Are Hispanic patients with subarachnoid hemorrhage treated differently in border states than in nonborder states?

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OBJECTIVE Recent studies have found an underutilization of in-hospital procedures in treatments of Hispanic patients admitted with coronary artery disease in states along the US-Mexico border (“border states”). The purpose of this study was to determine any treatment disparities between patients treated for subarachnoid hemorrhage (SAH) in border and nonborder states and whether this disparity was associated with differential hospital charges.

METHODS Using the National (Nationwide) Inpatient Sample, the authors retrieved data of Hispanic and non-Hispanic patients who were admitted in 2011 for SAH in a border state (California, Arizona, New Mexico, and Texas) or nonborder state (the remaining 46 US states). The authors determined the rates of use of endovascular coiling and surgical clipping treatments, hospital charges, and outcomes according to the patients’ demographics and treatment in border or nonborder states.

RESULTS In total, 18,368 patients were admitted with SAH in the selected time period, including 2310 Hispanic patients (12.6%). Of these patients, 1525 were admitted in a border state and 785 in a nonborder state. In border states, rates of surgical treatment significantly differed between patients of Hispanic (21.9%) and non-Hispanic (14.0%) origin ($p = 0.02$). In particular, Hispanic patients were more likely to undergo surgical clipping than were non-Hispanic patients. In the nonborder states, the rates of surgical treatment were similar for Hispanic and non-Hispanic patients (14.0% vs 15.6%, $p = 0.6$). Hispanic patients with SAH were billed significantly higher in-hospital charges in border states than in nonborder states (\$219,260 and \$192,418 [US dollars], respectively, $p < 0.001$).

CONCLUSIONS Use of surgical treatments for Hispanic patients with SAH residing in border states has a unique pattern, which significantly increases in-hospital charges in this patient population.

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CONSTITUTING about 17% of the US population, Hispanics are the fastest growing minority group in the United States. This group also has the highest prevalence of cardiovascular risk factors, such as hypertension, diabetes mellitus, coronary artery disease, and physical inactivity.^{4,13} It is projected that over the next 4 decades, 1.3 million strokes will occur each year in the United States, and Hispanics will contribute a large portion to this number.⁶ Subarachnoid hemorrhage (SAH), a specific type of stroke, is a major cause of disability and death and affects every 5 in 10,000 Hispanics.¹² The rate

of increase in this population and the expected increase of stroke incidence among Hispanics calls for innovative research that examines the current disparity gaps in prevention, prevalence, and treatment of SAH, which all result in detrimental outcomes for Hispanic patients.

Most studies have focused on the vast health care disparities between Hispanics and non-Hispanics; however, recent studies have also reported a growing disparity between Hispanics residing in border states and those living in nonborder states. Nearly three-quarters of Hispanic residents are situated in states along the US-Mexico border,

ABBREVIATIONS ICD-9-CM = *International Classification of Diseases, Ninth Revision, Clinical Modification*; LOS = length of stay; NIS = National (Nationwide) Inpatient Sample; SAH = subarachnoid hemorrhage.

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that is, in Arizona, California, New Mexico, and Texas.³ Hispanics living in these states tend to have higher poverty rates, less access to medical care, and be less acculturated to US health care.² For instance, a study by Gillum et al. reported significant health care disparities between Hispanics in border states and Hispanics in nonborder states receiving care for coronary artery disease.³ The authors observed an underutilization of hospital inpatient care for coronary artery disease in Hispanics living in the border states Texas, Arizona, and California compared with Hispanics living in nonborder states. Likewise, other studies have shown that Hispanics are less likely than non-Hispanic whites to be treated with recombinant tissue plasminogen activator for acute ischemic stroke.⁹ This observation poses the question whether other treatments, such as treatments for SAH (i.e., surgical clipping, coil embolization, or craniotomy), might also be underused in Hispanics living in border or nonborder states.

The purpose of the current study was to determine whether a disparity in SAH treatment and treatment costs exists between Hispanic and non-Hispanic patients in border and nonborder states. In addition, this study investigated whether Hispanic patients with SAH in border or nonborder states underwent different types of treatment and whether any such differences resulted in disparities in the cost of care.

Methods

For the analyses in the present study, we used data files from the National (Nationwide) Inpatient Sample (NIS), covering the year 2011. A comprehensive synopsis of the nature of the NIS data is available at <http://www.hcup-us.ahrq.gov>.

We used the *International Classification of Disease, Ninth Revision, Clinical Modification* (ICD-9-CM) primary diagnosis code 430 to identify patients admitted with SAH. Patients were categorized into those admitted in border states (i.e., Arizona, California, New Mexico, and Texas) and those admitted in nonborder states (the remaining 46 states). All patients were further divided by race into Hispanic, black, white, and Asian. Data from patients without information on race were excluded from further analysis.

The study variables included in the analyses were patient age, sex, race/ethnicity, and comorbidities; the latter were obtained from comorbidity data files of the Agency for Healthcare Research and Quality and included diabetes mellitus, hypertension, congestive heart failure, renal failure, chronic lung disease, and alcohol abuse. ICD-9-CM secondary diagnosis codes were used to identify patients with atrial fibrillation (427.3), nicotine dependence (305.1), and dyslipidemia (272.0).

ICD-9-CM secondary diagnosis codes were used to identify in-hospital complications, such as pneumonia (486, 481, 482.8, and 482.3), urinary tract infection (599.0 and 590.9), sepsis (995.91, 996.64, 038, 995.92, and 999.3), deep venous thrombosis (451.1, 451.2, 451.81, 451.9, 453.1, 453.2, 453.8, and 453.9), pulmonary embolism (415.1), and myocardial infarction (410). We also used ICD-9-CM primary and secondary procedure codes to estimate the

percentage of in-hospital procedures, such as cerebral angiography (88.41), surgical treatment (39.51 and 39.52), endovascular treatment (39.71 and 39.79), intubation (96.04), mechanical ventilation (96.72), transfusion (99.04), tracheostomy (31.2), and gastrostomy (431.1–431.9).

The admitting hospitals were classified as urban or rural and teaching or nonteaching; teaching hospitals were those that had an American Medical Association–approved residency program or were members of the Council of Teaching Hospitals. The information in NIS about hospital size based on the number of beds was used to stratify hospitals into small, medium, and large.

We determined the length of stay (LOS) and hospital charges (amount billed for services, but not the specific amounts received in payment). Discharge status retrieved from the NIS was categorized into routine; home health care; short-term hospital; other facility, including intermediate care and skilled nursing home; or death. We categorized a routine discharge as a status of no to minimal disability and any other discharge status as moderate to severe disability as previously described.¹⁰

Statistical Analysis

SAS software (version 9.1, SAS Institute) was used to convert the NIS database data into weighted counts to generate national estimates, following the recommendations of the Healthcare Cost and Utilization Project. We performed univariate analysis and chi-square tests for categorical variables and t-tests for continuous variables to identify differences in study variables and end points between patients admitted with SAH in border or nonborder states and Hispanic versus non-Hispanic patients in both border and nonborder states.

Logistic regression models were used to identify any associations between admission for SAH in border states and the odds of in-hospital death. Additional logistic regression models included only data from those patients who survived hospitalization to examine an association between admission in border states and the odds of moderate to severe disability. The logistic regression model was adjusted for age (as a continuous variable), sex (as a categorical variable), and confounding factors (as categorical variables) that were statistically significant ($p < 0.05$) in a univariate analysis.

Results

In total, 18,368 patients were admitted with SAH in 2011, including 2310 (12.6%) Hispanic patients; 5682 (30.9%) of all patients were admitted in border states and 12,686 (69.1%) in nonborder states.

Hispanic Versus Non-Hispanic Patients

A total of 1525 (26.8%) Hispanic and 4157 (73.2%) non-Hispanic SAH patients were admitted in the border states. The mean age ($\pm$ SD) was 61 ± 28.3 years and 64 ± 28.4 years for Hispanic and non-Hispanic SAH patients, respectively. The patient cohort included 954 (62.6%) Hispanic women and 2672 (64.3%) non-Hispanic women. Most Hispanic (68.6%) and non-Hispanic (75.8%) patients were admitted to teaching hospitals (Table 1).

TABLE 1. Demographics of Hispanic and non-Hispanic SAH patients in border states

Variable	No. of Patients (%)		p Value
	Hispanic (n = 1525)	Non-Hispanic (n = 4157)	
Comorbidities			
Hypertension	1202 (78.8)	2857 (68.7)	0.010
Diabetes mellitus	387 (25.4)	557 (13.4)	0.002
Dyslipidemia	68 (4.5)	213 (5.1)	0.600
Atrial fibrillation	66 (4.3)	435 (10.5)	0.002
Congestive heart failure	142 (9.3)	293 (7.1)	0.200
Chronic lung disease	137 (9.0)	594 (14.3)	0.002
Renal failure	129 (8.5)	323 (7.8)	0.700
Alcohol abuse	103 (6.8)	207 (5.0)	0.300
Nicotine dependence	189 (12.4)	575 (13.8)	0.600
In-hospital complications			
Pneumonia	116 (7.6)	191 (4.6)	0.020
Deep venous thrombosis	11 (0.7)	64 (1.5)	0.200
Urinary tract infection	384 (25.2)	661 (15.9)	0.009
Sepsis	119 (7.8)	191 (4.6)	0.070
Pulmonary embolism	10 (0.7)	42 (1.0)	0.500
Myocardial infarction	14 (0.9)	11 (0.3)	0.200
In-hospital procedures			
Cerebral angiography	734 (48.1)	2170 (52.2)	0.400
Gastrostomy	145 (9.5)	344 (8.3)	0.500
Tracheostomy	5 (0.3)	26 (0.6)	0.500
Mechanical ventilation	242 (15.9)	764 (18.4)	0.300
Intubation	311 (20.4)	969 (23.3)	0.200
Transfusion	105 (6.9)	407 (9.8)	0.200
Endovascular coiling	327 (21.4)	1014 (24.4)	0.400
Surgical clipping	334 (21.9)	580 (14.0)	0.020
Mean LOS in days (± SD)	13.0 ± 31.4	11.5 ± 26.7	0.001
Mean hospital charge in US\$ (± SD)	219,260 ± 652,662	201,249 ± 507,103	<0.001
Hospital bed size			0.080
Small	16 (1.2)	126 (3.2)	
Medium	196 (14.5)	560 (14.4)	
Large	1142 (84.3)	3206 (82.4)	
Hospital location			
Urban	1356 (100)	3838 (98.6)	
Rural	0 (0.0)	54 (1.4)	
Hospital teaching status			0.300
Nonteaching	425 (31.4)	942 (24.2)	
Teaching	930 (68.6)	2951 (75.8)	
Discharge disposition			
None to min disability	691 (45.3)	1775 (42.7)	0.400
Moderate to severe disability	588 (38.6)	1589 (38.2)	0.900
In-hospital death	245 (16.1)	793 (19.1)	0.300

Table 1 presents the demographic and clinical characteristics of the SAH patients admitted in the border states. In these states, Hispanic patients had statistically significantly higher rates of hypertension ($p = 0.01$) and diabetes mellitus ($p = 0.002$), and non-Hispanic patients presented with higher rates of atrial fibrillation ($p = 0.002$)

and chronic lung disease ($p = 0.002$). Hispanic patients in border states were statistically significantly more likely than their non-Hispanic counterparts to develop pneumonia ($p = 0.02$) or urinary tract infections ($p = 0.009$) and tended to have more sepsis ($p = 0.07$). More Hispanic than non-Hispanic SAH patients in the border states underwent

FIG. 1. Mean hospital charges for Hispanic and non-Hispanic patients with SAH in border and nonborder states. Hispanic patients admitted for SAH in border states had higher hospital charges than did their non-Hispanic counterparts and Hispanic patients in nonborder states.

surgery for SAH (21.9% vs 14.0%, $p = 0.02$). The mean hospital LOS in the border states was 13.0 ± 31.4 days for Hispanic patients and 11.5 ± 26.7 days for non-Hispanic patients ($p = 0.001$). Additionally, Hispanic patients in the border states had higher hospital charges than non-Hispanic patients ($p < 0.001$) (Fig. 1). In border states, 16.1% of Hispanic patients admitted with SAH died in the hospital, and 19.1% of non-Hispanic patients died, but this difference was not statistically significant ($p = 0.3$). In addition, 45.3% of the Hispanic patients had none to minimal disability at discharge, and 38.6% had moderate to severe disability; 42.7% of the non-Hispanic patients had none to minimal disability at discharge, and 38.2% had moderate to severe disability. None of the differences in disability between Hispanic and non-Hispanic patients in the border states was statistically significant ($p > 0.05$).

In the nonborder states, 785 (6.2%) Hispanic patients and 11,901 (93.8%) non-Hispanic patients were admitted for SAH (mean age 64 ± 28 years for both groups). Of the Hispanic patients, 497 (63.3%) were women, and 7645 (64.2%) of the non-Hispanic patients were women.

Table 2 presents the demographic and clinical characteristics of the SAH patients admitted in the nonborder states. Hispanic and non-Hispanic patients in these states presented similar rates of comorbidities, except for diabetes mellitus, the rate of which was again significantly higher among the Hispanic patients ($p = 0.01$). In the nonborder states, Hispanic and non-Hispanic patients did not statistically significantly differ in in-hospital complications, and Hispanic patients were surgically treated for SAH at rates similar to those of non-Hispanic patients (14.0% vs 15.6%, $p = 0.6$). The mean LOS in the nonborder states was 12.0 ± 37.8 days for Hispanic patients and 11.0 ± 25.5 days for non-Hispanic patients ($p < 0.001$). Similar to the findings for the border states, Hispanic patients in the nonborder states accrued higher hospital care charges than did their non-Hispanic counterparts ($p < 0.001$). Non-Hispanic patients in the nonborder states tended to have higher rates of in-hospital death (23.4%) than did Hispanic patients (18.6%) ($p = 0.07$). In the nonborder states, 42.2% of the Hispanic patients had none to minimal disability, and 39.1% had moderate to severe disability at discharge;

38.3% of non-Hispanic patients had none to minimal disability, and 38.3% had moderate to severe disability at hospital discharge. None of the differences in disability between Hispanic and non-Hispanic patients in the border states was statistically significant ($p > 0.05$).

Border Versus Nonborder States

Table 3 shows the outcomes data for Hispanic patients in border and nonborder states. A greater proportion of patients in the nonborder states reported having dyslipidemia, that is, 10.2% of patients in nonborder states versus 4.5% of patients in border states ($p = 0.03$). Hispanic patients in border states had a higher incidence of urinary tract infections during their hospital stay (25.2% vs 16.3%, $p = 0.04$). During their stay, Hispanic patients in border and nonborder states underwent similar proportions of in-hospital procedures that included surgical clipping, endovascular coiling, cerebral angiography, intubation, and mechanical intubation. The average LOS for Hispanic patients was 13.0 ± 31.4 days in the border states and 12.0 ± 37.8 days in the nonborder states ($p = 0.005$). Hispanic patients in the border states were billed on average \$219,260 for their hospital stay, and Hispanic patients in the nonborder states had hospital costs of on average \$192,418, resulting in a statistically significant difference of \$26,842 ($p < 0.001$). Disposition at discharge was similar for Hispanic patients in both border and nonborder states, and no statistically significant difference was detected in disability and in-hospital death between these 2 groups (Tables 4 and 5). When adjusted for age and sex, the odds ratio for in-hospital death of Hispanic patients was 0.8 (95% CI 0.5–1.2, $p = 0.4$) in the border states and 0.7 (95% CI 0.5–1.0, $p = 0.09$) in the nonborder states.

Discussion

The data of the patients with SAH in the present study were from the NIS database (collected in 2011) and were analyzed to identify any differences in outcomes and costs of treatments for SAH among Hispanic and non-Hispanic white patients in US border and nonborder states. Our analyses showed that Hispanic patients had a greater prevalence of hypertension and diabetes than non-Hispanics, regardless of state. This finding is alarming because hypertension alone increases the risk for SAH 2.5-fold.¹ Moreover, in a report from the Brain Attack Surveillance in Corpus Christi Project, conducted in a predominantly Mexican-American community, a higher prevalence of diabetes mellitus among Hispanics has been linked to a higher incidence of stroke among individuals of this group than among non-Hispanic whites.⁷ As the Hispanic population continues to grow, prevalence of hypertension and diabetes in this population will continue to place Hispanics at increased risk for SAH. For this reason, it is important that programs for prevention of hypertension, diabetes, and other modifiable risk factors be implemented in this population.

Our data also showed that Hispanic patients in border states were more likely than their non-Hispanic counterparts to be treated with surgical clipping. Of note, recent studies have shown that by decreasing the risk for rebleed-

TABLE 2. Demographics of Hispanic and non-Hispanic SAH patients in nonborder states

Variable	No. of Patients (%)		p Value
	Hispanic (n = 785)	Non-Hispanic (n = 11,901)	
Comorbidities			
Hypertension	616 (78.5)	8446 (71.0)	0.080
Diabetes mellitus	211 (26.9)	2030 (17.1)	0.010
Dyslipidemia	80 (10.2)	755 (6.3)	0.100
Atrial fibrillation	50 (6.4)	1206 (10.1)	0.100
Congestive heart failure	64 (8.2)	915 (7.7)	0.800
Chronic lung disease	103 (13.1)	1733 (14.6)	0.600
Renal failure	69 (8.8)	757 (6.4)	0.400
Alcohol abuse	34 (4.3)	656 (5.5)	0.300
Nicotine dependence	143 (18.2)	2574 (21.6)	0.200
In-hospital complications			
Pneumonia	45 (5.7)	810 (6.8)	0.600
Deep venous thrombosis	8 (1.0)	214 (1.8)	0.300
Urinary tract infection	128 (16.3)	1912 (16.1)	0.900
Sepsis	42 (5.4)	480 (4.0)	0.500
Pulmonary embolism	4 (0.5)	143 (1.2)	0.200
Myocardial infarction	0 (0.0)	42 (0.4)	
In-hospital procedures			
Cerebral angiography	445 (56.7)	5967 (50.1)	0.300
Gastrostomy	59 (7.5)	945 (7.9)	0.800
Tracheostomy	0 (0.0)	27 (0.2)	
Mechanical ventilation	127 (16.2)	1793 (15.1)	0.700
Intubation	172 (21.9)	2528 (21.2)	0.700
Transfusion	64 (8.2)	879 (7.4)	0.700
Endovascular coiling	236 (30.1)	2597 (21.8)	0.200
Surgical clipping	110 (14.0)	1859 (15.6)	0.600
Mean LOS in days	12.0 ± 37.8	11.0 ± 25.5	<0.001
Mean hospital charge in US\$ (± SD)	192,418 ± 475,784	144,859 ± 366,146	<0.001
Hospital bed size			0.500
Small	25 (3.2)	660 (5.7)	
Medium	122 (15.6)	2175 (18.7)	
Large	637 (81.2)	8796 (75.6)	
Hospital location			
Urban	785 (100)	11,331 (97.4)	
Rural	0 (0.0)	300 (2.6)	
Hospital teaching status			0.500
Nonteaching	168 (21.4)	2989 (25.7)	
Teaching	617 (78.6)	8643 (74.3)	
Discharge disposition			
None to min disability	331 (42.2)	4557 (38.3)	0.300
Moderate to severe disability	307 (39.1)	4563 (38.3)	0.800
In-hospital death	146 (18.6)	2781 (23.4)	0.070

ing, particularly among patients with aneurysmal SAH, endovascular coiling leads to better outcomes than surgical clipping.¹⁴ The reason why clipping was more frequently used than coiling in Hispanic patients in border states is unknown, and this lack of information may be considered a limitation of our study. Clipping compared with coiling

has also been found to be associated with higher hospital charges and longer LOS of patients with both ruptured and unruptured aneurysms.⁵ This observation is in agreement with our findings, as Hispanic patients in the border states also had higher hospital charges and a longer LOS than their non-Hispanic counterparts and Hispanics in nonbor-

TABLE 3. Summary of differences between Hispanic SAH patients treated in border or nonborder states

Variable	No. of Patients (%)		p Value
	Border State (n = 1525)	Nonborder State (n = 785)	
Mean age in years ($\pm$ SD)	61.0 $\pm$ 28.3	64.0 $\pm$ 28.0	0.900
Women	954 (62.6)	497 (63.3)	0.800
Comorbidities			
Hypertension	1202 (78.8)	616 (78.5)	0.900
Diabetes mellitus	387 (25.4)	211 (26.9)	0.700
Dyslipidemia	68 (4.5)	80 (10.2)	0.030
Atrial fibrillation	66 (4.3)	50 (6.4)	0.200
Congestive heart failure	142 (9.3)	64 (8.2)	0.600
Chronic lung disease	137 (9.0)	103 (13.1)	0.100
Renal failure	129 (8.5)	69 (8.8)	0.900
Alcohol abuse	103 (6.8)	34 (4.3)	0.100
Nicotine dependence	189 (12.4)	143 (18.2)	0.100
In-hospital complications			
Pneumonia	116 (7.6)	45 (5.7)	0.400
Deep venous thrombosis	11 (0.7)	8 (1.0)	0.600
Urinary tract infection	384 (25.2)	128 (16.3)	0.040
Sepsis	119 (7.8)	42 (5.4)	0.300
In-hospital procedure			
Cerebral angiography	734 (48.1)	445 (56.7)	0.300
Gastrostomy	145 (9.5)	59 (7.5)	0.300
Mechanical ventilation	242 (15.9)	127 (16.2)	0.900
Intubation	311 (20.4)	172 (21.9)	0.600
Transfusion	105 (6.9)	64 (8.2)	0.600
Endovascular coiling	327 (21.4)	236 (30.1)	0.200
Surgical clipping	334 (21.9)	110 (14.0)	0.100
Mean LOS in days ($\pm$ SD)	13.0 $\pm$ 31.4	12.0 $\pm$ 37.8	0.005
Mean hospital charges in US\$ ($\pm$ SD)	219,260 $\pm$ 652,662	192,418 $\pm$ 475,784	<0.001
Hospital bed size			0.600
Small	16 (1.2)	25 (3.2)	
Medium	196 (14.5)	122 (15.6)	
Large	1142 (84.3)	637 (81.2)	
Hospital location			
Urban	1356 (100)	785 (100)	
Rural	0 (0.0)	0 (0.0)	
Hospital teaching status			0.400
Nonteaching	425 (31.4)	168 (21.4)	
Teaching	930 (68.6)	617 (78.6)	
Discharge disposition			
None to min disability	691 (45.3)	331 (42.2)	0.800
Moderate to severe	588 (38.6)	307 (39.1)	0.700
In-hospital death	245 (16.1)	146 (18.6)	0.400

der states (Fig. 1). One important factor to consider is that many Hispanics lack access to quality medical care and lack knowledge to identify the warning signs of stroke.⁸ Delayed treatment in this patient population may also be contributing to a longer LOS, and this delay therefore contributes to higher costs of hospitalization. Hispanics are also less likely to have health insurance, which represents

another barrier to accessing needed care at the time of a stroke presentation and to stroke prevention.¹⁵ The lack of infrastructure and of trained personnel currently affecting many of the border towns may also be playing a role in why Hispanic patients in the border states are not receiving the appropriate treatment and are therefore staying longer in the hospital, resulting in additional costs.¹¹

TABLE 4. Treatment outcomes among Hispanic patients in border states

Outcome	OR (95% CI)					
	Unadjusted	p Value	Adjusted for Age & Sex	p Value	Adjusted for Age, Sex, & Confounding Factors*	p Value
None to min disability	1.1 (0.8–1.4)	0.4	1.0 (0.8–1.3)	0.8	1.0 (0.8–1.4)	0.7
Moderate to severe disability	1.0 (0.8–1.3)	0.9	1.0 (0.8–1.4)	0.6	1.0 (0.8–1.3)	0.9
In-hospital death	0.8 (0.5–1.2)	0.3	0.8 (0.5–1.2)	0.4	0.8 (0.6–1.3)	0.5

* Only factors statistically significant (at $p < 0.05$) in univariate analyses were included in this analysis.

TABLE 5. Treatment outcomes among Hispanic patients in nonborder states

Outcome	OR (95% CI)					
	Unadjusted	p Value	Adjusted for Age & Sex	p Value	Adjusted for Age, Sex, & Confounding Factors*	p Value
None to min disability	1.2 (0.8–1.6)	0.30	1.2 (0.8–1.6)	0.30	1.2 (0.8–1.6)	0.30
Moderate to severe disability	1.0 (0.7–1.4)	0.80	1.0 (0.7–1.4)	0.70	1.0 (0.7–1.3)	0.90
In-hospital death	0.7 (0.5–1.0)	0.07	0.7 (0.5–1.0)	0.09	0.8 (0.6–1.1)	0.10

* Only factors statistically significant (at $p < 0.05$) in univariate analyses were included in this analysis.

Subarachnoid hemorrhage can be very devastating, causing 60% of SAH survivors to have some form of disability and resulting in a 50% mortality rate; however, being white has been found to be associated with better outcomes in previous reports.¹ In contrast, non-Hispanic and Hispanic patients with SAH in the border states showed similar disability and mortality rates in our study. This observation opens up the question of whether the most appropriate and cost-effective treatments are being implemented in border states.

Study Limitations

One limitation of the present study is its retrospective nature. The reporting of race in the NIS is not very accurate because race is self-reported in this database. Furthermore, the term “Hispanic” is being used for Hispanics of different descent, such as Mexican, Puerto Rican, and Cuban, whose predominance may differ among states. Also, because the NIS database was lacking a significant amount of data in specific fields, including hospital volume and zip codes of patients’ residences, we were unable to characterize hospital treatment patterns or whether patients were coming to treatment sites that were close or distant to the border. Moreover, we were unable to classify patients into those who were undocumented aliens and those who were documented aliens or US citizens. Therefore, we could not perform additional analysis required for understanding the underlying reasons for the observed disparities in treatment outcomes and costs for Hispanic patients with SAH in border states. Another limitation was the lack of information on inclusion and exclusion criteria that were used to choose clipping versus coiling or neither treatment approach for the SAH patients in the present study.

Conclusions

Our results indicate that a disparity in treatment for SAH exists between Hispanic patients in border states and those in nonborder states. In the border states, Hispanic patients were more likely to undergo surgical clipping

than non-Hispanic patients, despite the fact that coiling has been associated with better outcomes. In particular, the data in the present study also show that SAH patients in the border states were staying longer in the hospital and were being charged more per hospitalization, with Hispanic patients accruing the highest charges and having a longer LOS in the hospital. These higher charges put a greater economic burden on a population that is generally less affluent.¹⁵ Further research is needed to determine the cost-effectiveness of the SAH treatments, as mortality and disability rates were not affected by the type of treatment. Moreover, implementing interventions to prevent stroke are particularly needed for Hispanic individuals to reverse an increase in hypertension and diabetes and, in turn, avert a future rise in stroke incidence in this population.

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Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: Hassan, Qureshi. Acquisition of data: Hassan. Analysis and interpretation of data: Hassan. Drafting the article: Hassan. Critically revising the article: Hassan, Villanueva, Malik, Shariff. Reviewed submitted version of manuscript: all authors. Statistical analysis: Hassan. Administrative/technical/material support: Hassan. Study supervision: Hassan, Qureshi.

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