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Untreated Hypertension: A Powerful Risk Factor for Lobar and Non-Lobar Intracerebral Hemorrhage in Whites, Blacks, and Hispanics

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Abstract

Background—Hypertension is a significant risk factor for intracerebral hemorrhage (ICH). While ethnic/racial disparities related to hypertension and ICH have been reported, these previous studies were limited by a lack of Hispanics and inadequate power to analyze by ICH location. In the current study, while overcoming these prior limitations, we investigated whether there was variation by ethnicity/race of treated and untreated hypertension as risk factors for ICH.

Methods—The Ethnic/Racial Variations of ICH (ERICH) study is a prospective, multicenter, case-control study of ICH among whites, blacks, and Hispanics. Cases were enrolled from 42 recruitment sites. Controls matched to cases 1:1 by age (±5 years), sex, ethnicity/race, and metropolitan area were identified by random-digit dialing. Subjects were interviewed to determine history of hypertension and use of anti-hypertensive medications. Cases and controls within ethnic groups were compared using conditional logistic regression. Multivariable conditional logistic regression models were computed for ICH as an overall group and separately for the location subcategories deep, lobar, and infratentorial (brainstem/cerebellar).

Results—958 white, 880 black, and 766 Hispanic ICH cases were enrolled. For ICH cases, untreated hypertension was higher in blacks (43.6%, p<0.0001) and Hispanics (46.9%, p<0.0001) versus whites (32.7%). In multivariable analyses adjusted for alcohol use, anticoagulation, hypercholesterolemia, education, and medical insurance status, treated hypertension was a significant risk factor across all locations of ICH in whites (odds ratio [OR] 1.57, 95% CI 1.24–1.98, p<0.0001), blacks (OR 3.02, 2.16–4.22, <0.0001), and Hispanics (OR 2.50, 1.73–3.62,

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<0.0001). Untreated hypertension was a substantially greater risk factor for all three racial/ethnic groups across all locations of ICH: whites (OR 8.79, 5.66–13.66, <0.0001), blacks (OR 12.46, 8.08–19.20, <0.0001), Hispanics (OR 10.95, 6.58–18.23, <0.0001). There was an interaction between race/ethnicity and ICH risk (P<0.0001).

Conclusions—Untreated hypertension confers a greater ICH risk in blacks and Hispanics relative to whites across all anatomic locations of ICH. Accelerated research efforts are needed to improve overall hypertension treatment rates and to monitor the impact of such efforts on racial/ethnic disparities in stroke.

Keywords

hypertension; intracerebral hemorrhage; stroke; race; ethnicity

Subject Terms

Hypertension; Intracranial Hemorrhage; Cerebrovascular Disease/Stroke; Race and Ethnicity

Intracerebral hemorrhage (ICH) comprises about 10% of strokes but 50% of stroke mortality.[1, 2] Survivors of ICH often have significant morbidity.[3] Hypertension is a major public health problem, with annual costs directly attributable to hypertension projected to increase by $130.4 billion from 2010 to 2030.[4] Hypertension is the single most important risk factor for all types of stroke,[5] and untreated hypertension is a significant risk factor for hemorrhagic stroke.[6, 7]

There are important ethnic/racial disparities related to hypertension and stroke, including ICH. Blacks have higher rates of hypertension compared with whites,[1] are more likely to develop hypertension at an earlier age, are more likely to experience complications,[8] and have hypertension that is more difficult to control.[9] ICH patients are on average younger than those with ischemic stroke, and a disproportionally large number of these younger patients are from ethnic/racial minorities.[10, 11] Although Hispanics have lower reported rates of hypertension,[12] they are less likely to be screened and treated.[13, 14]

We reported in 2004 that untreated and treated hypertension were significant risk factors for hemorrhagic stroke, including ICH and subarachnoid hemorrhage, in a biracial population.[6] We did not adequately assess differences in ICH by type and location of hemorrhage, and Hispanics were underrepresented in that study. Given the ethical ramifications, randomized trials cannot assess the risk of untreated versus treated hypertension for ICH; however, case-control studies may allow a robust evaluation of the differential risk for ICH conferred by treated and untreated hypertension. We examined the hypothesis that untreated and treated hypertension are significant risk factors for ICH in white, black, and Hispanic patients, and we analyzed the proportion of untreated hypertension in ICH patients in these three ethnic/racial groups. To the best of our knowledge, this is the first report to quantify the impact of both treated and untreated hypertension for ICH risk in blacks, whites and Hispanics.

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METHODS

The Ethnic/Racial Variations of Intracerebral Hemorrhage (ERICH) study is a prospective, multicenter, case-control study of ICH among white, black, and Hispanic patients. The study protocol has been previously published.[2] There were 19 clinical recruitment centers and 42 total recruitment sites. In order to minimize the effect of early mortality following ICH, which is a common barrier to patient recruitment and can result in survival bias, cases were enrolled using hot-pursuit. This enrollment strategy involves early identification of ICH cases through active screening of admission logs from the emergency department, neurology service, neurosurgery service, neurosurgical/neurological intensive care unit, and general admission logs at each recruitment site.[2] Potential cases were reviewed by site investigators. Controls, matched 1:1 to cases by age (±5 years), sex, ethnicity/race, and metropolitan area, were recruited using two random-digit dialing centers. A more detailed description of control recruitment methodology is included in the online supplement. Institutional Review Board approval at each participating center was required before initiation of study enrollment. Informed consent was obtained from each enrolled subject or legally authorized representative.

Recruited ICH patients were self-reported non-Hispanic white, non-Hispanic black, or Hispanic, ≥ 18 years of age, and residents of an area within 75 miles of one of the 19 recruitment centers. A distance of 100 miles was allowed if the population center had fewer than 1 million people. Informed consent was provided by the patient or legal representative. ICH was defined as a spontaneous, nontraumatic, and abrupt onset of severe headache, focal neurologic deficit, or altered level of consciousness associated with a focal blood collection in the brain parenchyma. ICH due to trauma, aneurysm, tumor, dural venous sinus thrombosis, vascular malformation, malignancy associated coagulopathy, or hemorrhagic conversion of an ischemic stroke were excluded. ICH volume was determined by imaging review undertaken centrally.

Among the items on baseline interview, participants (both cases and controls) were asked if they have ever been diagnosed as having hypertension (“history of hypertension”) and they were asked to provide a list of all medications they took in the two weeks prior to ICH onset (for cases) or prior to interview (for controls). There were 34 ICH cases and 2 controls for which hypertension status was unknown, therefore, hypertension variables were missing for these subjects. Elevated blood pressure at the time of study enrollment was not used to define “hypertension” for the present analysis because, for cases, ICH itself can result in elevated blood pressure. Treated hypertension was defined as a history of hypertension plus use of antihypertensive medications. Untreated hypertension was defined as a history of hypertension without use of antihypertensive medications.

STATISTICAL ANALYSIS

Cases and controls within ethnic groups were compared using conditional logistic regression. ICH volumes, being heavily skewed, were natural log transformed to best approximate distributional assumptions. Multivariable conditional logistic regression models were computed for ICH as an overall group and separately for the location subcategories deep, lobar, and infratentorial (brainstem/cerebellar). In each multivariable model, those

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with untreated hypertension and treated hypertension were compared with those without hypertension after adjusting for other risk factor variables. To begin each multivariable model, variables with $p \leq 0.1$ from the univariate analyses were included with subsequent backward elimination. Odds ratios (OR), corresponding confidence intervals (CI), and p-values (significance <0.05) were calculated.

RESULTS

A total of 958 white, 880 black, and 766 Hispanic case-control pairs were enrolled between September 2010 and September 2015. Demographic information is shown for ICH cases by ethnicity/race in Table 1 and by hypertensive status in eTable 1. Among cases of ICH, untreated hypertension was higher in blacks (43.6%, p<0.0001) and Hispanics (46.9%, p<0.0001) compared with whites (32.7%). Medical insurance coverage was identified as a potentially important factor related to access to care and subsequently seeking medical evaluation and treatment. Therefore, the analysis was adjusted for whether a subject had medical insurance, and after this adjustment, a significant difference persisted for the proportion of untreated hypertension in ICH for whites versus Hispanics (p=0.0064), but not for whites versus blacks (p=0.12). After adjusting for medical insurance status and age, given higher mean age for white ICH cases (68.6 years) compared with blacks (58.0 years) and Hispanics (59.3 years), there were no significant differences in untreated hypertension for black (p=0.81) and Hispanic (p=0.14) ICH cases versus whites.

Univariate analyses comparing cases and controls were computed for each of the three ethnic/racial groups (Tables 2–4). To evaluate treated and untreated hypertension as risk factors for ICH, multivariable analyses were controlled for frequent alcohol use, hypercholesterolemia, education, medical insurance status, and anticoagulant use (Figure, eTable 2). Treated hypertension was a significant risk factor across all locations of ICH in whites (OR 1.57), blacks (OR 3.02), and Hispanics (OR 2.50). Untreated hypertension was a substantially greater risk factor across all locations of ICH for all three racial/ethnic groups: whites (OR 8.79), blacks (OR 12.46), Hispanics (OR 10.95). A formal test of interaction between race/ethnicity and ICH risk was highly significant, including separate statistical models for treated and untreated hypertension (P<0.0001 for both).

For deep ICH, treated hypertension was a significant risk factor in whites (OR 2.13), blacks (OR 4.45), and Hispanics (OR 2.28), and untreated hypertension was a much more substantial risk factor for deep ICH: whites (OR 18.98), blacks (OR 20.30), and Hispanics (OR 16.51). In lobar ICH, treated hypertension was a significant risk factor in blacks (OR 1.85), but not in whites (OR 1.18), or Hispanics (OR 1.47), whereas untreated hypertension was a significant risk factor in all three ethnic groups: whites (OR 3.93), blacks (OR 9.21), and Hispanics (OR 6.42). Finally, in patients with infratentorial ICH, treated hypertension was a significant risk factor in Hispanics (OR 7.07), but not in whites (OR 1.53), or blacks (OR 2.28). Untreated hypertension was a significant risk factor for infratentorial ICH in all three ethnic groups: whites (OR 11.64), blacks (5.11), and Hispanics (OR 38.47).

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DISCUSSION

We found that both untreated and treated hypertension were significant risk factors for ICH in white, black, and Hispanic patients, with untreated hypertension representing a substantially greater risk. Over a decade ago, we found results similar to the current study for untreated and treated hypertension and concluded that about one fourth of hemorrhagic strokes could be prevented if all hypertensive patients were treated.[6] A separate study from the same time period verified that untreated hypertension was a significant risk factor for lobar ICH.[7] The current investigation supports the critical role of untreated hypertension as a risk factor for ICH in all three ethnicities, with greater risk noted in blacks and Hispanics compared with whites.

A formal test of interaction between race and hypertension was highly significant, which suggests that untreated hypertension confers a greater ICH risk in blacks and Hispanics relative to whites, or in blacks relative to Hispanics and whites. We acknowledge that the odds ratios for the risk conferred by untreated hypertension for all three groups suggest great risk for all three, but the significant test for interaction and the larger odds ratios do suggest a consistent direction of greater risk in blacks, particularly. Compared with whites, blacks and Hispanics with ICH and a history of hypertension were significantly more likely to have their hypertension untreated. However, after adjusting for medical insurance status there was no longer a significant difference in untreated hypertension for black versus white ICH cases, while a significant difference persisted for Hispanics compared to whites. In a prior report of hypertensive patients, only 58% of uninsured had a blood pressure check within the previous 6 months, compared with 82% of privately insured. Uninsured individuals had lower odds of adequate blood pressure control than privately insured (adjusted odds ratio 0.63, 95% CI 0.44–0.92). Even among individuals treated for hypertension, the uninsured had lower odds of adequate control than privately insured (adjusted odds ratio 0.42, 95% CI 0.23–0.73).[15]

The enrollment of Hispanics, lacking in prior reports,[6, 7] was an important strength of the current study. Survey data from the Pew Research Center found that 45% of Hispanics without a healthcare provider had health insurance.[16] The related literature suggests factors in the Hispanic population beyond access to care, such as delay in seeking care and stopping treatments when symptoms resolve, that adversely affect successfully obtaining treatment.[17] It has also been noted that Hispanics are less likely to be screened and treated specifically for hypertension.[13] Over a 10 year period, despite overall increases in antihypertensive medication use and blood pressure control in adults in the United States, Mexican Americans with hypertension were noted to be less likely to take antihypertensive medication than non-Hispanic whites.[14] Improved understanding of factors contributing to antihypertensive treatment adherence in Hispanics is warranted, along with efforts to improve adherence.

Given that white ICH cases were older compared to blacks and Hispanics, we further adjusted the analysis of untreated hypertension rates for age in addition to medical insurance status. In this model the proportion of untreated hypertension in ICH cases was no longer significantly different among the three ethnic/racial groups. Our findings contribute to the

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larger literature related to persistent ethnic/racial disparities of hypertension diagnosis and treatment, as well as ethnic/racial differences in cardiovascular diseases, including hemorrhagic stroke.

Notably, blacks have an increased risk of ICH at younger ages. The risk of ICH at 45 years of age was more than five times higher for blacks than whites, but only about one third as great for blacks at age 85.[11] Similar results were found in a large pooled cohort with over 263,489 person-years of follow-up.[10] Over 20 years ago, it was reported that the risk of ICH was 2.3 times higher in blacks than whites for those under 75 years of age,[3] and a more recent study found that blacks had 2.90 times greater risk of stroke than whites at 45 years of age, 1.66 times greater risk at 65 years of age, and that about one quarter of the racial disparity in increased stroke risk was attributable to systolic hypertension.[18] Because of this increased incidence of ICH at younger ages, blacks have substantial years of life lost and increased years with disability. We also found a significantly lower age for black and Hispanic ICH patients compared with whites. Our results reinforce previous reports and represent a call to action for efforts to mitigate the unrelenting contribution of unrecognized and untreated hypertension in racial/ethnic minorities to stroke disparities.

Our finding that treated hypertension is also a significant risk factor for ICH is consistent with prior literature in stroke,[19] and specifically hemorrhagic stroke.[6] Though the risk for treated hypertension could be attributed to poor treatment adherence or inadequate control of blood pressure despite treatment, recent evidence suggests that the interaction might be more complex. In a large cohort study of 26,875 black and white patients, it was reported that although pharmacologic treatment to maintain normotensive status markedly reduced risk of stroke, those treated still had higher risk than normotensive individuals who did not require treatment.[20] The increased risk for treated hypertension compared with normotension was also found in a study of men with stroke, myocardial infarction, and mortality from coronary artery disease.[19] Acknowledgment of a residual risk for treated hypertension, even with normotensive status from that treatment, has provided further evidence for the importance of prevention,[20] such as nutritional strategies,[21] and the need for ongoing educational efforts related to hypertension.[22]

We found that treated hypertension was a significant risk factor for ICH in all three ethnic groups. In addition, we found that treated hypertension was a more substantial risk factor in Hispanics (OR 2.5) compared with whites (OR 1.6), and highest overall in blacks (OR 3.0). Blacks have higher rates of treatment resistance to hypertension medications, but the mechanisms of such resistance have not been adequately studied and identified.[23] In a large randomized trial of hypertension medication, black women had the lowest blood pressure control rate (59%), whereas non-black men had the highest rate of control (70%).[24] Compared with whites, blacks were more likely to be aware of their hypertension (OR 1.31, 95% CI 1.07–1.59), those aware of their hypertension were more likely to be on treatment (OR 1.69, 95% CI 1.40–2.05), but those treated were still less likely to have their blood pressure controlled (OR 0.73, 95% CI 0.64–0.83).[9] Using NHANES data from two separate periods, Hertz et al. found that although blood pressure control rates improved in both blacks and whites, there was actually an increase in the ethnic/racial disparity in blood pressure control for those treated, with control of blood pressure in 59.7% of whites but only 48.9%

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of blacks (p<.001).[25] Finally, recent evidence suggests that for a given degree of hypertension, there is a differential stroke risk for blacks vs. whites. Specifically, for each 10 mm Hg increase in systolic blood pressure, there was an 8% increased risk of stroke in whites, but a 24% increased risk in blacks.[26] Our test of interaction confirmed that the risk ICH in our cohort did depend on race/ethnicity, consistent with these prior reports. Further research is needed to elucidate the ethnic/racial disparities of mechanisms of hypertension treatment resistance and increased stroke risk.[23]

Hypertension is the predominant risk factor for deep ICH, while cerebral amyloid angiopathy (CAA) is an important etiology of lobar ICH and more common in the elderly.[27] While many studies suggest that hypertension has a less important role in lobar than deep ICH,[28] a subgroup analysis of the PROGRESS trial reported that blood pressure treatment is likely to provide protection against all types of ICH, including CAA-related ICH.[29] We found that in all three ethnic/racial groups, apart from blacks with untreated hypertension and brainstem/cerebellar ICH, both untreated and treated hypertension conferred less risk for lobar ICH than for all ICH, deep ICH, and brainstem/cerebellar ICH. However, untreated hypertension remained an important risk factor for lobar ICH, particularly in blacks and Hispanics. (Figure, eTable 2).

Limitations of our study include the classification of hypertension based on history as opposed to blood pressure measurements. We also defined treated hypertension as a “history of treatment” without information regarding the blood pressure response to treatment. From the available data, it was not possible to provide an analysis including actual blood pressure values. Given that patient awareness of hypertension is a concern for such a study design, we note an increase in the number of patients aware of their high blood pressure over the past several decades.[22] We recognize that patients with untreated hypertension may have had other factors, not identified in our study, which contributed to the increased risk of ICH such as additional comorbidities, variations in access to and quality of medical care, and different treatment adherence behaviors. However, we also note the primacy of hypertension as a risk factor for cardiovascular disease, with improved control of hypertension identified as the most likely factor that has decreased stroke mortality.[30]

Strengths of our investigation include the multiple centers for recruitment and the multi-ethnic patients studied with large samples sizes, allowing for the analysis of risk factors in whites, blacks, and Hispanics. As a result, we were able to present, as far as we are aware, the first report of treated and untreated hypertension as risk factors for ICH in all three of these ethnic/racial groups. In comparison, randomized trials are not feasible because it is unethical to randomize subjects to non-treatment of hypertension. Also, cohort studies can have difficulty accruing ICH cases, such as a recent study that noted only 62 ICH events despite 156,876 person-years of exposure.[11]

CONCLUSION

We provide compelling evidence that both treated and untreated hypertension are important risk factors for ICH. Our findings also confirm the importance of untreated hypertension as a risk factor for lobar ICH, particularly in minority populations. There are major ethnic/racial

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disparities in the proportions of ICH patients with hypertension that receive treatment. Given that untreated hypertension confers a greater ICH risk in blacks and Hispanics relative to whites, accelerated research efforts are needed to improve overall hypertension treatment rates, better define mechanisms of hypertension treatment resistance, particularly in minorities, and to monitor the impact of such efforts on racial/ethnic disparities in stroke.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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CLINICAL PERSPECTIVE

What is new?

- As the largest case-control study of treated and untreated hypertension as risk factors for intracerebral hemorrhage (ICH), the presented research substantially contributes to this literature and associated ethnic/racial disparities.
- We enrolled large numbers of white, black, and Hispanic ICH case-control pairs, thereby having adequate power to also analyze hypertension risk by ICH location, a common limitation of prior studies.
- By including Hispanics, often lacking in other investigations, we report novel findings that, like blacks, Hispanics also have increased risk of ICH conferred by treated and untreated hypertension relative to whites.

What are the clinical implications?

- This study reinforces the previously reported importance of hypertension as a critical risk factor for ICH.
- Our findings also include notable associated ethnic/racial disparities for blacks and Hispanics compared to whites, such as higher rates of untreated hypertension and higher ICH risk conferred by both treated and untreated hypertension.
- Clinical implications include a renewed call for hypertension prevention and treatment to reduce ICH risk.
- Our results also highlight the importance of efforts to lessen the associated ethnic/racial disparities, including, but not limited to: access to medical care, compliance with prescribed medication regimens, and a better understanding of medication treatment resistance.

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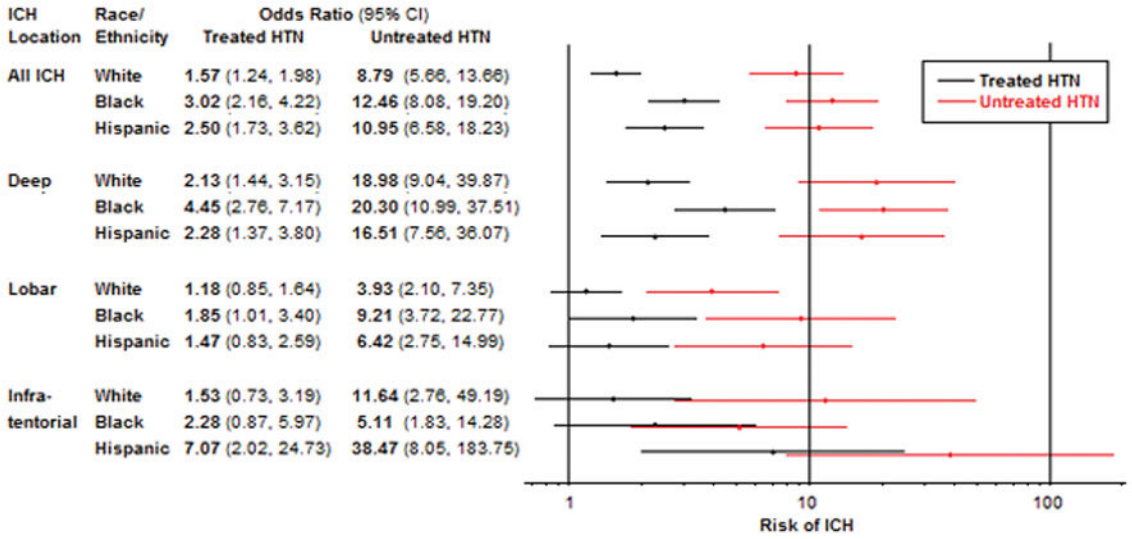

Figure.

Multivariable Analyses: Risk of ICH Associated with Treated and Untreated Hypertension by ICH Location and Ethnicity/Race.

Controlled for frequent alcohol use, hypercholesterolemia, education, medical insurance status, and anticoagulant use, with the exception that anticoagulant use was not included in the model of brainstem/cerebellum ICH in blacks. Cases and controls were matched for age, ethnicity/race, sex, and metropolitan area.

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Table 1

Demographic Information for ICH Cases by Ethnicity/Race

	White Cases	Black Cases	Hispanic Cases	p-value
n	958	880	766	
Average Age, years (SD) *	68.6 (13.4)	58.0 (11.9)	59.3 (13.5)	<0.0001
Female, n (%)	422 (44.1)	398 (45.2)	328 (42.8)	0.6177
Hypertension, n (%)	685 (72.3)	753 (86.6)	582 (77.4)	<0.0001
Untreated Hypertension, n (%) **	224 (32.7)	328 (43.6)	273 (46.9)	<0.0001
Heavy Alcohol Use, n (%)	64 (6.8)	96 (11.3)	78 (10.4)	0.0020
Hypercholesterolemia, n (%)	450 (49.5)	278 (33.6)	279 (38.5)	<0.0001
Anticoagulant Use, n (%)	133 (13.9)	41 (4.7)	55 (7.2)	<0.0001
Education Level n (%)				
Less than High School	87 (9.1)	193 (22.1)	352 (46.9)	
High School	301 (31.6)	315 (36.0)	225 (30.0)	
Greater than High School	565 (59.3)	366 (41.9)	174 (23.2)	<0.0001
Medical Insurance Status n (%)	851 (88.8)	580 (65.9)	492 (64.2)	<0.0001
Location				
-Lobar n (%)	400 (43.0)	202 (23.3)	207 (28.0)	
-Deep n (%)	429 (46.1)	544 (62.8)	410 (55.4)	
-Brainstem n (%)	36 (3.9)	58 (6.7)	44 (5.9)	
-Cerebellum n (%)	66 (7.1)	63 (7.3)	79 (10.7)	<0.0001
ICH Volume: Geometric Mean (95% CI) ***	11.5 (10.6, 12.5)	8.7 (8.0, 9.5)	11.3 (10.3, 12.4)	<0.0001
MRI Imaging, n	274	286	299	

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	White Cases	Black Cases	Hispanic Cases	p-value
Microbleed Positive n (%)	126 (46.0)	170 (59.4)	147 (49.2)	
Mean number of microbleeds (95% CI) ****	18.0 (10.6–25.3)	14.5 (9.8–19.2)	11.6 (7.6–15.6)	

* P-values for individual ethnic/racial groups are as follows: blacks and Hispanics, p=0.0357, blacks and whites, p<0.0001, Hispanics and whites, p<0.0001

** Untreated hypertension is presented in reference to the number of subjects with a diagnosis of hypertension

*** P-values for individual ethnic/racial groups are as follows: blacks and Hispanics, p<0.0001, blacks and whites, p<0.0001, Hispanics and whites, p=0.7675

**** Mean number of microbleeds is calculated from the total microbleed positive cases, not from the total number of cases with MRI imaging data available

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Table 2

Univariate Analyses for White ICH Cases and Controls

	White Cases	White Controls	OR (95% CI)	p-value
n	958	958		
Age mean (%)	68.6 (13.4)	68.4 (12.9)		matched
Number Female n (%)	422 (44.1)	422 (44.1)		matched
Diagnosis of Hypertension n (%)	685 (72.3)	494 (51.6)	2.41 (1.98, 2.94)	<0.0001
Treated Hypertension n (%)	461 (48.6)	459 (47.9)	1.69 (1.37, 2.09)	<0.0001
Untreated Hypertension n (%)	224 (23.6)	35 (3.7)	10.17 (6.72, 15.36)	<0.0001
No Diagnosis of Hypertension n (%)	263 (27.7)	464 (48.4)	Reference	
Heavy Alcohol Use n (%)	64 (6.8)	52 (5.5)	1.26 (0.86, 1.84)	0.2448
Hypercholesterolemia n (%)	450 (49.5)	498 (52.0)	0.87 (0.72, 1.05)	0.1598
Anticoagulant Use n (%)	133 (13.9)	63 (6.6)	2.40 (1.73, 3.34)	<0.0001
Education Level: n (%)				
Less than High School	87 (9.1)	25 (2.6)	6.29 (3.73, 10.61)	<0.0001
High School	301 (31.6)	145 (15.1)	3.36 (2.59, 4.36)	<0.0001
Greater than High School	565 (59.3)	788 (82.3)	Reference	
Medical Insurance Status n (%)	851 (88.8)	919 (95.9)	0.31 (0.21, 0.47)	<0.0001

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Table 3

Univariate Analyses for Black ICH Cases and Controls

	Black Cases	Black Controls	OR (95% CI)	p-value
N	880	880		
Average Age	58.0 (11.9)	58.0 (11.8)		Matched
Number Female n (%)	398 (45.2)	398 (45.2)		Matched
Diagnosis of Hypertension n (%)	753 (86.5)	533 (60.6)	4.47 (3.42, 5.84)	<0.0001
Treated Hypertension n (%)	425 (48.9)	465 (52.9)	2.75 (2.07, 3.65)	<0.0001
Untreated Hypertension n (%)	328 (37.7)	68 (7.7)	12.83 (8.81, 18.69)	<0.0001
No Diagnosis of Hypertension n (%)	117 (13.5)	346 (39.4)	Reference	
Heavy alcohol Use	96 (11.3)	33 (3.8)	3.75 (2.39, 5.88)	<0.0001
Hypercholesterolemia	278 (33.6)	359 (40.9)	0.70 (0.57, 0.86)	0.0007
Anticoagulant Use	41 (4.7)	11 (1.3)	3.73 (1.92, 7.25)	0.0001
Education Level: n (%)				
Less than High School	193 (22.1)	82 (9.3)	4.00 (2.93, 5.47)	<0.0001
High School	315 (36.0)	196 (22.3)	2.73 (2.15, 3.47)	<0.0001
Greater than High School	366 (41.9)	602 (68.4)	Reference	
Medical Insurance Status n (%)	580 (65.9)	756 (85.9)	0.28 (0.21, 0.37)	<0.0001

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Table 4

Univariate Analyses for Hispanic ICH Cases and Controls

	Hispanic Cases	Hispanic Controls	OR (CI)	p-value
N	766	766		
Average Age	59.3 (13.5)	58.9 (13.4)		Matched
Number Female n (%)	328 (42.8)	328 (42.8)		Matched
Diagnosis of Hypertension n (%)	582 (77.4)	365 (47.7)	4.30 (3.30, 5.61)	<0.0001
Treated Hypertension	309 (41.1)	320 (41.8)	2.43 (1.82, 3.24)	<0.0001
Untreated Hypertension n (%)	273 (36.3)	45 (5.9)	14.44 (9.38, 22.22)	<0.0001
No Diagnosis of Hypertension n (%)	170 (22.6)	400 (52.3)	Reference	
Heavy alcohol Use	78 (10.4)	16 (2.1)	5.77 (3.20, 10.40)	<0.0001
Hypercholesterolemia	279 (38.5)	361 (47.5)	0.68 (0.54, 0.85)	0.0008
Anticoagulant Use	55 (7.2)	20 (2.6)	3.33 (1.87, 5.94)	<0.0001
Education Level: n (%)				
Less than High School	352 (46.9)	184 (24.2)	4.74 (3.56, 6.31)	<0.0001
High School	225 (30.0)	171 (22.4)	3.12 (2.33, 4.17)	<0.0001
Greater than High School	174 (23.2)	407 (53.4)	Reference	
Medical Insurance Status n (%)	492(64.2)	654 (85.4)	0.22 (0.16, 0.30)	<0.0001

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