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Black-White Differences in Left Ventricular Hypertrophy Rates among Young Adults with Ischemic Stroke

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Abstract

Objectives: Few studies have addressed Black-White differences in left ventricular hypertrophy (LVH) in young stroke patients without a history of hypertension.

Methods: A case-only cross-sectional analysis performed in 2019 of data from the Stroke Prevention in Young Adults Study, a population-based case-control study of ischemic stroke patients ages 15–49. The main outcomes were hypertension indicators at the time of stroke hospitalization: self-reported history of hypertension, LVH by echocardiography (Echo-LVH) and LVH by electrocardiogram (ECG-LVH). The prevalence of Echo-LVH was further determined in those with and without a history of hypertension. Adjusted odds ratios and 95% confidence intervals comparing blacks and whites were calculated by logistic regression.

Results: The study population included 1,028 early-onset ischemic stroke patients, 48% Black cases, 54% men, median age 43 years (interquartile range, 38–46 years). Overall, the prevalence of hypertension history, Echo-LVH and ECG-LVH were 41.3%, 34.1% and 17.5%, respectively. Each of the hypertension indicators were more frequent in men than in women and in Black cases than in White cases. Black patients without a history of hypertension had higher rates of Echo-LVH than their white counterparts, 40.3% vs 27.7% (age and obesity adjusted OR 1.8; 95% CI 1.02–3.4) among men and 20.9% vs 7.6% (adjusted OR 2.7; 95% CI 1.2–6.2) among women.

Conclusions: LVH was common in young patients with ischemic stroke, regardless of self-reported history of hypertension. These findings emphasize the need for earlier screening and more effective treatment of hypertension in young adults, particularly in the Black population.

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Keywords

left ventricular hypertrophy; stroke; hypertension; health disparities; young adults

Introduction

Left ventricular hypertrophy (LVH), a marker of long-standing uncontrolled hypertension, is a strong predictor of stroke. In the Framingham Heart Study, among men, ECG-LVH was the strongest predictor of stroke, even after controlling for hypertension and other risk factors; among women, only atrial fibrillation was a stronger predictor of stroke.¹ Even at young ages, the prevalence of LVH is higher in the general population among Black persons than among White persons.² However, few studies have addressed race differences in the prevalence of LVH among young adults with ischemic stroke, with and without a history of hypertension. Determining the prevalence of LVH in young stroke patients without a known history of hypertension is important because of the clear potential for preventive interventions. We examined this question using data from a case-control study of ischemic stroke in young adults. We hypothesized that the prevalence of LVH would be higher in Black cases than in their White counterparts and that this disparity would also be present among those without a history of hypertension.

Methods

The Stroke Prevention in Young Adults Study was designed as a population-based case-control study of early-onset ischemic stroke. During 3 study periods between 1992 and 2007, patients with a first-ever ischemic stroke ages 15 to 49 years were identified by discharge surveillance from 59 hospitals in the greater Baltimore/Washington, DC, area and by direct referral from regional neurologists. Determination of ischemic stroke and ischemic stroke subtypes was performed by 2 neurologists, with disagreements adjudicated by a third neurologist. Study details have previously been published.³ History of hypertension was determined by patient interview, based on the question, “Before your stroke, had a doctor ever told you that you had high blood pressure”. Results of electrocardiogram and echocardiography at the time of the stroke, when available, were abstracted by chart review from each hospital and LVH was considered to be present if noted in the study report. Prevalence of the hypertension indicators (history of hypertension, Echo-LVH and ECG-LVH) were compared across race and sex groups. In addition, the prevalence of Echo-LVH was determined among those with and without a history of hypertension, stratified by race and sex. This is a case-only analysis because the controls were obtained by random digit dialing and did not have information on EKG-LVH or Echo-LVH.

Data were analyzed using SAS software (version 9.4; SAS Institute, Cary, NC). Odds ratios, 95% confidence intervals, and P-values were calculated by logistic regression, adjusting for age and, when appropriate, sex, race, or obesity (defined as a body mass index of 30.0 or higher).⁴ A P-value of less than 0.05 was considered statistically significant.

The study was approved by the University of Maryland at Baltimore Institutional Review Board and all participants or their legally authorized proxies gave written informed consent.

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Results

The study population included a total of 1028 patients. The median age was 43 years (interquartile range, 38–46 years), 54.0% were men, and 47.6% were Black cases. Table 1 shows the unadjusted prevalence of history of hypertension, Echo-LVH, and ECG-LVH, and the proportion of patients who had an echocardiogram and an electrocardiogram, stratified by race and sex. Black cases, and particularly black men, had a higher prevalence of the hypertension indicators. A similar proportion of each race-sex group had echocardiograms and electrocardiograms. There was substantial variation in the proportion of cases with LVH across the TOAST subtypes, with small vessel disease having the highest proportion of Echo-LVH (Large artery 36.5%, cardioembolic 35.5%, small vessel 50%; other 21.1%, and undetermined 30.8%; Chi-square $P=0.001$).

Table 2 compares the prevalence of the hypertension indicators by sex and race. Men and blacks had higher prevalence of each of the 3 hypertension indicators, with adjusted odds ratios ranging from 1.4 to 2.6, all $P < 0.05$.

Table 3 shows the findings stratified by history of hypertension, adjusted for age and obesity. Among patients with a history of hypertension, Black women, but not Black men, had significantly higher rates of Echo-LVH than their White counterparts. Among patients without a history of hypertension, Black patients of both sexes had significantly higher rates of Echo-LVH than White patients, with a prevalence of 40% in Black men and 21% in Black women. The results were substantially the same after additionally adjusting for TOAST subtype.

Discussion

The key finding of our study of ischemic stroke in young adults was the high prevalence of LVH regardless of hypertension history, with higher rates among Black cases. Our finding of high rate of LVH in early-onset ischemic stroke is consistent with other studies. The Helsinki Young Stroke Registry found a 14% prevalence of ECG-LVH by Sokolow-Lyon criteria in ischemic stroke patients ages 15–49.⁵ The Norwegian Stroke in the Young Study performed quantitative echocardiography on ischemic stroke patients ages 15–60 years found a 16% prevalence of LVH.⁶

Our findings are relevant for understanding the causes of stroke-related health disparities. Black persons have an excess stroke risk compared to White persons, with greater risk disparities at younger ages.⁷ Known risk factors, particularly hypertension and diabetes, can explain the excess risk of older, but not younger, black persons.⁸ It has been speculated that the contribution of hypertension to the excess risk of stroke in the Black population has been underestimated for a variety of reasons, including earlier onset and more severe hypertension in Black persons^{9, 10} and the regression-dilution bias.¹¹

In addition, our findings can inform future stroke prevention strategies in young adults. First, the high rate of LVH among young Black cases with ischemic stroke but without a self-reported history of hypertension indicates that hypertension is underdiagnosed in this group. Second, the higher rates of LVH among young Black patients with ischemic stroke and a history of hypertension suggests that Black persons have greater end organ damage from hypertension than White persons. While many factors are likely responsible for this greater end organ damage, inadequate treatment is a contributing factor.¹² Thus, early identification and aggressive management of hypertension in the young Black population could be a cost effective stroke prevention strategy. Studies of early-onset congestive heart failure have also found a marked excess risk among Black persons and have suggested that the number of young Black hypertensive patients that one would need to treat to prevent one case of heart failure could be as low as 21; our study suggests an additional potential benefit for stroke prevention.²

Our study has several limitations. First, ECG and Echo were obtained as part of clinical care at each hospital and, thus, definitions for these findings may have varied across hospitals. While a prospective study with standardized Echo readings by a core laboratory would be optimal, variation in ECG and ECHO criteria for LVH would not bias our findings unless criteria were less stringent at hospitals with higher proportions of Black patients. We believe that this systematic bias in hospital criteria for LVH is unlikely. Second, there could be concern that the findings from patients recruited 1992–2007 may not be relevant at this time. While there have been marked improvements in blood pressure distributions between 1960 and 2005 among both White and Black persons¹³, this trend has not persisted in recent years. Data from NHANES show no significant change in hypertension prevalence among Black and White adults during the 10-year interval between 1999 and 2007¹² and, in fact, evidence for overall worsening of blood pressure control between 2007 to 2018.¹⁴ Similarly, there has been an increase in the prevalence of hypertension in young adults hospitalized with acute stroke between 2003 and 2012.¹⁵ Furthermore, Echo criteria for LVH have changed over time from measurements of LV septal thickness to measurements of LV mass, which is more sensitive for detecting LVH. Thus, if the study were to be repeated using currently accepted guidelines for LVH, an even higher proportion of early-onset strokes would have LVH.¹⁶ Third, there could be biased ECG and Echo testing by race. Although these tests were not obtained on every patient, a similar proportion in each race-sex group had an Echo and ECG and the slightly higher proportion of tests obtained in Black men would not be expected to increase the proportion with Echo- and ECG-LVH among those tested. Fourth, there is a potential for bias in determining LVH in Black cases. Due to chest morphology differences electrocardiography is known to overestimate the prevalence of LVH in Black persons.¹⁷ Similarly, Black persons have higher rates of obesity in childhood and young adulthood,¹⁸ and obesity is associated with Echo-LVH independent of hypertension. However, Black cases still had higher rates of Echo-LVH, even after adjustment for obesity. Fifth, our study didn't exclude other uncommon diseases that may cause LVH in young stroke patients, such as aortic stenosis, hypertrophic cardiomyopathy and Fabry's disease.¹⁹ Finally, the definition of hypertension in our analysis has limitations. The most common cause of LVH is hypertension, regardless of whether it was recognized. Young Black stroke patients might have less access to health care and, thus, less opportunity

for a physician diagnosis of high blood pressure. Information about blood pressure levels during the index hospitalization were not abstracted. Information on new diagnoses of hypertension would have been valuable additional information.

Despite these limitations, our findings are of a high prevalence of LVH in young stroke patients without a history of hypertension, particularly among Black cases, is novel. Replication of our findings in prospective studies of early-onset stroke with standardized ECG and ECHO measurements is needed. Such replication might be done in an existing cohort study, such as the CARDIA study¹⁰ or, potentially, within a large HMO, such as Kaiser-Permanente.²⁰

Conclusions

Our study shows LVH is common in young patients with ischemic stroke. Young Black case, particularly men, had the highest prevalence of LVH, even among those who did not have a history of hypertension. These findings emphasize the need for earlier screening and effective treatment of hypertension in all young adults, and particularly in the Black population.

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Table 1.

Characteristics of Study Population, Stratified by Race and Sex

	Black men	Black women	White men	White women
Totals	248	242	311	227
	N (%)	N (%)	N (%)	N (%)
Risk Factors				
Age (mean \pm SD)	42.7 \pm 5.8	40.1 \pm 7.4	42.5 \pm 5.9	38.3 \pm 7.7
Current Smoking	125 (50.4%)	122 (50.6%)	117 (37.6%)	112 (49.3%)
Obesity	123 (49.6%)	112 (46.3%)	110 (35.4%)	65 (28.6%)
Diabetes	60 (24.2%)	46 (19.0%)	43 (13.8%)	21 (9.3%)
Hx Angina/MI	30 (12.2%)	34 (14.1%)	41 (13.3%)	25 (11.2%)
Hx Atrial Fibrillation	10 (4.0%)	4 (1.7%)	8 (2.6%)	2 (0.9%)
Hx HTN	151 (60.9%)	104 (43.0%)	109 (35.1%)	60 (26.4%)
Hypertension Indicators				
Echo performed	199 (80.0%)	184 (76.0%)	236 (76.8%)	168 (74.0%)
Echo-LVH	107 (53.8%)	60 (32.6%)	83 (35.2%)	18 (10.7%)
ECG performed	233 (94.0%)	201 (83.1%)	289 (93.0%)	184 (81.1%)
ECG-LVH	75 (32.2%)	31 (15.4%)	42 (14.5%)	11 (6.0%)
TOAST Subtypes				
Cardioembolic	57 (23.0%)	43 (17.8%)	65 (20.9%)	47 (20.7%)
Large Artery	19 (7.7%)	8 (3.3%)	27 (8.7%)	15 (6.6%)
Small Vessel	47 (19.0%)	39 (16.1%)	46 (14.8%)	17 (7.5%)
Other Determined	10 (4.0%)	23 (9.5%)	12 (3.9%)	39 (17.2%)
Undetermined	115 (46.4%)	129 (53.3%)	161 (51.8%)	109 (48.0%)

Table 2.

Sex and Race Differences in Prevalence of Hypertension History, Echo- LVH* and ECG-LVH*

Prevalence	Men	Women	OR (95% CI)*	P
Hx HTN	260/559 (46.5%)	164/469 (35.0%)	1.4 (1.1–1.8)	0.02
Echo-LVH	190/435 (43.7%)	78/352 (22.2%)	2.7 (1.9–3.8)	<0.0001
ECG-LVH	117/522 (22.4%)	42/385 (10.9%)	2.5 (1.7–3.8)	<0.0001
Prevalence	Black	White	OR (95% CI) †	P
Hx HTN	255/490 (52.0%)	169/538 (31.4%)	2.2 (1.7–2.9)	<0.0001
Echo-LVH	437/383 (43.6%)	101/404 (25.0%)	2.4 (1.7–3.3)	<0.0001
ECG-LVH	106/434 (24.4%)	53/473 (11.2%)	2.8 (2.0–4.1)	<0.0001

* Analyses restricted to cases who had test performed

† Adjusted for age and race

‡ adjusted for age and sex

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Table 3.

Race Differences in Prevalence of Echo-LVH* stratified by History of Hypertension

Prevalence of Echo-LVH	Black Men	White Men	OR (95% CI) †	P
Hx HTN	76/122 (62.3%)	40/81 (49.4%)	1.7 (1.0–3.1)	0.06
No Hx HTN	31/77 (40.3%)	43/155 (27.7%)	1.8 (1.0–3.4)	0.04
Prevalence of Echo-LVH	Black Women	White Women	OR (95% CI) †	P
Hx HTN	37/74 (50.0%)	9/49 (18.4%)	4.0 (1.7–9.5)	0.002
No Hx HTN	23/110 (20.9%)	9/119 (7.6%)	2.7 (1.2–6.2)	0.02

* Analyses restricted to cases who had test performed

† Adjusted for age and obesity (defined as a body mass index of 30.0 or higher)

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