Published in final edited form as:

J Stroke Cerebrovasc Dis. 2020 February ; 29(2): 104567. doi:10.1016/j.jstrokecerebrovasdis.2019.104567.

Race, Socioeconomic Status, and Gastrostomy after Spontaneous Intracerebral Hemorrhage

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Abstract

Introduction—Spontaneous intracerebral hemorrhage is a disabling form of stroke, and some patients will require nutritional interventions for dysphagia. We sought to determine if socioeconomic status indicators mediate whether minorities undergo gastrostomy tube placement.

Materials and Methods—Patients with spontaneous intracerebral hemorrhage were enrolled in a single center, observational cohort study from 2010 to 2017. A socioeconomic index score was imputed using neighborhood characteristics by patients' ZIP code, according to an established method utilizing six indicators of wealth/income, education and occupation. Multivariable logistic regression models were generated and stratified by racial/ethnic groups to determine the association of socioeconomic status with gastrostomy tube placement.

Results—Among 512 patients, 93 (18.2%) underwent gastrostomy tube placement. There were 245 Whites, 220 Blacks, and 47 Hispanic. Blacks underwent the highest percentage of gastrostomy placement (22.7%), and Whites had the lowest percentage (13.5%). Among patients

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Conflicts of Interests: The authors declare that they have no conflicts of interest.

with gastrostomy, Blacks and Hispanics had lowest median socioeconomic index (−2.1 [IQR: −3.0,0.7]; 0.7 [IQR: −1.6,2.9], respectively, $p < 0.001$). Increasing intracerebral hemorrhage score was correlated with higher odds of gastrostomy across all groups (p -values < 0.01) but only Hispanics had reduced adjusted odds of gastrostomy with increasing socioeconomic index (OR 0.56; 95% 0.33–0.84; $p = 0.01$).

Discussion—Racial/ethnic minorities had lower socioeconomic index and underwent more gastrostomy placement. Socioeconomic index was independently associated with gastrostomy only in Hispanics, in whom the odds of gastrostomy decreased with increasing socioeconomic index.

Summary & Conclusion—Differences in utilization of gastrostomy were evident among minorities, and socioeconomic status may mediate this relationship among Hispanics.

Keywords

healthcare disparities; minority health; stroke; intracerebral hemorrhage; socioeconomic position

Introduction

Dysphagia after stroke is common, affecting 27% to 50% of patients, and is associated with increased risk of mortality.(1,2) Decisions about gastrostomy placement after acute stroke are influenced by many factors including whether life-prolonging measures should be provided and are often made by surrogate decision-makers.(3) The optimal timing for gastrostomy is controversial, but studies have documented that decision-makers often feel inadequately prepared when proceeding with the procedure.(3–6) Cultural differences in end-of-life practices, medical illiteracy, lack of advance directives, and other disadvantages disproportionately affect low socioeconomic status (SES) and ethnic/racial minority groups in ways that may influence care decisions.(7–9)

Spontaneous intracerebral hemorrhage (ICH) is a morbid and deadly form of stroke affecting 10–15% of patients with cerebrovascular disease in United States.(11) Studies from population-based national administrative databases have shown increased adjusted odds of gastrostomy tube placement among Blacks, Hispanics and Asians/Pacific Islanders in comparison to Whites,(12) especially among minority men.(13) A qualitative study on preferences for gastrostomy placement among healthy elderly Black patients found that extended lifespan was a priority and all interventions should focus on prolonging life.(8) The factors underpinning these disparities in utilization of life-prolonging procedures have not been fully explored. The end-of-life literature suggest that disparities are driven by a complex interplay between cultural familial interdependence, physician mistrust, preferences for disclosure of diagnosis and prognosis, attitudes towards advanced directives, level of acculturation, and education.(14–16) SES, as defined by low household income and enrollment in Medicaid, have also been associated with increased odds of gastrostomy after ICH(12) but the role of education, occupation and other household and neighborhood factors has not been evaluated. In this study, we use gastrostomy tube insertion as a proxy for maximal care and we assessed the association between a composite SES index score and

preference for gastrostomy after ICH, and whether that relationship was mediated by race/ethnicity.

Materials

Population

Patients presenting to Northwestern Memorial Hospital with spontaneous ICH between January 2010 and March 2017 were prospectively enrolled in an observational study, as previously reported in detail.⁽¹⁷⁾ Briefly, all patients were diagnosed by a board-certified neurointensivist. Patients with ICH attributed to trauma, hemorrhagic conversion of ischemic stroke, structural lesions, or vascular malformations were excluded. All patients were admitted to and managed in a neuro-intensive care unit. The Glasgow Coma Scale (GCS) score and NIH Stroke Scale (NIHSS) score were prospectively recorded at the time of initial evaluation by trained neurologists and/or neurosurgeons. Demographic information, medical history, medication history, standardized clinical instruments (GCS, pre-ICH modified Rankin Scale [mRS]), pretreatment blood pressure, laboratory data, imaging data including hematoma volumes using Analyze software (Mayo Clinic, Rochester, MN) by a semi-automated process, medical management variables, surgical interventions, and medical complications were prospectively recorded, along with the mRS score at 3 months obtained by a validated interview, as has been reported in detail.⁽¹⁷⁾ Patients were self-identified by race as well as ethnicity status. Race and ethnicity were categorized together as non-Hispanic Whites (NHWs), non-Hispanic Blacks (NHBs), and Hispanic Whites (HWs), with the small group of patients of groups excluded due to low sample numbers. Additionally, patients who died within 48 hours of admission were excluded. A schematic illustrating major in-hospital events and points of decision following acute hospitalization for ICH is shown in Figure 1 to elucidate the complex nature of these relationships.

The study was approved by the Northwestern University Institutional Review Board. Written informed consent was obtained from the patient or their legally authorized representative. The institutional review board approved a waiver of consent for patients who died during initial hospitalization, or who were incapacitated and for whom a legal representative could not be located.

Socioeconomic Index

Patient level SES was imputed based on an area index previously described that is calculated from socioeconomic neighborhood indicators from the patients' home ZIP code.⁽¹⁸⁾ Six variables collected by the US Bureau of the Census in 1990 reflecting wealth/income (median household income, median value of housing units, and percentage of households with investments in the form of interest, dividend, or net rental income), education (percentage adults to complete high school or college degrees), and occupation (percentage of persons with executive employment in the form of managerial or professional specialty occupations) were combined into a composite SES index score. Median household income and median value of housing units were log transformed before the construction of the score due to non-normal distribution. For each of the census variables, a Z score was estimated by subtracting the mean and dividing by the standard deviation; Z scores were then summed to

get a final neighborhood summary score, with increasing neighborhood score signifying increasing neighborhood advantage.(18)

Neighborhood data was obtained from five-year (2011–2016) estimates of area-level socioeconomic variables from the American Community Survey (ACS) at the census tract- and block group-level. The ACS is administered annually to a nationally representative sample of about three million American households.(19) Neighborhood data were matched to individual patient ZIP codes. Additionally, the Gini coefficient, which measures income inequality, was extracted from the ACS Fact Finder by ZIP code and compared to calculated area scores.(19)

Statistical Analysis

Descriptive statistics comparing patients with gastrostomy and stratified by ethnic/racial subgroup to those without maximal care were compared using students t-test and chi-squared test for continuous and categorical variables, respectively. When necessary, the Fisher exact test and Wilcoxon-Mann-Whitney test were used for small cell counts. Non-normally distributed data are presented using median and interquartile range (IQR).

Multivariable binary logistic regression models were constructed to test the association of combined predictors with gastrostomy placement as the primary outcome stratified by ethnic/racial group. Collinearity was assessed across all predictive variables. Statistical tests were considered significant if $p < 0.05$. Odds ratios (ORs) are presented with 95% confidence intervals (CIs). Data were analyzed using R version 3.5.0 (R Foundation for Statistical Computing, Vienna, Austria).

Results

There were 245 NHW, 220 NHBs, and 47 HWs suffering from ICH over the study period representing a total of 512 patients. Characteristics of patients by gastrostomy status are summarized in Table 1. Ninety-three patients (18.2%) underwent gastrostomy. NHBs underwent the highest percentage of PEG placement (22.7%), and NHWs had the lowest percentage (13.5%, Table 1). The median time to gastrostomy was 10 days (IQR: 7–13), with no difference in time to procedure across the three ethnic/racial groups ($p = 0.75$). The median SES score was significantly lower in the gastrostomy group (0.45 [IQR: –2.38, 3.57]) when compared to patients without gastrostomy (2.18 [IQR: –1.76, 6.58], Table 1). This effect was most concentrated among NHBs (–2.12; [IQR: –2.97, 0.68], Table 2). Figure 2 shows a density distribution plot of SES index scores by ethnic/racial group, showing that NHWs have the greatest density distribution of high index scores. There was no difference in Gini coefficient across groups or by procedure frequency (p -values > 0.05). Risk of mortality was similar across the three ethnic/racial groups ($p = 0.67$), even when stratified by gastrostomy status (Table 2). Withdrawal of care was undertaken in 56% of patients without gastrostomy and only 5% among the gastrostomy group. Overall NHWs had the highest frequency (51%), followed by HWs (40%), and NHBs (34%) but among the gastrostomy group, during the acute hospitalization, only one patient underwent withdrawal of care among NHBs.

In multivariable regression analysis, increasing ICH score was associated with gastrostomy across all ethnic/racial subgroups (p-values < 0.01 , Table 3), after adjustment for sex, age, and imputed SES index score. GCS was also evaluated in the multivariable model but found to be highly collinear with ICH score, and proved to be less predictive of the outcome. SES index score was not associated with gastrostomy placement among NHWs or NHBs, meanwhile in HWs higher SES index was associated with lower odds of gastrostomy placement (OR 0.56, 95%CI: 0.33–0.84, $p = 0.01$).

Discussion

The decision for gastrostomy tube placement after severe ICH, differed by both ethnicity/race and SES, but an independent effect of SES on care decisions was only observed in HW patients. The distribution of SES index scores was generally high in NHW patients and low in NHB patients in our sample, and no independent effect of SES was seen in these 2 groups. The SES distribution for HW patients was much broader, and among HW patients' higher SES index scores was associated with lower odds of pursuing gastrostomy. These data suggest that socioeconomic factors may inform end-of-life care decisions among Hispanic populations, but our inference is limited by power and patient-level socioeconomic factors.

The decision to proceed with a life-prolonging procedure, such as a gastrostomy, is often undertaken by surrogate decision makers following a thorough stroke evaluation. Gastrostomy served as a proxy for maximal care, as this procedure can represent an important decision point for patients after life-disabling stroke. The decision to proceed with life-prolonging procedures, such as gastrostomy or tracheostomy, is led by a neuro-intensivist and stroke provider at our institution. Our workforce is 15% minority status, and translator services are used in the decision-making and consent process when a language barrier is present. Additionally, our clinical providers practice culturally competent methodologies to minimize differences between surrogate decision makers and the medical or surgical team. Evidence based guidelines on timing of gastrostomy following ICH are limited (2,3) and as a result, numerous clinical, cultural, patient, and physician factors influence the process of choosing to prolong the life of patients severely affected after stroke. Despite our best efforts to minimize these factors in the clinical practice at our institution, we recognize that disparities in utilization of life-prolonging procedures following stroke have been well characterized among minority groups (8,12,20) and are present among in our patient population. Qualitative literature on terminally-ill patients has addressed some of the deterministic factors. Minority patients have also been less likely to undergo withdrawal of care after spontaneous ICH despite no differences in mortality, which is validated in this study.(9) Hispanics or Latinos caring for terminally ill family members suggest this process is viewed as family-centered, and consideration should include all family members in addition to the patient.(15) Additionally, there can be cultural preferences for beneficence over autonomy in such extreme circumstances.

SES is an important determinant influencing these preferences.(12) How specific elements mediate disparities in utilization of life prolonging procedures after stroke is not clearly described beyond insurance status and household income. It is possible that higher SES and

educational attainment influence the health literacy of decision makers. Health literacy may play an important role but can so be confounded by language barriers, which were not collected in our prospective cohort. White and Black patients and their surrogates tend to value patient autonomy, but Black patients more often elect for more life prolonging procedures with trust or lack of trust in family members and healthcare system serving as an important factor in decision making.(7,8,16) The NHB patients in our cohort had the highest percentage (22.7%) of gastrostomy in comparison to the other groups, accounted for over half of all gastrostomy tubes placed, and had the lowest SES index score. Male sex and ICH score were significant covariates associated with gastrostomy placement among NHB patients. These data cannot inform as to how SES factors specifically influence decision making, but a hypothesis would be that components of higher SES, for example, higher income and educational attainment, might be associated with greater institutional trust and differences in care goals among Hispanics.

There are several important limitations to this study, most importantly generalizability and small sample bias. The patients included in this study come from a single urban academic hospital, which may not generalize to hospitals with different institutional characteristics or service population demographics. Important patient level factors such as education, language proficiency, and income were not collected in this study. Cultural or physician related factors that also influence these relationships could not be evaluated; specifically, it is not known if certain care providers are associated with higher gastrostomy rates or to which patients' gastrostomy is being offered. Finally, neighborhood SES is an imprecise surrogate for individual SES, and aggregate SES scores may obscure the relative influence of component factors.

Conclusions

Ethnic/racial minorities elected for more maximal care, as measured by gastrostomy placement after ICH, and had lower SES compared to NHWs. Higher SES was independently associated with lower likelihood of pursuing gastrostomy among Hispanic patients. Further work should focus on identifying patient level socioeconomic and educational factors that underpin these relationships.

Acknowledgements:

Dr. Naidech receives support from Agency for Healthcare Research and Quality grant K18 HS023437. Dr. Maas receives support from National Institutes of Health grants K23 NS092975. Dr. Garcia serves as the StrokeNet Research fellow under grant U24 NS107233-01. Research reported in this publication was supported by the National Institutes of Health. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Grant Support: Agency for Healthcare Research and Quality grant K18 HS023437, National Institutes of Health NINDS grant K23 NS092975 and NINDS U24 NS107233-01.

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Figure 1. Schematic of possible in-hospital events following acute hospitalization for intracerebral hemorrhage

The complex sequence of in-hospital events following acute spontaneous intracerebral hemorrhage is diagramed. Patients suffering from this disabling form of stroke can undergo numerous invasive life-saving and life-prolonging procedures which can lead to further in-hospital complications and events.

Figure 2. Density Plot Distribution of Socioeconomic Imputed Area Scores by Three Racial/Ethnic Subgroups among Patients with Spontaneous Intracranial Hemorrhage

Imputed socioeconomic index scores are shown by ethnic/racial group according each summary score and plotted by density among 512 patients with spontaneous intracerebral hemorrhage. Six indicators from wealth/income, education and occupation were extracted by patient ZIP code from the five-year (2011–2016) estimates of the American Community Survey and combined into a summary SES index score shown on density plot.

Abbreviations: ¹ = HW, Hispanic Whites; ² = NHB, Non-Hispanic Blacks; ³ = NHW, Non-Hispanic Whites; ⁴ = SES, socioeconomic status.

Table 1:

Characteristics of Patients with Spontaneous Intracerebral Hemorrhagic Stroke by Gastrostomy Tube Placement

	No Gastrostomy	Gastrostomy	p-value
n (total n = 512)	419	93	
Age (mean, SD ¹)	65.87 (15.02)	63.31 (12.09)	0.13
Male Sex (n, %)	199 (47.5)	57 (61.3)	0.02
Ethnicity Race (n, %)			0.03
Hispanic Whites	37 (8.8)	10 (10.8)	
Non-Hispanic Blacks	170 (40.6)	50 (53.8)	
Non-Hispanic Whites	212 (50.6)	33 (35.5)	
Hypertension (n, %)	306 (73.0)	75 (80.6)	0.16
Atrial Fibrillation (n, %)	38 (9.1)	7 (7.5)	0.79
Diabetes Mellitus (n, %)	83 (19.9)	22 (23.7)	0.50
Alcohol Abuse (n, %)	37 (8.9)	12 (12.9)	0.32
Dementia (n, %)	18 (4.3)	0 (0.0)	0.09
Statin (n, %)	88 (21.1)	16 (17.2)	0.49
Antiplatelet Agent (n, %)	0.37 (0.48)	0.32 (0.47)	0.41
Warfarin (n, %)	37 (8.9)	10 (10.8)	0.71
Novel Anticoagulant (n, %)	8 (1.9)	0 (0.0)	0.38
Admission GCS ² (median [IQR ³])	14.00 [11.00, 15.00]	8.00 [6.00, 12.00]	<0.001
Supratentorial Location (n, %)	368 (88.2)	80 (86.0)	0.68
Admission NIHSS ⁴ (median [IQR])	7.00 [2.00, 16.00]	19.00 [12.00, 24.00]	<0.001
ICH ⁵ Score (n, %)			<0.001
0	126 (30.5)	4 (4.3)	
1	133 (33.2)	17 (18.5)	
2	67 (16.2)	36 (39.1)	
3	56 (13.6)	25 (27.2)	
4	23 (5.6)	10 (1.1)	
5	7 (1.7)	0	
6	1 (<1)	0	
Craniotomy (n, %)	34 (8.1)	19 (20.4)	0.001
Tracheostomy (n, %)	5 (1.2)	72 (77.4)	<0.001
Ventriculostomy (n, %)	79 (18.9)	47 (50.5)	<0.001
Disposition (n, %)			<0.001
Home	116 (27.7)	1 (11)	
Rehabilitation	159 (37.9)	25 (26.9)	
Nursing facility	38 (9.1)	26 (28.0)	

	No Gastrostomy	Gastrostomy	p-value
Acute Care	15 (3.6)	38 (40.9)	
Dead	91 (21.7)	3 (3.2)	
Discharge or 14 Day NIHSS (median [IQR])	6.50 [2.00, 20.00]	21.00 [16.00, 24.00]	<0.001
Discharge or 14 Day mRS ⁷ median [IQR])	4.00 [3.00, 5.00]	5.00 [5.00, 5.00]	<0.001
28 Day mRS median [IQR])	4.00 [2.50, 6.00]	5.00 [5.00, 5.00]	<0.01
3 Month mRS (median [IQR])	4.00 [2.00, 6.00]	5.00 [4.00, 5.00]	0.03
Imputed Socioeconomic Factors			
Median Household Income (median [IQR])	64,574.00 [40,353.00, 81,381.00]	53,390.00 [34,397.00, 77,094.00]	<0.01
Median Housing Value (median [IQR])	240,400.00 [155,400.00, 40,9750.00]	187,200.00 [152,600.00, 312,100.00]	0.05
% with High School Degree (median [IQR])	0.19 [0.08, 0.25]	0.20 [0.15, 0.28]	0.08
% with Bachelor's Degree (median [IQR])	0.23 [0.14, 0.39]	0.19 [0.12, 0.32]	0.06
Investments % (median [IQR])	0.19 [0.10, 0.30]	0.14 [0.08, 0.27]	<0.01
Executive Employment % (median [IQR])	12.80 [10.50, 21.95]	11.50 [10.40, 15.20]	0.10
SES ⁶ Index Score (median [IQR])	2.18 [-1.76, 6.58]	0.45 [-2.38, 3.57]	0.01
Gini Coefficient (median [IQR])	0.45 [0.41, 0.50]	0.44 [0.41, 0.50]	0.64

Characteristics of patients with spontaneous intracerebral hemorrhage by gastrostomy tube status from 2010 to 2017 with socioeconomic index factors. Abbreviations:

¹ = SD, standard deviation;

² = GCS, Glasgow Coma Score;

³ = IQR, Interquartile Range;

⁴ = NIHSS, National Institute of Health Stroke Scale;

⁵ = ICH, Intracerebral Hemorrhage;

⁶ = SES, socioeconomic status;

⁷ = mRS, modified Rankin Score.

Table 2:

Imputed Socioeconomic Factors Stratified by Gastrostomy Tube Placement and Ethnic/Racial Groups Among Patients with Spontaneous Intracerebral Hemorrhagic Stroke

	No Gastrostomy				Gastrostomy			
Ethnicity Race	HW ¹	NHB ²	NHW ³	p- value	HW	NHB	NHW	p- value
n	37	170	212		10	50	33	
Time to Gastrostomy (median [IQR ⁴]) in days	-	-	-	-	6.75 (5.013.8)	7.0 (4.0– 10.0)	8 (4.010.0)	0.75
Death (%)	9 (24)	35 (21)	48 (23)	0.48	0	3 (6)	0	0.85
Imputed Socioeconomic Factors Estimates								
Median Household Income (median [IQR])	61,708.00 [53,158.00, 77,094.00]	38,743.50 [32,024.00, 60,692.50]	77,094.00 [62,752.50, 92,545.00]	<0.001	47,450.50 [38,158.75, 65,858.75]	36,978.00 [26,246.00, 54,333.00]	76,587.00 [58,533.00, 92,545.00]	<0.001
Median Housing Value (median [IQR])	259,700.00 [173,500.00, 335,600.00]	159,100.00 [132,300.00, 238,950.00]	316,600.00 [209,700.00, 463,300.00]	<0.001	208,700.00 [155,375.00, 270,100.00]	159,100.00 [138,300.00, 217,600.00]	30,4950.00 [181,275.00, 420,900.00]	<0.001
% with High School Degree (median [IQR])	0.22 [0.15, 0.25]	0.24 [0.18, 0.28]	0.13 [0.07, 0.23]	<0.001	0.25 [0.19, 0.28]	0.20 [0.18, 0.29]	0.16 [0.07, 0.24]	0.04
% with Bachelor's Degree (median [IQR])	0.22 [0.16, 0.30]	0.14 [0.10, 0.23]	0.33 [0.21, 0.39]	<0.001	0.18 [0.09, 0.28]	0.15 [0.10, 0.22]	0.29 [0.18, 0.39]	<0.01
Investments % (median [IQR])	0.19 [0.13, 0.21]	0.10 [0.08, 0.17]	0.29 [0.20, 0.37]	<0.001	0.15 [0.11, 0.21]	0.09 [0.07, 0.16]	0.27 [0.20, 0.36]	<0.001
SES ⁵ Index Score (median [IQR])	1.7 [0.4, 4.9]	-1.9 [-2.6, 0.7]	5.0 [1.7 7.5]	<0.001	0.7 [-1.6, 2.9]	-2.1 [-3.0, 0.7]	4.3 [1.6, 7.3]	<0.001
Gini Coefficient (median [IQR])	0.45 [0.40, 0.48]	0.45 [0.41, 0.50]	0.45 [0.41, 0.51]	0.58	0.41 [0.40, 0.43]	0.45 [0.41, 0.51]	0.43 [0.42, 0.47]	0.21

Characteristics of patients with spontaneous intracerebral hemorrhage by gastrostomy tube status and stratified by ethnicity/race from 2010 to 2017 with socioeconomic index factors.

Abbreviations:

¹ = NW, Hispanic Whites;

² = NHB, Non-Hispanic Blacks;

³ = NHW, Non-Hispanic Whites;

⁴ = IQR, Interquartile Range;

⁵ = SES, socioeconomic status.

Table 3:

Multivariable Logistic Regression Models with Gastrostomy Tube Placement as Primary Outcome Among Patients with Spontaneous Intracerebral Hemorrhagic Stroke by Ethnic/Racial Group

Ethnicity Race	Hispanic Whites				Non-Hispanic Blacks				Non-Hispanic Whites			
Variable	OR ¹	95 % CI ²		P-value	OR	95 % CI		p-value	OR	95 % CI		p-value
Male Sex	2.69	0.41	25.43	0.33	2.45	1.21	5.10	0.01	1.71	0.75	4.08	0.21
Age	1.05	0.99	1.13	0.17	0.98	0.95	1.01	0.18	0.98	0.95	1.01	0.12
ICH ³ Score	4.62	1.68	19.40	0.01	1.88	1.43	2.51	0.00	1.59	1.18	2.16	0.00
SES ⁴ Index Score	0.56	0.33	0.84	0.01	0.99	0.89	1.09	0.87	0.98	0.88	1.11	0.79

Legend:

¹ = OR, Odds Ratio;

² = CI, confidence interval;

³ = ICH, intracerebral hemorrhage;

⁴ = SES, socioeconomic status.