

# ADDRESSING STROKE RISK FACTORS IN BLACK AND WHITE AMERICANS: FINDINGS FROM THE NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY, 2009-2010

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**Objectives:** Recurrent stroke affects 5%-15% of stroke survivors, is higher among Blacks, and preventable with secondary stroke prevention medications. Our study aimed to examine racial differences in risk factors being addressed (defined as either on active treatment or within guideline levels) among stroke survivors and those at risk for stroke.

**Methods:** A cross-sectional study using NHANES 2009-2010 standardized interviews of Whites and Blacks aged  $\geq 18$  years. Risk factors were defined as being addressed if: 1) for hypertension, SBP <140, DBP <90 (SBP <130, DBP <80 for diabetics) or using BP-lowering medications; 2) for current smoking, using cessation medications; and 3) for hyperlipidemia, LDL <100 (LDL <70 for stroke survivors) or using lipid-lowering medications. Participants were stratified by stroke history. Prevalence of addressed risk factors was compared by race.

**Results:** Among 4005 participants (mean age 48, 52% women, 15% Black), 4% reported a history of stroke. Among stroke survivors, there were no statistically significant differences in Blacks and Whites having their hypertension or hyperlipidemia addressed. Among stroke naïve participants, the prevalence of addressed hypertension ( $P < .01$ ) and hyperlipidemia ( $P < .01$ ) was lower in Blacks compared with Whites.

**Conclusions:** We found that addressed hypertension and hyperlipidemia in stroke naïve participants were significantly lower in Blacks than Whites. Our observations call attention to areas that require further investigation, such as why Black Americans may not be receiving evidence-based pharmacologic therapy for hypertension and hyperlipidemia or why Black Americans are not at goal blood pressure or goal LDL. A better understanding of this information is critical to preventing stroke and other

## INTRODUCTION

Each year, more than 690,000 Americans experience an ischemic stroke.<sup>1</sup> This devastating vascular disease is a leading cause of serious, long-term adult disability, with costs from 2005 through 2050 in the US projected to exceed \$2.2 trillion dollars, and the highest per capita in non-Whites.<sup>2</sup> Preventing new and recurrent stroke is a key component in reducing the morbidity and mortality of stroke.<sup>1</sup>

It is well-known that primary prevention can be accomplished by treating and controlling vascular risk factors such as hypertension, smoking, and hyperlipidemia.<sup>1,3</sup> Prior work, using cross-sectional

design, found that although Blacks received antihypertensive medications, they were not reaching their blood pressure goals.<sup>4</sup> This finding was confirmed in a national prospective cohort.<sup>5</sup> In addition to not having their blood pressure adequately controlled, Blacks have been found to be less likely to receive tobacco-cessation interventions<sup>6,7</sup> and less likely to successfully stop smoking when compared with Whites.<sup>8,9</sup> Similar results have been reported for hyperlipidemia, where Blacks are less likely to receive pharmacologic treatment and less likely to reach goal cholesterol levels.<sup>10-14</sup>

Stroke survivors are at increased risk of suffering a second stroke.<sup>15</sup>

vascular diseases. *Ethn Dis.* 2016;26(1):9-16; doi:10.18865/ed.26.1.9

**Keywords:** Stroke, Cerebral Infarction, Primary Prevention, Secondary Prevention, Disparities, African Americans

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Recurrent strokes cause greater disability and expense.<sup>15,16</sup> One of the groups with the highest risk of recurrent stroke are Black Americans, with rates reported as high as 20%.<sup>17-26</sup> Secondary prevention can be accomplished through the use of antiplatelet agents or anticoagulants, in combination with risk factor modification.<sup>27</sup> Notwithstanding their increased risk for recurrent stroke, multiple studies have reported lower rates of secondary stroke prevention medication use in minorities.<sup>28-30</sup> Little is known about stroke survivors who are at the greatest risk—those who are not on risk factor modifying treatments despite guideline recommendations.

Practicing clinicians may choose only to medicate risk factors that they see as uncontrolled or not within guideline levels. Few studies have compared the prevalence of treated or controlled risk factors in individuals with a history of stroke and individuals without a history of stroke. Herein, we use data from the National Health and Nutrition Examination Survey (NHANES) to describe racial differences in the prevalence of addressed stroke risk factors in Black and White Americans. We hypothesized that addressed risk factors would significantly differ in Whites and Blacks, regardless of history of prior stroke. For the purpose of this article addressed is defined as either on active treatment or within guideline levels.

## METHODS

The NHANES was conducted by the National Center for Health

Statistics of the Centers for Disease Control and Prevention (CDC). Each two-year survey includes a nationally representative, stratified multistage probability sample of the non-institutionalized US civilian population. Detailed methods of the design and conduct of NHANES are available online.<sup>31</sup> In brief, each participant in NHANES is interviewed in person at their home, with a standardized physical examination

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conducted afterwards in a mobile examination center. The protocol for NHANES was approved by the ethics review board of the National Center for Health Statistics and informed consent was obtained from each participant. The University of Alabama at Birmingham IRB reviewed the NHANES dataset and determined that local IRB approval was not required for our study.

Of relevance to our analysis, the in-home survey includes questions relating to prescription and over-the-

counter (OTC) medication use. Participants were asked if they had used a prescription or OTC medication in the past month. When a participant answered yes, they were then asked the name, duration, and purpose of each medication used. Additionally, the interviewers asked for the medication bottles in order to record the exact name of the medication from the medication label. In instances where the medication bottle was unavailable, the participants reported their medications verbally to the interviewers. Participant demographics, as well as self-reported medical and smoking history, were also obtained with the questionnaire. Individuals were asked if they have ever been told by a health professional that they had a history of stroke, hypertension, or high cholesterol.

Participants were categorized as having a history of stroke, hypertension, and high cholesterol/hyperlipidemia based on the self-reported medical history questionnaire. Participants who indicated that they “smoke cigarettes now” were categorized as current smokers. Medications from the medication questionnaire were grouped into medication categories according to type. There were four medication categories relevant to our analyses: 1) anti-thrombotics (antiplatelet agents or anticoagulants); 2) antihypertensive or blood pressure lowering agents; 3) smoking cessation medications; and 4) cholesterol lowering agents. A stroke risk factor was defined as being addressed if participants were within guideline levels (controlled) or actively taking medications for the condition (treated). Guidelines

available in 2009-2010 were used to define risk factor treatment goals.<sup>32-35</sup>

Specifically, participants were said to have their hypertension addressed if their systolic blood pressure (SBP) was <140 mm Hg and their diastolic blood pressure (DBP) was <90 mm Hg (SBP<130 and DBP<80 for diabetics) or if the participant reported using a blood pressure lowering medication. For current smoking, if the participant reported using a smoking cessation medication, current smoking was considered to be addressed. Participants were said to have had their hyperlipidemia addressed if they had a low density lipoprotein (LDL) level <100 (LDL <70 for stroke survivors) or reported using lipid-lowering medications.

Data from the 2009-2010 NHANES were included in this analysis. The overall response rate was 79.4% for the interviewed sample and 77.3% for the examined sample. This analysis was limited to Black and White individuals aged >18 years. All analyses were stratified by history of stroke and then by race. The proportion of Blacks with history of stroke taking either

**Table 1. NHANES 2009-2010 sample participant demographics**

	All participants, n=4,005	History of stroke, n=170	No history of stroke, n=3,835
Age, mean (SE)	47.5 (.5)	64.1 (1.6)	47.9 (.5)
Black	14.6	19.2	14.2
Female	52.0	54.6	52.0
<12th grade education	14.5	28.4	14.1
Annual household income <\$20,000	13.2	19.0	12.8
Hypertension	27.4	68.7	27.0
Current smoking	21.0	21.2	21.0
Hyperlipidemia	2.1	39.1	19.6
No medical insurance	15.8	5.2	16.1

Values are expressed as percentage, except for age, which is expressed as mean and (standard error).

an antiplatelet or anticoagulant was compared with Whites using Chi-squared tests. Similar comparisons were made for addressed stroke risk factors. The association between race and the prevalence of the outcomes of interest were evaluated using prevalence odds ratios (POR).

Data management was conducted using SAS version 9.2 (SAS Institute, Cary, NC) and all statistical analyses were performed using SUDAAN version 10.0 (Research Triangle Institute) to account for the complex sampling design of NHANES (weighting, clustering, stratification). The appropriate sam-

pling weights were used to account for the differential selection probabilities, over-sampling of certain populations, and participant non-response. A *P* value <.05 was considered to be statistically significant.

## RESULTS

### Overall Sample

Of the 4,005 participants included in our analysis, the mean age was 47.5 years (SE .5); 14.6% were Black, and 52.0% were female (Table 1). Efforts to estimate socio-

**Table 2. NHANES 2009-2010 sample demographics for participants with and without a history of stroke by race**

	History of stroke, n=170			No history of stroke, n=3,835		
	Whites, n=119	Blacks, n=51	P	Whites, n=2,791	Blacks, n=1,044	P
Age, mean (SE)	65.5 (1.9)	58.2 (2.1)	.02	48.6 (.5)	44.1 (1.0)	<.01
Female	52.3	64.1	.29	51.5	54.6	.03
<12th grade education	24.4	44.9	.06	12.5	23.7	<.01
Annual household income <\$20,000	15.2	35.1	.09	1.8	25.0	<.01
Hypertension	66.9	76.3	.39	25.9	33.4	.01
Current smoking	18.8	31.2	.07	19.8	27.9	.01
Hyperlipidemia	41.1	32.1	.30	2.0	15.9	.02
No medical insurance	2.7	16.0	.05	14.0	28.5	<.01

Values are expressed as percentage, except for age which is expressed as mean and standard error. Means were compared using t-tests; proportions were compared using Chi-squared tests.

economic status found that 14.5% of participants had <12th grade education and 13.2% of participants had an annual household income of <\$20,000. More than a quarter (27.4%) of participants reported having hypertension. Twenty-one percent reported current smoking. One in 5 participants (20.1%) reported hyperlipidemia. Despite the prevalence of these stroke risk factors, 15.8% of participants reported having no medical insurance.

### Participants Reporting Prior Stroke

Overall, 170 (4.2%) participants reported a history of previous stroke. Table 2 illustrates baseline racial differences in participants reporting a history of stroke. Blacks were, on average, 7 years younger than their White counterparts (58.2 vs 65.5 years,  $P=.02$ ). A higher proportion of Black participants reporting a history of stroke did not have medical insurance (16% vs 2.7%,  $P=.05$ ). There were no statistically significant differences in sex, education, income, hypertension, current smoking status, or hyperlipidemia among Blacks and Whites with a history of stroke.

As seen in Table 3, there were no statistically significant differences in the proportion of Blacks and Whites with history of stroke who reported taking an antiplatelet or anticoagulant, who had their hypertension addressed, or who had their hyperlipidemia addressed. In the fully adjusted model, there were no statistically significant differences in the odds of Black participants with a history of stroke of taking an antiplatelet agent or an anticoagulant when com-

**Table 3. Percentage of addressed stroke risk factors in Black and White NHANES 2009-2010 participants overall and stratified by history of stroke**

	Whites, n=2,910	Blacks, n=1,095	P
<b>Overall</b>			
Addressed hypertension	97.0	92.7	<.01
Addressed current smoking	2.0 <sup>b</sup>	1.8 <sup>b</sup>	.87
Addressed hyperlipidemia	92.9	84.3	<.01
<b>History of stroke</b>			
Stroke (taking AP or AC medications)	42.9	29.2	.09
Addressed hypertension	97.8	98.7	.66
Addressed current smoking <sup>a</sup>	---	---	---
Addressed hyperlipidemia	94.1	88.3	.33
<b>No history of stroke</b>			
Addressed hypertension	96.9	92.2	<.01
Addressed current smoking	1.9 <sup>b</sup>	1.9 <sup>b</sup>	.98
Addressed hyperlipidemia	92.8	84.0	<.01

Values are expressed as percentages. A stroke risk factor was defined as being addressed if participants were within guideline levels (controlled) or actively taking medications for the condition (treated). Proportions were compared using Chi-squared tests.

AP, antiplatelet agent; AC, oral anticoagulant.

a. Inadequate raw observations to provide valid estimates.

b. Represents 15 or fewer raw observations.

pared with their White counterparts (Table 4). Although not statistically significant, after adjustment for age, sex, education, income, and insurance status, Black participants reporting a history of stroke and hypertension had higher odds of having their hypertension addressed (POR 1.46, 95% CI .05-43.01) when compared with Whites. In a similar manner, Black participants reporting a history of stroke and hyperlipidemia had a non-statistically significant lower odds of having their hyperlipidemia addressed (POR .33, 95% CI .07-1.53) when compared with Whites in the fully adjusted model.

### Participants with No History of Prior Stroke

Overall, 3,835 participants reported no previous history of stroke. Table 2 shows the baseline racial differences in stroke naïve participants. Blacks were, on average, younger

than their White counterparts (44.1 vs 48.6 years,  $P<.01$ ). A higher proportion of stroke naïve Black participants were female (54.6% vs 51.5%,  $P=.03$ ), had <12th grade education (28.5% vs 14.0%,  $P<.01$ ), had an annual income of <\$20,000 (25% vs 10.8%,  $P<.01$ ), had higher proportions of hypertension (33.4% vs 25.9%,  $P<.01$ ), were current smokers (27.9% vs 14.0%,  $P<.01$ ), and were without medical insurance (28.5% vs 20%,  $P=.05$ ). Among stroke naïve participants, Blacks had lower proportions of hyperlipidemia (15.9% vs 20.0%,  $P=.02$ ) compared with Whites.

The lower proportion of stroke naïve Blacks had their hypertension (92.2% vs 96.9%,  $P<.01$ ) and hyperlipidemia (84.0% vs 92.8%,  $P<.01$ ) addressed when compared with Whites (Table 3). These differences remained statistically significant even after adjustment for age,



sex, education, income, and insurance status (POR 0.42, 95% CI .21-.84; POR .75, 95% CI 0.15-3.72). There were no significant racial differences observed in having current smoking status addressed (Table 4).

## DISCUSSION

Among participants reporting a prior history of stroke, we did not observe significant racial differences in antiplatelet or anticoagulant use. Similarly, we did not observe racial differences in those who were either on active treatment or at goal for their hypertension or hyperlipidemia. Our observations differ from prior studies reporting that Blacks were less likely to be given antithrombotics,<sup>7</sup> blood pressure lowering agents,<sup>36</sup> and cholesterol lowering agents.<sup>7,36</sup> These differing findings may be because the sample for each study was

selected from different populations. Reports of racial disparities in stroke care originated from a population of individuals hospitalized for stroke, sampled at select hospitals. In contrast, NHANES is a complex, multistage, probability sample of community-dwelling individuals. While racial differences in stroke care were observed at the time of discharge,<sup>7,36</sup> our study suggests that they may not be present in the post-hospitalization period. One possible explanation is that antithrombotics, blood pressure lowering agents, and cholesterol lowering agents are being prescribed in the outpatient setting, resulting in our observation of the lack of racial differences in having secondary stroke prevention, hypertension, and hyperlipidemia addressed. Another possible explanation is that NHANES failed to capture stroke survivors who were discharged to locations other than home. By de-

sign, NHANES samples community-dwelling individuals. Perhaps disparities exist in discharge prescribing for individuals who are not well enough to be discharged home.

Conversely, we did observe that Blacks with no history of stroke had lower odds of having their hypertension and hyperlipidemia addressed (ie, on active treatment or within guideline levels) when compared with Whites. This observation is consistent with prior studies that

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*Among participants reporting a prior history of stroke, we did not observe significant racial differences in antiplatelet or anticoagulant use.*

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**Table 4. Adjusted prevalence odds ratios (PORs) comparing addressed risk factors in Black compared with White NHANES 2009-2010 participants overall and stratified by history of stroke**

	POR (95% CI)	P
<b>Overall</b>		
Addressed hypertension	.45 (.23, .89)	.02
Addressed current smoking	.66 (.13, 3.44)	.60
Addressed hyperlipidemia	.42 (.25, .72)	<.01
<b>History of stroke</b>		
Stroke (taking AP or AC medications)	.83 (.34, 2.02)	.66
Addressed hypertension	1.46 (.05, 43.01)	.82
Addressed current smoking <sup>a</sup>	---	---
Addressed hyperlipidemia	.33 (.07, 1.53)	.14
<b>No history of stroke</b>		
Addressed hypertension	.42 (.21, .84)	.02
Addressed current smoking	.75 (.15, 3.72)	.71
Addressed hyperlipidemia	.41 (.23, .74)	<.01

Models are adjusted for age, sex, education, income, and insurance status. A stroke risk factor was defined as being addressed if participants were within guideline levels (controlled) or actively taking medications for the condition (treated).

AP, antiplatelet agent; AC, oral anticoagulant.

a. Inadequate raw observations to provide valid estimates.

have reported that Blacks are receiving antihypertensive treatment, but are not reaching blood pressure treatment goals.<sup>4,5</sup> Whereas prior reports focused on awareness, receiving treatment, and achieving blood pressure goals, we assessed individuals who are either on active treatment or at their goal blood pressure (to allow for those who no longer require medication). This allowed us to isolate the highest risk group—individuals who are neither at their blood pressure treatment goal nor on active treatment trying to achieve their blood pressure goal. Only 3% of Whites in our sample were in this high risk category as compared with

8% of Blacks. One can speculate the reasons to why more than twice as many Blacks are neither on blood pressure treatment nor at goal. It is possible that differences in financial resources or access to care prevent this group from seeking care. It is also possible that this group is not being prescribed medications for blood pressure control. Finally, it is possible that blood pressure medications were prescribed, but that these individuals simply chose not to take them. This issue is complex and cannot be addressed with the current cross-sectional analysis.

Similar to our observations with hypertension, we observed that 16% of Blacks were neither on cholesterol lowering treatment nor at their goal LDL, as compared with 7% of Whites. These findings are consistent with prior studies that have reported Blacks with hyperlipidemia are less likely to use statins, and Blacks are also less likely to achieve their goal cholesterol level.<sup>12-14</sup> The reasons for Blacks having more than twice the proportion of Whites to neither be on a cholesterol lowering medication nor at their goal LDL are likely similar to the reasons stated for hypertension. However, with statins, side effects are also likely contributing to racial differences. Hippisley-Cox et al found that Black Caribbean and Black African men had six to eight times the risk of statin-induced myopathy compared with White males, while Black Caribbean and Black African women had four to five times the risk of statin-induced myopathy compared with White females.<sup>37</sup>

Our study is not without limitations. The cross-sectional nature

of this study does not lend itself to causal inference. In addition, the sample size provided by the two-year survey may have limited our ability to detect existing differences between groups. History of stroke and stroke risk factors were identified using self-report. Since self-reporting requires awareness, disease prevalence may be under- or over-estimated in certain groups. For example, Blacks have been shown to have increased awareness of hypertension and decreased awareness of hyperlipidemia, when compared with their White counterparts.<sup>38</sup> Measurement error remains a concern, as NHANES collected yes/no information on disease state and medications taken. It did not collect detailed information on severity of each disease, the duration of each disease, or medication adherence. Finally, our findings should be interpreted with caution as addressed risk factors (on active treatment or within guideline levels) does not necessarily equate to risk factor control, and thus may be an over-estimate of risk factor control.

## CONCLUSION

Unlike prior reports, our study examined the prevalence of hypertension, smoking, and hyperlipidemia in community dwelling stroke survivors and stroke naïve Black and White Americans. Further, we estimated the odds that a risk factor would be addressed in each of these groups. Our observations call attention to areas that require further investigation, such as why Black Americans may not be receiving ev-

idence-based pharmacologic therapy for hypertension and hyperlipidemia or why Black Americans are not at goal blood pressure or goal cholesterol levels. Future research is needed to better understand the interplay between primary and secondary prevention medication prescribing and adherence, and the relationship of each to the disparities observed in stroke and other vascular events.

## ACKNOWLEDGMENTS

The project described was supported by Award Numbers 5 T32 HS013852-10 from The Agency for Healthcare Research and Quality (AHRQ), 3 P60 MD000502-08S1 from The National Institute on Minority Health and Health Disparities (NIMHD), National Institutes of Health (NIH) and 13PRE13830003 from the American Heart Association (AHA). The content is solely the responsibility of the authors and does not necessarily represent the official views of the AHA, AHRQ or the NIH.

## CONFLICT OF INTEREST

No conflicts of interest to report.

## AUTHOR CONTRIBUTIONS

Research concept and design: Albright, Boehme, Tanner, Blackburn, G. Howard, V. Howard, Safford, Beasley, Limdi. Acquisition of data: Albright. Data analysis and interpretation: Tanner, Blackburn, Albright, Boehme, G Howard, V Howard, Safford, Beasley, Limdi. Manuscript draft: Albright, Tanner, Boehme. Statistical expertise: Beasley, G Howard, Tanner, Blackburn. Acquisition of funding: Safford. Supervision: Blackburn, G Howard, V Howard, Safford, Beasley, Limdi

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