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Sex-Specific Racial and Ethnic Variations in Short-Term Outcomes Among Patients with First or Recurrent Ischemic Stroke: Paul Coverdell National Acute Stroke Program, 2016-2020

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Abstract

Background and Purpose: To understand the association of sex-specific race and ethnicity on the short-term outcomes of initial and recurrent ischemic stroke events.

Methods: Using the Paul Coverdell National Acute Stroke Program from 2016-2020, we examined 426,062 ischemic stroke admissions from 629 hospitals limited to non-Hispanic White (NHW), non-Hispanic Black (NHB), and Hispanic patients. We performed multivariate logistic regression analyses to assess the combined effects of sex-specific race and ethnicity on short-term outcomes for acute ischemic stroke patients presenting with initial or recurrent stroke events. Outcomes assessed include rates of in-hospital death, discharge to home, and symptomatic intracranial hemorrhage (sICH) after reperfusion treatment.

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GA has nothing to disclose.
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KL has nothing to disclose.

Declarations of interest:
None

Results: Among studied patients, the likelihood of developing sICH after reperfusion treatment for initial ischemic stroke was not significantly different. The likelihood of experiencing in-hospital death among patients presenting with initial stroke was notably higher among NHW males (AOR 1.59 [95% CI 1.46, 1.73]), NHW females (AOR 1.34 [95% CI 1.23, 1.45]), and Hispanic males (AOR 1.57 [95% CI 1.36, 1.81]) when compared to NHB females. Hispanic females were more likely to be discharged home when compared to NHB females after initial stroke event (AOR 1.32 [95% CI 1.23, 1.41]). NHB males (AOR 0.90 [95% CI 0.87, 0.94]) and NHW females (AOR 0.89 [95% CI 0.86, 0.92]) were less likely to be discharged to home. All groups with recurrent ischemic strokes experienced higher likelihood of in-hospital death when compared to NHB females with the highest likelihood among NHW males (AOR 2.13 [95% CI 1.87, 2.43]). Hispanic females had a higher likelihood of discharging home when compared to NHB females hospitalized for recurrent ischemic stroke, while NHB males and NHW females with recurrent ischemic stroke hospitalizations were less likely to discharge home.

Conclusions: Sex-specific race and ethnic disparities remain for short-term outcomes in both initial and recurrent ischemic stroke hospitalizations. Further studies are needed to address disparities among recurrent ischemic stroke hospitalizations.

Keywords

Race/Ethnicity; Sex; Outcomes; stroke

INTRODUCTION

Nearly one in four Americans hospitalized with strokes have had a history of a previous stroke.[1-3] In fact, recurrent strokes are more disabling and even costlier than an initial stroke event.[2] As the mortality rates from initial ischemic stroke events have declined over time, the number and cost of individuals with recurrent stroke have become greater concerns.[4] Stroke-related costs in the United States have reached nearly $53 billion, which has included the costs for healthcare services, medications to treat and prevent stroke, and missed days of work.[1]

Over the years, much work has been published on assessing the disparities in stroke care. For instance, significant differences exist between males and females with ischemic stroke as it pertains to etiology, risk factors, clinical manifestations, delays in pre- and in-hospital interventions, and thrombolysis implementation.[5,6] In addition, Non-Hispanic Black (NHB) and Hispanic ischemic stroke patients were less likely to receive reperfusion therapies compared to non-Hispanic White (NHW) patients with ischemic stroke.[6]

The incidence of stroke is known to be higher among NHB and Hispanic populations, but the prevalence within these groups is lower due to higher long-term stroke mortality rates, when compared to the NHW population.[7-9] An increased incidence of stroke among NHB and Hispanic individuals is largely explained by an increased burden of vascular disease risk factors.[9] However, there is some published data that NHB and Hispanic patients with ischemic stroke have better short-term outcomes when compared to NHW ischemic stroke patients,[10] though this remains unclear among those with recurrent ischemic stroke events. For this reason, we elected to study a multistate stroke registry to understand the

association of sex-specific race and ethnicity on the short-term outcomes of initial and recurrent ischemic stroke events.

METHODS

The study is limited to NHW, NHB, and Hispanic patients who were admitted with acute ischemic stroke in the Paul Coverdell National Acute Stroke Program (PCNASP) from 2016-2020; patients with a diagnosis of transient ischemic attack were excluded from this analysis. There were 426,062 admissions from 629 hospitals identified. The PCNASP is supported by the Centers for Disease Control and Prevention (CDC) and is an ongoing acute stroke quality improvement program for patients across the stroke care continuum. During the study period, there were 9 participating states (California, Georgia, Massachusetts, Michigan, Minnesota, New York, Ohio, Washington, and Wisconsin). Hospital participation within each state is voluntary. Trained abstractors collect detailed information on stroke admissions concurrent with or soon after hospital discharge using standard data definitions provided by CDC.[11,12] This study was approved by the CDC Institutional Review Board.

Demographic information collected for each admission included: age, sex, race and ethnicity (Hispanic, NHB, NHW), and insurance status (private, Medicaid, Medicare, and none/self-pay). Baseline clinical characteristics included stroke severity upon presentation as defined by the National Institutes of Health Stroke Scale (NIHSS) score (0-4, 5-24, and 25+), arrival by ambulance, history of hypertension, dyslipidemia, coronary artery disease, heart failure, diabetes mellitus, atrial fibrillation, peripheral artery disease, valvular heart disease, and current tobacco use. We also assessed reperfusion treatment with either intravenous thrombolysis (IVT) or intra-arterial treatment (IAT). Outcomes assessed for our study include in-hospital death, discharge to home, and symptomatic intracranial hemorrhage (sICH) after reperfusion treatment.

For our analysis, descriptive statistics were expressed as means with standard error (SE), medians with interquartile ranges (IQR), and frequency (percentages). Categorical variables were compared across treatment groups using two-tailed Fisher’s exact or chi-square tests. Continuous variables were compared using the Wilcoxon-Mann-Whitney rank test or the Kruskal-Wallis test. We performed multivariate logistic regression analyses using generalized estimating equations (GEE) to assess the combined associations of race and ethnicity and sex on short-term outcomes for acute ischemic stroke patients presenting with initial or recurrent stroke events. We performed the following multivariate analyses by adjusting for age, stroke severity upon presentation, arrival by ambulance, insurance status, reperfusion treatment, and baseline comorbidities (hypertension, dyslipidemia, coronary artery disease, heart failure, diabetes mellitus, atrial fibrillation, peripheral artery disease, valvular heart disease, or current tobacco use). Because NHB patients face the highest burden of stroke mortality[7,13] and females face more severe stroke syndromes,[14] NHB females were used as the reference group in our models. Results of our multivariate analyses are presented as adjusted odds ratios (AOR) with 95% confidence intervals (CI). Statistical analyses were performed using SAS software (version 9.4; SAS Institute, Cary, NC).

RESULTS

Among included patients, the mean age was 70.6 years and 49.4% were females. Among studied patients, 76.1% were NHW, 18.7% were NHB, and 5.2% were Hispanic. The median NIHSS score upon admission was 3 (IQR: 1-8) (Table 1). Approximately 45.6% of patients arrived via ambulance to participating hospitals to seek medical care. Overall, 15.8% of patients received reperfusion treatment either by IVT, IAT, or a combined approach of IVT+IAT, and approximately 49.5% of patients were discharged home. Patients with private insurance comprised 21.9% of patients, Medicaid 8.4%, Medicare 65.0%, and no insurance/self-pay 3.3%.

Baseline and clinical characteristics among patients hospitalized for their initial ischemic stroke event are presented in Table 2. There were significant differences in mean age ($p<0.0001$) at time of hospitalization among males (NHB 62.1±0.1 years, Hispanic 63.2±0.2 years, NHW 69.5±0.04 years) and females (NHB 66.1±0.1 years, Hispanic 67.7±0.2 years, NHW 74.6±0.04 years). Over half of Hispanic (54.5%) and NHB (58.6%) males were aged 18-64 years as compared to NHW males (35.2%). A higher proportion of Hispanic (40.0%) and NHB (45.6%) females were aged 18-64 years as compared to NHW females (22.5%). Insurance status was also significantly different among groups ($p<0.0001$). Most notable were higher proportions of Hispanic and NHB males and females who were Medicaid beneficiaries when compared to NHW males and females. In contrast, higher proportions of NHW males and females were Medicare beneficiaries when compared to Hispanic and NHB males and females. **Stroke severity upon presentation was significantly different across race/ethnicity NIHSS scores ($p<0.0001$).** The proportions of patients receiving reperfusion treatment among groups were significantly different ($p<0.0001$). The proportions of patients experiencing in-hospital death and discharge to home were significantly different among groups ($p<0.0001$).

Among patients hospitalized for recurrent ischemic stroke events (Table 3), age at admission was significantly different ($p<0.0001$) among males (NHB 64.2±0.1 years, Hispanic 66.4±0.2 years, NHW 71.7±0.1 years) and females (NHB 67.1±0.1 years, Hispanic 69.4±0.3 years, NHW 75.7±0.1 years). Higher proportions of NHB (males 51.9%, females 42.4%) and Hispanic (males 43.5%, females 35.7%) patients were aged 18-64 years as compared to NHW (males 28.3%, females 19.6%) patients. Presenting stroke severity by groups were significantly different ($p<0.0001$). Proportions of patients experiencing of reperfusion treatment, in-hospital death and discharged to home, were similar to those presenting with initial stroke in our study ($p<0.0001$).

Among patients with initial stroke, the likelihood of developing sICH after reperfusion treatment was not different among sex-specific racial ethnic groups (Table 4). When compared to NHB females, the likelihood of experiencing in-hospital death among patients presenting with initial stroke was significantly higher among NHW males (AOR 1.59 [95% CI 1.46, 1.73]), NHW females (AOR 1.34 [95% CI 1.23, 1.45]), and Hispanic males (AOR 1.57 [95% CI 1.36, 1.81]) (Table 4). Hispanic females were much more likely to be discharged home when compared to NHB females after initial stroke event (AOR 1.32 [95%

CI 1.23, 1.41]). In contrast, NHB males (AOR 0.90 [95% CI 0.87, 0.94]) and NHW females (AOR 0.89 [95% CI 0.86, 0.92]) were less likely to be discharged to home.

All groups with recurrent ischemic strokes experienced higher likelihood of in-hospital death when compared to NHB females in multivariate models, with the highest likelihood among NHW males (AOR 2.11 [95% CI 1.84, 2.41]) (Table 4). Hispanic females had a higher likelihood of discharging home (AOR 1.51 [95%CI 1.35, 1.68]) when compared to NHB females hospitalized for recurrent ischemic stroke, while NHB males (AOR 0.80 [95%CI 0.75, 0.85]) and NHW females (AOR 0.84 [95%CI 0.80, 0.89]) with recurrent ischemic stroke hospitalizations were less likely to discharge home.

DISCUSSION

We found sex-specific racial and ethnic variations in short-term outcomes among patients hospitalized with initial ischemic stroke. What is new is the finding of sex-specific racial and ethnic variations in short-term outcomes for those admitted with recurrent ischemic stroke. In more recent studies, research has focused on disparities in access to reperfusion therapies, including both IVT and IAT. Reperfusion treatment rates are lowest in NHB women,[15] and NHB patients in general were less likely to be treated with IVT due to contraindications to treatment as well as delays in presentation.[16] Over the last decade, however, treatment gaps in IVT and IAT reduced between NHW patients and NHB and Hispanic patients.[5,6,17,] In our study, significant reperfusion treatment gaps continue to exist among sex-specific racial and ethnic groups. This may be explained by ongoing presentation delays and lack of ambulance utilization.[15,18] However, among those who do receive acute reperfusion treatments, no significant outcome differences were found between sex and race/ethnic groups.[5,8,19]

With known racial and ethnic variations in outcomes for initial ischemic stroke admissions,[7,9,13,20] we sought to examine short-term outcomes in our study. Among patients receiving acute reperfusion treatments for initial stroke, there was no association by sex-specific race/ethnicity and post-reperfusion sICH. This confirms findings in other studies examining outcomes for ischemic stroke patients exposed to either IVT or IAT.[5,8,17,19,21] Older age may play a role for the higher likelihood among NHW males, but further investigations are necessary to learn disparities in short-term outcomes among patients hospitalized with recurrent ischemic stroke and receipt of reperfusion treatment.

Early mortality after stroke has been attributed to stroke hospitalizations or recurrent stroke.[22] Previous reports have suggested a higher mortality rate among NHB patients over NHW patients.[23] In our study, we found that NHW males and females along with Hispanic males were more likely as compared to NHB females to suffer in-hospital death for initial ischemic stroke events. Additionally, all patients were more likely to die in the hospital in comparison to NHB females when hospitalized for recurrent ischemic stroke. Higher rates of in-hospital death among NHW patients with initial or recurrent ischemic strokes could be associated with higher rates of opting for Do Not Resuscitate status and withdrawal of care within this group.[10,19] In contrast, racial and ethnic minorities are more likely to favor active interventions in the hospital irrespective of severity or prognosis of stroke.[19]

Discharge to home typically is viewed as a favorable outcome, and racial and ethnic minorities tend to be discharged home more often than NHW patients[24] due to a perception of inferior care at skilled nursing facilities and nursing home.[24,25] This perception is likely based on findings that Hispanic and NHB stroke patients have frequently been readmitted to hospitals if discharged to skilled nursing facilities.[25] Hispanic stroke patients have typically recovered well when discharged home and were less likely to be readmitted to the hospital; this observation could be attributed to the reliance of a strong and extended family unit.[25] These previous perceptions may explain our findings.

Important strengths of our study include the large number of patients from a multi-state registry during regular care delivery. The voluntary nature of the PCNASP limits generalizability, and hospitals more oriented toward quality improvement may be more likely to participate in the registry. Despite the quality improvement initiative, there were still more than 5% of patients missing stroke severity score measured by NIHSS. As a deidentified data set, it remains unclear how many patients within the PCNASP registry were included for both initial and recurrent stroke events. Among patients admitted with recurrent stroke events, it is unclear what baseline deficits the patients may have had prior to their recurrent stroke hospitalizations. However, neither of these limitations should impact the findings within our study on sex-specific racial and ethnic disparities in short-term outcomes.

CONCLUSION

We conclude that from our multistate registry analysis, sex-specific racial and ethnic variations remain for short-term outcomes in both initial and recurrent ischemic stroke hospitalizations. Additional studies are needed to address disparities among recurrent ischemic stroke hospitalizations.

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Table 1:

Demographic and Clinical Characteristics Among Ischemic Stroke Patients by Sex and Race/Ethnicity

Variables	Overall n (%) or statistics (N=426062)	NHW men (n=164294)	NHB men (n=39222)	Hispanic men (n=11949)	NHW women (n=160002)	NHB women (n=40554)	Hispanic women (n=10041)
Mean (SE) age, years	70.6 (0.02)	70.0 (0.03)	62.7 (0.1)	64.0 (0.1)	74.9 (0.04)	66.5 (0.1)	68.1 (0.2)
Age in groups							
18-44	18734 (4.4)	5525 (3.4)	2894 (7.4)	962 (8.1)	5453 (3.4)	3036 (7.5)	864 (8.6)
45-54	39223 (9.2)	14722 (9.0)	6772 (17.3)	1983 (16.6)	9150 (5.7)	5368 (13.2)	1228 (12.2)
55-64	82448 (19.4)	34874 (21.2)	12498 (31.9)	3233 (27.1)	20347 (12.7)	9682 (23.9)	1814 (18.1)
65-74	104214 (24.5)	44420 (27.0)	10072 (25.7)	2935 (24.6)	34640 (21.6)	9935 (24.5)	2212 (22.0)
75-84	101691 (23.9)	40419 (24.6)	5165 (13.2)	1965 (16.4)	44252 (27.7)	7630 (18.8)	2260 (22.5)
85+	79752 (18.7)	24334 (14.8)	1821 (4.6)	871 (7.3)	46160 (28.8)	4903 (12.1)	1663 (16.6)
Insurance							
Medicaid	35720 (8.4)	10318 (6.3)	6821 (17.4)	2627 (22.0)	7646 (4.8)	6270 (15.5)	2038 (20.3)
Medicare	276869 (65.0)	105033 (63.9)	18285 (46.6)	5268 (44.1)	119625 (74.8)	23325 (57.5)	5333 (53.1)
Private	93172 (21.9)	41661 (25.4)	10355 (26.4)	2928 (24.5)	27820 (17.4)	8401 (20.7)	2007 (20.0)
Self pay/no insurance	13939 (3.3)	4557 (2.8)	3344 (8.5)	896 (7.5)	2349 (1.5)	2281 (5.6)	512 (5.1)
Not documented	6362 (1.5)	2725 (1.7)	417 (1.1)	230 (1.9)	2562 (1.6)	277 (0.7)	151 (1.5)
Arrival by ambulance	194327 (45.6)	68995 (42.0)	18958 (48.3)	4719 (39.5)	76975 (48.1)	20359 (50.2)	4321 (43.0)
Median (IQR) NIHSS score	3 (1-8)	3 (1-7)	4 (1-8)	3 (1-8)	4 (1-9)	4 (2-10)	4 (1-10)
NIHSS in groups							
0-4	229999 (54.0)	95764 (58.3)	20136 (51.3)	6558 (54.9)	83142 (52.0)	19309 (47.6)	5090 (50.7)
5-24	148090 (34.8)	52214 (31.8)	14567 (37.1)	4269 (35.7)	57297 (35.8)	15929 (39.3)	3814 (38.0)
25+	14148 (3.3)	4247 (2.6)	1111 (2.8)	393 (3.3)	6359 (4.0)	1566 (3.9)	472 (4.7)
Missing	33825 (7.9)	12069 (7.3)	3408 (8.7)	729 (6.1)	13204 (8.3)	3750 (9.2)	665 (6.6)
Reperfusion treatment (n, %)	67368 (15.8)	26299 (16.0)	5603 (14.3)	2005 (16.8)	25872 (16.2)	5709 (14.1)	1880 (18.7)
Outcomes							
Symptomatic ICH after reperfusion treatment	2557 (3.8)	913 (3.5)	198 (3.5)	69 (3.4)	1108 (4.3)	206 (3.6)	63 (3.4)
Discharge to home	210941 (49.5)	86318 (52.5)	20409 (52.0)	6724 (56.3)	71576 (44.7)	20287 (50.0)	5627 (56.0)
In-hospital death	18508 (4.3)	7098 (4.3)	1191 (3.0)	502 (4.2)	7957 (5.0)	1327 (3.3)	433 (4.3)
Comorbidities							
Hypertension	325174 (76.3)	120542 (73.4)	32179 (82.0)	8685 (72.7)	121441 (75.9)	34694 (85.6)	7633 (76.0)

Variables	Overall n (%) or statistics (N=426062)	NHW men (n=164294)	NHB men (n=39222)	Hispanic men (n=11949)	NHW women (n=160002)	NHB women (n=40554)	Hispanic women (n=10041)
Hypercholesterolemia	217559 (51.1)	88687 (54.0)	16743 (42.7)	5192 (43.5)	83766 (52.4)	18605 (45.9)	4566 (45.5)
Diabetes	145655 (34.2)	54195 (33.0)	16179 (41.2)	5577 (46.7)	45842 (28.7)	19104 (47.1)	4758 (47.4)
Current smoker	81679 (19.2)	34294 (20.9)	11889 (30.3)	1930 (16.2)	24477 (15.3)	8159 (20.1)	930 (9.3)
Coronary artery disease	98456 (23.1)	48660 (29.6)	7301 (18.6)	2235 (18.7)	31794 (19.9)	6973 (17.2)	1493 (14.9)
Atrial fibrillation	82597 (19.4)	34230 (20.8)	3810 (9.7)	1375 (11.5)	37278 (23.3)	4463 (11.0)	1441 (14.4)
Heart failure	46617 (10.9)	16428 (10.0)	5047 (12.9)	1000 (8.4)	17836 (11.1)	5389 (13.3)	917 (9.1)
Peripheral artery disease	22812 (5.4)	10623 (6.5)	1519 (3.9)	373 (3.1)	8510 (5.3)	1485 (3.7)	302 (3.0)
Heart valve prosthesis	5972 (1.4)	3070 (1.9)	247 (0.6)	90 (0.8)	2202 (1.4)	293 (0.7)	70 (0.7)

Abbreviations: ICH=intracranial hemorrhage; IQR=interquartile range; NHB=Non-Hispanic black; NHW=Non-Hispanic white; NIHSS=National Institutes of Health Stroke Scale; SE=standard error

Table 2:

Demographic Information Among Initial Acute Ischemic Stroke Patients by Sex and Race/Ethnicity

Variables	NHW men (n=124873)	NHB men (n=27129)	Hispanic men (n=8934)	NHW women (n=122017)	NHB women (n=27505)	Hispanic women (n=7473)	P-value
Mean (SE) age, years	69.50 (0.04)	62.06 (0.08)	63.20 (0.15)	74.62 (0.04)	66.14 (0.09)	67.66 (0.19)	<0.0001
Age in groups							
18-44	4730 (3.8)	2296 (8.5)	825 (9.2)	4538 (3.7)	2309 (8.4)	718 (9.6)	<0.0001
45-54	11927 (9.6)	5013 (18.5)	1578 (17.7)	7214 (5.9)	3799 (13.8)	950 (12.7)	
55-64	27310 (21.9)	8580 (31.6)	2463 (27.6)	15737 (12.9)	6440 (23.4)	1322 (17.7)	
65-74	33449 (26.8)	6620 (24.4)	2088 (23.4)	26516 (21.7)	6449 (23.4)	1600 (21.4)	
75-84	29563 (23.7)	3364 (12.4)	1351 (15.1)	33046 (27.1)	5084 (18.5)	1650 (22.1)	
85+	17894 (14.3)	1256 (4.6)	629 (7.0)	34966 (28.7)	3424 (12.4)	1233 (16.5)	
Insurance							
Medicaid	7827 (6.3)	4670 (17.2)	2008 (22.5)	5672 (4.6)	4265 (15.5)	1522 (20.4)	<0.0001
Medicare	76940 (61.6)	11677 (43.0)	3631 (40.6)	89853 (73.6)	14977 (54.5)	3802 (50.9)	
Private	34151 (27.3)	7852 (28.9)	2335 (26.1)	22543 (18.5)	6307 (22.9)	1614 (21.6)	
Self pay/no insurance	3791 (3.0)	2607 (9.6)	764 (8.6)	1931 (1.6)	1744 (6.3)	409 (5.5)	
Not documented	2164 (1.7)	323 (1.2)	196 (2.2)	2018 (1.7)	212 (0.8)	126 (1.7)	
Arrival by ambulance	50170 (40.2)	12388 (45.7)	3359 (37.6)	56756 (46.5)	13077 (47.5)	3090 (41.3)	<0.0001
Median (IQR) NIHSS score	3 (1-7)	3 (1-8)	3 (1-8)	3 (1-9)	4 (1-9)	4 (1-9)	
NIHSS in groups							
0-4	74755 (59.9)	14808 (54.6)	5105 (57.1)	65357 (53.6)	14044 (51.1)	3963 (53.0)	<0.0001
5-24	38104 (30.5)	9372 (34.5)	3016 (33.8)	42238 (34.6)	10068 (36.6)	2684 (35.9)	
25+	3200 (2.6)	734 (2.7)	282 (3.2)	4699 (3.9)	976 (3.5)	341 (4.6)	
Missing	8814 (7.1)	2215 (8.2)	531 (5.9)	9723 (8.0)	2417 (8.8)	485 (6.5)	
Reperfusion treatment	21301 (17.1)	4277 (15.8)	1607 (18.0)	20892 (17.1)	4255 (15.5)	1442 (19.3)	<0.0001
Outcomes							
Symptomatic ICH after reperfusion treatment	716 (3.4)	160 (3.7)	59 (3.7)	870 (4.2)	155 (3.6)	49 (3.4)	0.002
Discharge to Home	68319 (54.7)	14970 (55.2)	5224 (58.5)	56453 (46.3)	14414 (52.4)	4247 (56.8)	<0.0001
In-hospital death	5350 (4.3)	826 (3.0)	386 (4.3)	6089 (5.0)	941 (3.4)	317 (4.2)	<0.0001
Comorbidities							
Hypertension	88342 (70.7)	21329 (78.6)	6174 (69.1)	89952 (73.7)	22933 (83.4)	5470 (73.2)	<0.0001
Hypercholesterolemia	62840 (50.3)	10096 (37.2)	3465 (38.8)	59838 (49.0)	11215 (40.8)	3169 (42.4)	<0.0001
Diabetes	38189 (30.6)	10367 (38.2)	3822 (42.8)	32326 (26.5)	11973 (43.5)	3352 (44.9)	<0.0001
Current smoker	26410 (21.1)	8350 (30.8)	1461 (16.4)	18844 (15.4)	5492 (20.0)	693 (9.3)	<0.0001
Coronary artery disease	33459 (26.8)	4253 (15.7)	1381 (15.5)	21483 (17.6)	3863 (14.0)	919 (12.3)	<0.0001
Atrial fibrillation	23947 (19.2)	2311 (8.5)	896 (10.0)	26089 (21.4)	2659 (9.7)	986 (13.2)	<0.0001
Heart failure	11182 (9.0)	3130 (11.5)	633 (7.1)	12325 (10.1)	3232 (11.8)	607 (8.1)	<0.0001

Variables	NHW men (n=124873)	NHB men (n=27129)	Hispanic men (n=8934)	NHW women (n=122017)	NHB women (n=27505)	Hispanic women (n=7473)	P-value
Peripheral artery disease	5913 (4.7)	859 (3.2)	203 (2.3)	4633 (3.8)	807 (2.9)	164 (2.2)	<0.0001
Heart valve prosthesis	2126 (1.7)	165 (0.6)	54 (0.6)	1492 (1.2)	180 (0.7)	45 (0.6)	<0.0001

Abbreviations: ICH=intracranial hemorrhage; IQR=interquartile range; NHB=Non-Hispanic black; NHW=Non-Hispanic white; NIHSS=National Institutes of Health Stroke Scale; SE=standard error

Table 3:

Demographic Information Among Recurrent Acute Ischemic Stroke Patients by Sex and Race/Ethnicity

Variables	NHW men (n=39424)	NHB men (n=12093)	Hispanic men (n=3015)	NHW women (n=37985)	NHB women (n=13049)	Hispanic women (n=2568)	P-value
Mean (SE) age, years	71.7 (0.1)	64.2 (0.1)	66.4 (0.2)	75.7 (0.1)	67.1 (0.1)	69.4 (0.3)	<0.0001
Age in groups							
18-44	795 (2.0)	598 (4.9)	137 (4.5)	915 (2.4)	727 (5.6)	146 (5.7)	<0.0001
45-54	2795 (7.1)	1759 (14.5)	405 (13.4)	1936 (5.1)	1569 (12.0)	278 (10.8)	
55-64	7564 (19.2)	3918 (32.4)	770 (25.5)	4610 (12.1)	3242 (24.8)	492 (19.2)	
65-74	10971 (27.8)	3452 (28.5)	847 (28.1)	8124 (21.4)	3486 (26.7)	612 (23.8)	
75-84	10856 (27.5)	1801 (14.9)	614 (20.4)	11206 (29.5)	2546 (19.5)	610 (23.8)	
85+	6440 (16.3)	565 (4.7)	242 (8.0)	11194 (29.5)	1479 (11.3)	430 (16.7)	
Insurance status							
Medicaid	2491 (6.3)	2151 (17.8)	619 (20.5)	1974 (5.2)	2005 (15.4)	516 (20.1)	<0.0001
Medicare	28093 (71.3)	6608 (54.6)	1637 (54.3)	29772 (78.4)	8348 (64.0)	1531 (59.6)	
Private	7510 (19.1)	2503 (20.7)	593 (19.7)	5277 (13.9)	2094 (16.0)	393 (15.3)	
Self pay/no insurance	766 (1.9)	737 (6.1)	132 (4.4)	418 (1.1)	537 (4.1)	103 (4.0)	
Not documented	561 (1.4)	94 (0.8)	34 (1.1)	544 (1.4)	65 (0.5)	25 (1.0)	
Arrival by ambulance	18825 (47.8)	6570 (54.3)	1360 (45.1)	20219 (53.2)	7282 (55.8)	1231 (47.9)	
Median (IQR) NIHSS score	3 (1-8)	5 (2-10)	4 (2-9)	4 (2-10)	5 (2-11)	5 (2-11)	
NIHSS in groups							
0-4	21009 (53.3)	5328 (44.1)	1453 (48.2)	17785 (46.8)	5265 (40.3)	1127 (43.9)	<0.0001
5-24	14110 (35.8)	5195 (43.0)	1253 (41.6)	15059 (39.6)	5861 (44.9)	1130 (44.0)	
25+	1047 (2.7)	377 (3.1)	111 (3.7)	1660 (4.4)	590 (4.5)	131 (5.1)	
Missing	3255 (8.3)	1193 (9.9)	198 (6.6)	3481 (9.2)	1333 (10.2)	180 (7.0)	
Reperfusion treatment	4998 (12.7)	1326 (11.0)	398 (13.2)	4980 (13.1)	1454 (11.1)	438 (17.1)	<0.0001
Outcomes							
Symptomatic ICH after reperfusion treatment	197 (3.9)	38 (2.9)	10 (2.5)	238 (4.8)	51 (3.5)	14 (3.2)	0.006
Discharge to home	17999 (45.7)	5439 (45.0)	1500 (49.8)	15123 (39.8)	5873 (45.0)	1380 (53.7)	<0.0001
In-hospital death	1748 (4.4)	365 (3.0)	116 (3.8)	1868 (4.9)	386 (3.0)	116 (4.5)	<0.0001
Comorbidities							
Hypertension	32200 (81.7)	10850 (89.7)	2511 (83.3)	31489 (82.9)	11761 (90.1)	2163 (84.2)	<0.0001
Hypercholesterolemia	25847 (65.6)	6647 (55.0)	1727 (57.3)	23928 (63.0)	7390 (56.6)	1397 (54.4)	<0.0001
Diabetes	16006 (40.6)	5812 (48.1)	1755 (58.2)	13516 (35.6)	7131 (54.6)	1406 (54.8)	<0.0001
Current smoker	7884 (20.0)	3539 (29.3)	469 (15.6)	5633 (14.8)	2667 (20.4)	237 (9.2)	<0.0001
Coronary artery disease	15201 (38.6)	3048 (25.2)	854 (28.3)	10311 (27.1)	3110 (23.8)	574 (22.4)	<0.0001
Atrial fibrillation	10283 (26.1)	1499 (12.4)	479 (15.9)	11189 (29.5)	1804 (13.8)	455 (17.7)	<0.0001
Heart failure	5246 (13.3)	1917 (15.9)	367 (12.2)	5511 (14.5)	2157 (16.5)	310 (12.1)	<0.0001

Variables	NHW men (n=39424)	NHB men (n=12093)	Hispanic men (n=3015)	NHW women (n=37985)	NHB women (n=13049)	Hispanic women (n=2568)	P-value
Peripheral artery disease	4710 (11.9)	660 (5.5)	170 (5.6)	3877 (10.2)	678 (5.2)	138 (5.4)	<0.0001
Heart valve prosthesis	944 (2.4)	82 (0.7)	36 (1.2)	710 (1.9)	113 (0.9)	25 (1.0)	<0.0001

Abbreviations: ICH=intracranial hemorrhage; IQR=interquartile range; NHB=Non-Hispanic black; NHW=Non-Hispanic white; NIHSS=National Institutes of Health Stroke Scale; SE=standard error

Table 4:

Associations of Sex and Race/Ethnicity on Outcomes of In-hospital Death, Discharge to Home, and Symptomatic ICH*

		Initial acute ischemic stroke	Recurrent acute ischemic stroke
Symptomatic ICH after reperfusion treatment	NHW men	0.94 (0.78, 1.13)	1.20 (0.87, 1.65)
	NHB men	1.09 (0.87, 1.37)	0.85 (0.55, 1.31)
	Hispanic men	0.98 (0.71, 1.33)	0.72 (0.36, 1.45)
	NHW women	1.05 (0.88, 1.26)	1.28 (0.93, 1.76)
	NHB women	Ref	Ref
	Hispanic women	0.86 (0.62, 1.19)	0.87 (0.48, 1.60)
In-hospital Death	NHW men	**1.59 (1.46, 1.73)**	**2.11 (1.84, 2.41)**
	NHB men	1.08 (0.97, 1.21)	**1.39 (1.17, 1.64)**
	Hispanic men	**1.57 (1.36, 1.81)**	**1.47 (1.14, 1.89)**
	NHW women	**1.34 (1.23, 1.45)**	**1.65 (1.44, 1.89)**
	NHB women	Ref	Ref
	Hispanic women	1.10 (0.94, 1.28)	**1.53 (1.20, 1.96)**
Discharge to Home	NHW men	0.96 (0.93, 1.00)	**0.84 (0.80, 0.89)**
	NHB men	**0.90 (0.87, 0.94)**	**0.80 (0.75, 0.85)**
	Hispanic men	1.05 (0.99, 1.12)	1.03 (0.94, 1.13)
	NHW women	**0.89 (0.86, 0.92)**	**0.84 (0.80, 0.89)**
	NHB women	Ref	Ref
	Hispanic women	**1.32 (1.23, 1.41)**	**1.51 (1.35, 1.68)**

*Adjusted by age, arrival by ambulance, National Institutes of Health Stroke Scale score, reperfusion treatment, insurance status, and comorbidities

Abbreviations: ICH=intracranial hemorrhage; IQR=interquartile range; NHB=Non-Hispanic black; NHW=Non-Hispanic white