	3.53%	6.20%	
Insured	1096	83.15%	87.65%	83.85%	0.14	83.15%	87.65%	83.85%	0.14
Comorbidity Score	1090	1.00 (0.00, 2.00)	1.00 (0.00, 2.00)	1.00 (0.00, 2.00)	0.42	1.00 (0.00, 2.00)	1.00 (0.00, 2.00)	1.00 (0.00, 2.00)	0.49
Stroke Type	1096				0.72				0.72

Ischemic	957	87.47%	86.47%	87.32%		87.47%	86.47%	87.32%	
Intracerebral hemorrhage	139	12.53%	13.53%	12.68%		12.53%	13.53%	12.68%	
With History of Stroke	1094	22.19%	23.53%	22.39%	0.70	22.25%	23.53%	22.45%	0.71

Table 2: Differences in Stroke Outcomes between English speakers and Spanish speakers based on weighted Tobit regression using imputed data

Outcome Variable	English Speaker Mean (SD[3])	Spanish Speaker Mean (SD)	Base Model[1]		Adjusted Model[2]	
			Mean Difference (95% CI[4])	p-value	Mean Difference (95% CI)	p-value
NIHSS (0-44, higher scores worse)	4.08 (5.40)	7.07 (8.50)	1.90 (0.74, 3.06)	< 0.01	1.93 (0.77, 3.10)	< 0.01
ADL/iADL (1-4, higher scores worse)	2.44 (0.99)	2.83 (1.02)	0.09 (-0.08, 0.26)	0.32	0.05 (-0.12, 0.22)	0.53
MSE (0-90, lower scores worse)	64.95 (11.46)	74.41 (12.31)	-4.36 (-6.89, -1.83)	< 0.01	-1.28 (-3.70, 1.15)	0.30

[1] Adjusted for age, sex, and initial NIHSS.

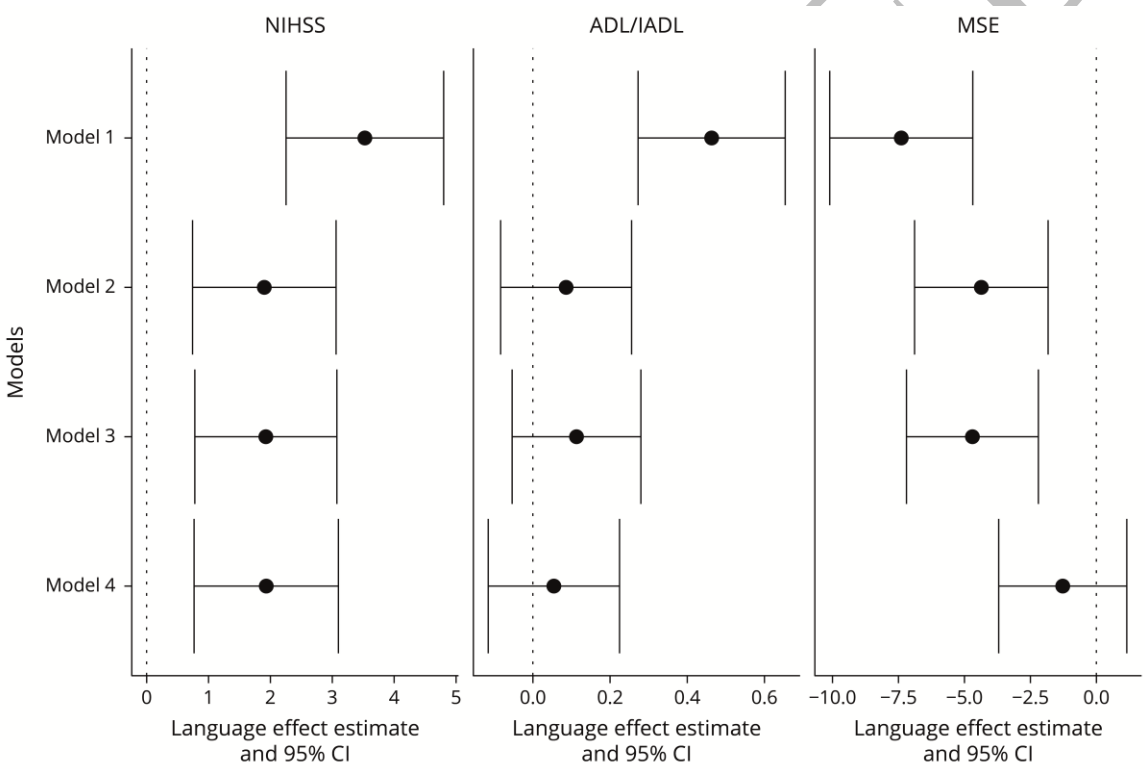
[2] Adjusted for age, sex, initial NIHSS, hypertension, diabetes, atrial fibrillation, smoking status, comorbidity score, education, BMI, stroke type, history of stroke, and insurance status.

[3] Standard deviation

[4] Confidence interval

Figure: Sequential adjustment of outcomes based on weighted Tobit regression using imputed data.

Model 1: no adjustment; model 2: adjusted for age, sex, initial National Institutes of Health Stroke Scale (NIHSS) score; model 3: further adjusting for hypertension, diabetes, atrial fibrillation, smoking status, comorbidity score; model 4: further adjusting for education, stroke type, history of stroke, insurance status. ADL indicates activities of daily living; IADL, instrumental activities of daily living; and MSE, Mini-Mental Status Exam.



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