

ASSOCIATION OF REGION OF RESIDENCE AND IMMIGRANT STATUS WITH HYPERTENSION, RENAL FAILURE, CARDIOVASCULAR DISEASE, AND STROKE, AMONG AFRICAN-AMERICAN PARTICIPANTS IN THE THIRD NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY (NHANES III)

Objective: To determine whether current region of residence and immigrant status (born in the United States [US] vs abroad), are associated with the prevalence of hypertension (HTN), uncontrolled HTN, and HTN-related target-organ damage, among African Americans.

Methods: We studied the survey and physical examination data from a nationally representative cohort of 3,369 self-designated Black participants, aged 30–79 years, in the third National Health and Nutrition Examination Survey (NHANES III), which took place during 1988–1994. We calculated the age-adjusted prevalence rates of HTN, uncontrolled HTN, and history of HTN-related target-organ damage in US-born northern African Americans, US-born southern African Americans, and foreign-born African Americans.

Results: Hypertension (HTN) was more common among southern African-American men and women, compared to northern African-American men and women (42.2% vs 34.1%, $P < .002$ for men; 42.7% vs 37.2%, $P = .02$ for women). Uncontrolled HTN was also more common among hypertensive southern African-American women compared to hypertensive northern African-American women (79.8% vs 70.4%, $P = .05$). Among women, hypertensive Black immigrants had lower rates of HTN-related target-organ damage than either hypertensive US-born southern and northern African Americans (3.3% vs 16.3% and 15.8%, respectively, $P = .05$).

Conclusions: In this nationally representative cohort, immigrant status and geographic region of residence were associated with HTN prevalence, rates of blood pressure control, and HTN-related target-organ damage. Further examination of environmental exposures, cultural issues, and access to care, factors that can differ between groups, may yield important information about modifiable risk factors associated with HTN and target organ damage. (*Ethn Dis.* 2003;13:316–323)

Key Words: Hypertension, Region, Immigrants, Race

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INTRODUCTION

The disproportionately higher prevalence of hypertension (HTN) among African Americans compared to Whites has been studied extensively since the 1930s.¹ African-American patients suffer from higher rates of target-organ damage secondary to HTN, and have different responses to some antihypertensive drugs, when compared to age-matched White controls.² These differences have led the Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC VI) to consider African-American patients as a special population when considering anti-hypertensive treatment.³

Numerous studies have examined potential causes for the racial differences in HTN prevalence and severity, including baseline insulin levels,⁴ sympathetic nervous activity,^{5,6} intracellular calcium levels,⁷ and intracellular sodium levels.⁸ Although many authors have ascribed these race-related differences to genetic influences, recent work has suggested that the high prevalence of HTN among African Americans may not be

strictly genetically based. Cooper et al have noted that while African Americans and African Europeans have among the highest rates of HTN in the world, native Africans and African Caribbeans have much lower rates of HTN.⁹ Other studies have demonstrated regional differences in the risk of HTN and HTN-related morbidity among African Americans,^{10–12} and have reported that foreign-born African Americans may be at lower risk for cardiovascular death, compared to northern- or southern-born African Americans.¹³ However, regional rates of uncontrolled HTN and related target-organ damage among African Americans have not been closely compared. In addition, there has been little examination of the association between immigrant status and risk for HTN, and its related outcomes among African Americans.

Regional differences in healthcare utilization patterns, environmental exposures, the presence of cardiovascular risk factors, and dietary habits, may influence the prevalence and control of HTN and related target-organ damage among African Americans currently residing in different geographical regions. Given the observed differences in rates of HTN throughout the African diaspora,⁹ there may also be additional non-biological factors that influence the prevalence of HTN and cause its outcomes to vary between US-born and immigrant African Americans. To understand further the regional differences in HTN prevalence, HTN control, and rates of HTN-related target-organ damage among foreign-born and US-born African Americans, we examined nearly

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To understand further the regional differences in HTN prevalence, HTN control, and rates of HTN-related target-organ damage among foreign-born and US-born African Americans, we examined nearly 3400 Black participants in a national survey.

3400 Black participants in a national survey.

METHODS

Study Population and Data Source

Using data from the third National Health and Nutrition Examination Survey (NHANES III), a national survey conducted in 22 US states from 1988–1994, we examined the prevalence of HTN among 3,369 self-designated Black participants aged 30 to 79 years. Participants were asked the state or country of their birth (United States, Mexico, or other). Participants born in the United States were classified as southern African-American (SAA), if they resided in the South census region, or northern African-American (NAA), if they resided in the Northeast, Midwest, or West census regions at the time of the survey. We classified participants as Black American immigrants (BAI) if they were born outside the United States, but data were not available on their specific country of origin.

Hypertension (HTN) was defined by an average systolic blood pressure (SBP) ≥ 140 , a diastolic blood pressure (DBP) ≥ 90 , or receiving treatment for

HTN within a month prior to the interview.^{3,14} Uncontrolled HTN was defined by an elevated average SBP or DBP among individuals with HTN. The standardized methods by which blood pressure measurements were obtained have been previously described.¹⁴ Target-organ damage was defined by having HTN and either a serum creatinine level greater than 2.0 mg/dL (among 82.8% of participants who were tested), or a patient report of any of the following complications: prior myocardial infarction, stroke, or congestive heart failure.

NHANES III participants were evaluated during a 1-hour home visit, which included an extensive interview focusing on health conditions and risk factors (www.cdc.gov/nchs/nhanes.htm). Survey data included demographic information, such as participant age, gender, insurance status, and household poverty income ratio (poverty defined by the eligibility threshold for the Federal Special Supplemental Nutrition Program for Women, Infants, and Children [WIC]); cardiovascular risk factors, such as body mass index (BMI) (obesity defined by $\text{BMI} \geq 27 \text{ kg/m}^2$), and history of diabetes; dietary habits, including table salt intake, and alcohol intake; and use of medications, including antihypertensive drug therapy. Participants were also asked how many months it has been since they last saw a doctor, whether they go to a particular place for health care, or have one particular doctor they see.

Statistical Analysis

Using NAA as the population standard we determined age-adjusted prevalence rates of HTN and target-organ damage by sex among the 3 regional groups. We used chi-square tests to examine the association between each of the HTN categories, or the presence of target-organ damage, and immigrant or regional status, stratified by sex. We report 2-tailed *P* values with statistical significance set at $P \leq .05$.

In a secondary analysis, logistic regression was used to adjust for previously identified HTN risk factors, cardiovascular risk factors, healthcare utilization patterns and demographic characteristics of each group listed in Table 1, stratified by sex. Data were available on every variable for 3052 of the 3369 participants (90.6%) for multivariate analysis. We report adjusted odds ratios with 95% confidence intervals for HTN categories and the presence of target-organ damage. All analyses were done using SUDAAN statistical software (Research Triangle Institute, Research Triangle Park, North Carolina) to adjust for the nationally representative weighting of data in NHANES III.¹⁵

RESULTS

Demographic and Clinical Characteristics

Of the 3,369 Black participants 1,403 (42%) were NAA, 1,751 (52%) were SAA, and 215 (6%) were BAI (Table 1). Of the 215 BAI participants, 86 (40%) resided in the South, and 129 (60%) resided in the North (data not shown). Approximately 55% of each group was female. The NAA and SAA participants were older than the BAI participants. The BAI women were less likely than NAA or SAA women to have had a doctor's visit within a year prior to their interview, a regular site of health care, or a specific provider. The BAI women were less likely than NAA or SAA women to consume high levels of alcohol (>12 grams/day). The BAI men added table salt to meals less often than did NAA or SAA men. The BAI participants had a lower mean body-mass index (BMI), compared to NAA and SAA participants. The NAA women were more likely than SAA or BAI women to have a history of a prior myocardial infarction.

Hypertension Prevalence

In unadjusted analyses, a non-significant trend was observed toward a high-

Table 1. Demographic and clinical characteristics of Black participants, age 30–79, in NHANES III

Characteristic	Northern African Americans	Southern African Americans	Black Immigrants (N=215)	P Value*
Female (%)	57.5	55.4	53.2	.35
Mean age				
Men	48.0	46.1	42.7	<.001
Women	48.3	46.7	43.9	.02
Below poverty level (%)				
Men	40.8	45.7	40.2	.41
Women	46.9	50.6	39.4	.33
Private insurance (%)				
Men	79.5	74.1	76.0	.58
Women	76.0	73.5	67.5	.49
Doctors visit within 1 year (%)				
Men	76.7	74.8	68.9	.17
Women	90.9	86.3	87.1	.02
Regular doctor or health center (%)				
Men	72.2	74.1	63.0	.22
Women	87.9	89.8	74.5	.04
>12 gm/day of alcohol (%)				
Men	37.2	31.9	33.1	.16
Women	19.6	15.6	6.6	.03
Often add table salt to meals (%)				
Men	22.3	20.6	6.8	.004
Women	12.9	11.8	9.1	.44
Mean body mass index (kg/m ²)				
Men	26.8	26.9	25.3	.05
Women	29.2	30.3	28.2	.01
Diabetes (%)				
Men	6.8	7.1	8.2	.85
Women	12.6	11.0	7.4	.10
Prior myocardial infarction (%)				
Men	5.0	3.4	2.1	.25
Women	4.9	2.3	0.6	.01
Hypertension (%)				
Men	34.1	39.6	29.0	.06
Women	37.8	40.6	19.5	.001
Antihypertensive medication within 1 month (%)				
Men	16.3	17.0	8.2	.08
Uncontrolled hypertension (%)†				
Men	64.1	66.4	61.8	.78
Women	74.9	80.5	74.4	.15
Target-organ damage (%)†				
Men	25.4	18.0	15.4	.04
Women	25.1	17.4	5.5	.09

* P values are for comparisons between the 3 groups using linear regression for age and body mass index and chi square tests used for all other variables, using SUDAAN to account for the complex survey design and weighted data.

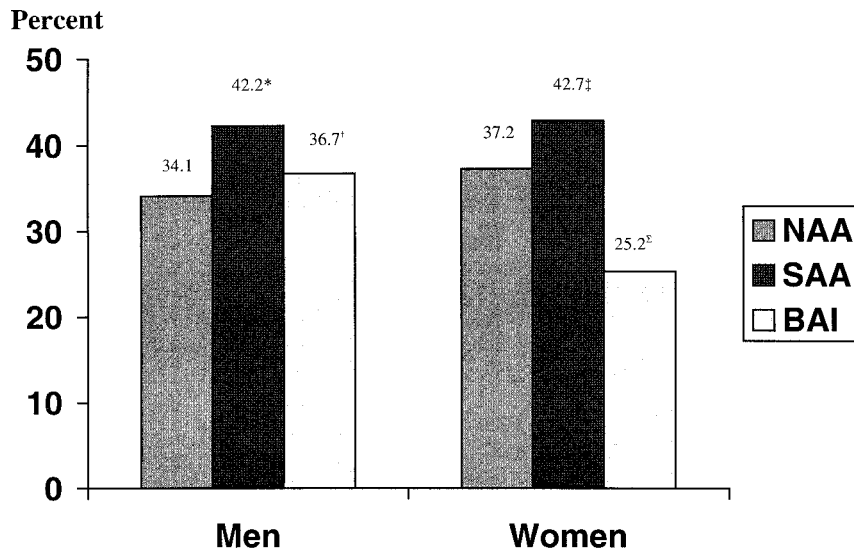
† Among participants with hypertension.

er prevalence of HTN in SAA men, compared to NAA or BAI men (Table 1). Among women, SAAs had a higher rate of HTN, compared to NAAs, while BAI women had a significantly lower rate. The BAI women were significantly less likely than NAA or SAA women to have taken an antihypertensive medication within the month prior to the interview.

After adjustment for age, both SAA men and SAA women had significantly higher rates of HTN, compared to NAA men and women, respectively (Figure 1). After multivariate adjustment for age, BMI, table salt intake, alcohol intake, most recent doctor's visit, continuity of medical care, income level, insurance status, and diabetes, SAA men remained significantly more likely than

NAA men to have HTN (Odds Ratio: 1.60, $P=.005$), and BAI women were significantly less likely than NAA women to have HTN (Odds Ratio: 0.49, $P=.01$).

After multivariate analysis, no significant differences were found in the odds for HTN between groups (Table 2). Participants with HTN were more likely to be obese (BMI>27 kg/m²).



* $P < 0.002$ vs. NAA men, † $P = 0.74$ vs. NAA men, ‡ $P = 0.02$ vs. NAA women, § $P = 0.07$ vs. NAA women

Fig 1. Age-adjusted prevalence of hypertension is presented among northern African Americans (NAA), southern African Americans (SAA), and Black American immigrants (BAI) for men and women. The statistical significance of each association is noted beneath the figures

Among men, those with HTN were more likely to report having a regular site of health care, or a specific provider. Both men and women without HTN reported adding more table salt to food (Table 2).

Uncontrolled HTN

In unadjusted analyses, no significant differences were observed between groups in the prevalence of uncontrolled HTN among hypertensive participants (Table 1). After age-adjustment, SAA

women had a significantly higher rate of uncontrolled HTN, compared to NAA women (Figure 2).

After multivariate analysis, no significant differences were found in the odds for uncontrolled HTN between groups (Table 3). Those subjects with uncontrolled HTN were more likely to report having a regular healthcare site, or a specific provider, or having seen their doctor within a year. Among men, those with uncontrolled HTN were also more likely to report having diabetes. Among women, those without uncontrolled HTN reported adding more table salt to food.

Target-Organ Damage

In the unadjusted analysis, BAI men and SAA men were significantly less likely to have target-organ damage than NAA men (Table 1). After age-adjustment, no significant differences were found in the prevalence of target-organ damage among men; however, BAI women were less likely than NAA women to have target-organ damage (Figure 3).

After multivariate analysis, SAA men were less likely than NAA men to have HTN-related target-organ damage (Table 4). For both sexes, participants with target-organ damage were more likely to report having diabetes, and were less likely to be obese. Men with target-organ damage were more likely to report having a recent doctor's visit, and were also more likely to be poor. Men with private insurance and higher alcohol consumption were less likely to have target-organ damage. Women with target-organ damage were more likely to report having a regular site of health care, or a specific provider.

Table 2. Adjusted odds ratios for significant predictors of HTN†

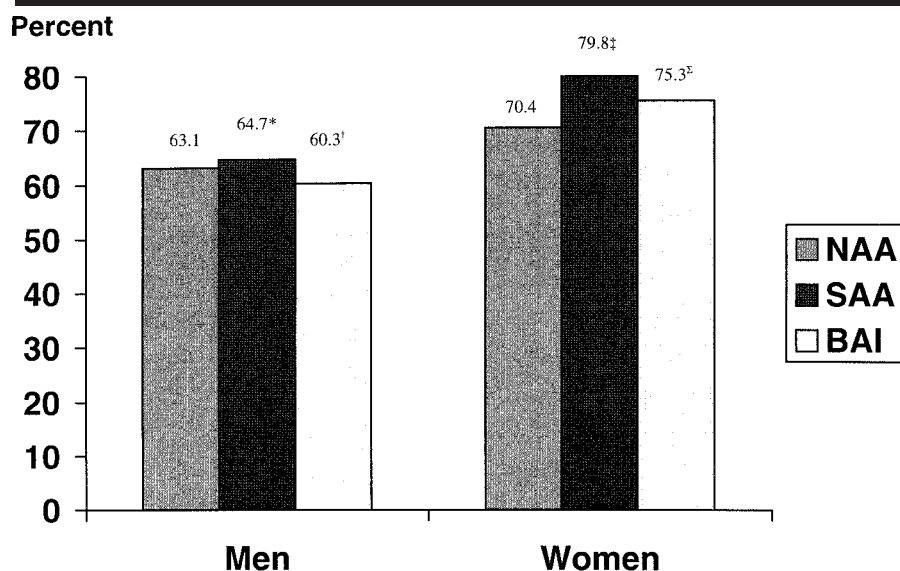
Variable	Adjusted Odds Ratio (N=3052)	95% CI
Southern African Americans*		
Men	1.60	[1.16–2.20]
Black American immigrants*		
Men	1.16	[0.65–2.09]
Women	0.49	[0.28–0.85]
Regular doctor or health center		
Men	1.59	[1.06–2.39]
Women	1.48	[0.95–2.29]
Often add table salt to meals		
Men	0.65	[0.49–0.87]
Women	0.60	[0.38–0.95]
Body mass index >27 kg/m ²		
Men	2.08	[1.52–2.85]
Women	1.70	[1.33–2.18]

* Northern African Americans used as reference group.

† Adjusted for age, income, insurance status, annual doctor's visit, regular physician or site of care, alcohol intake, amount of table salt added to meals, body mass index, and diabetes using SUDAAN to account for the complex survey design and weighted data.

DISCUSSION

Differences in HTN prevalence, HTN treatment, and HTN-related target-organ damage between African Americans and White Americans have



* $P=0.41$ vs. NAA men, † $P=0.96$ vs. NAA men, ‡ $P=0.05$ vs. NAA women, § $P=0.84$ vs. NAA women

Fig 2. Age-adjusted prevalence of uncontrolled hypertension is presented among northern African Americans (NAA), southern African Americans (SAA), and Black American immigrants (BAI) by sex. The statistical significance of each association is noted beneath the figures

Table 3. Adjusted odds ratios for significant predictors of uncontrolled HTN†

Variable	Adjusted Odds Ratio (N=1215)	95% CI
Southern African Americans*		
Men	1.12	[0.72–1.75]
Women	1.53	[0.98–2.39]
Black American immigrants*		
Men	1.12	[0.51–2.47]
Women	1.62	[0.49–5.39]
Doctors visit within 1 year		
Men	2.38	[1.40–4.04]
Women	4.08	[1.98–8.40]
Regular doctor or health center		
Men	2.71	[1.73–4.25]
Women	2.19	[1.04–4.63]
Often add table salt to meals		
Men	0.80	[0.47–1.35]
Women	0.42	[0.18–0.98]
Diabetes		
Men	2.97	[1.40–6.29]
Women	1.48	[0.77–2.87]

* Northern African Americans used as reference group.

† Adjusted for age, income, insurance status, annual doctor's visit, regular physician or site of care, alcohol intake, amount of table salt added to meals, body mass index, and diabetes using SUDAAN to account for the complex survey design and weighted data.

long been noted. In a recent study, only 25% of hypertensive participants in NHANES III were noted to have controlled HTN, and African Americans were found to have slightly higher rates of treated, but uncontrolled, HTN, compared to non-Hispanic Whites (32% vs 29%).¹⁶ Although the racial differences in HTN prevalence and control among NHANES III participants have been studied, relatively little is known about the sociodemographic factors influencing these outcomes among African Americans. In this large national cohort, we found that geographic region of residence and immigrant status were associated with HTN prevalence, rates of blood pressure control, and HTN-related target-organ damage.

We found that SAA men and women had a higher age-adjusted prevalence of HTN, relative to NAA men and women. Our findings are consistent with observations made during 1971–1978 in NHANES I,¹² which also demonstrated a higher prevalence of HTN among SAA women; however, until recently, there had been little understanding of the reasons for this difference. After adjusting for dietary, clinical, and demographic characteristics, including salt intake, alcohol intake, low income, body mass index, and cardiovascular risk factors, the difference in prevalence of HTN between SAA and NAA women was similar in magnitude, but no longer significant. However, after adjusting for these factors, geographic variations in HTN prevalence persisted among men, and BAI women were significantly less likely than US-born Black women to have HTN (Table 2).

Our findings are supported by population data from the CARDIA study, which revealed that regional differences in rates of elevated blood pressure were significant in younger Black men.¹⁰ Kiefe et al reported that among young adults (<30 years old), Southern Black men were more likely than Northern Black men to develop elevated blood pressure over a 7-year period, even after

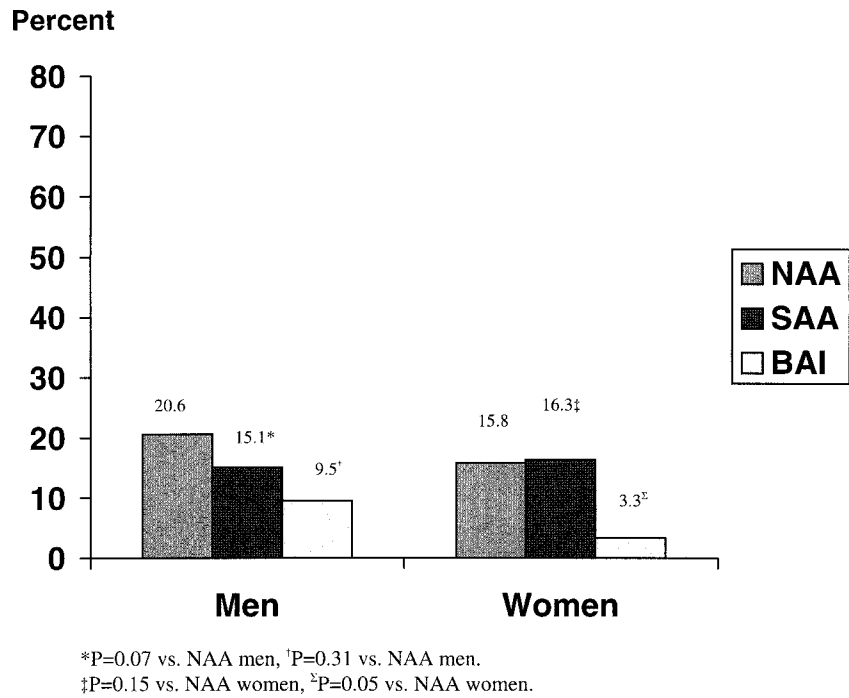


Fig 3. Age-adjusted prevalence of hypertension-related target-organ damage is presented among northern African Americans (NAA), southern African Americans (SAA), and Black American immigrants (BAI) by sex. The statistical significance of each association is noted beneath the figures

adjustment for numerous dietary habits, demographic characteristics, and family history.¹⁰ Such gender differences in blood pressure prevalence based on geographic region are not unique to African Americans. Data from Great Britain,¹⁷ and among Native Americans¹⁸ have also demonstrated gender differences in geographic variability of HTN.

Gender differences also exist in the geographic variability in rates of HTN control. We found that among hypertensive participants, SAA women, but not men, had higher age-adjusted rates of uncontrolled HTN, compared to NAA men and women. We also found a significantly lower rate of age-adjusted HTN-related target-organ damage among BAI women, compared to US-born African-American women. These differences in age-adjusted rates support previous findings that SAAs are significantly more likely than NAAs, and all US-born Blacks are more likely than Caribbean immigrants, to die from

HTN-associated vascular events.¹³ After multivariate adjustment, however, we found that SAA men were less likely to have HTN-related target organ damage. This suggests that Southern hypertensive African-American men have a risk of target-organ damage equal to that of Northern hypertensive African-American men, or BAI men; however, adjusting for differences in characteristics hypothesized to be associated with poor HTN control among African Americans,^{19,20} results in a lower odds ratio that Southern African-American men will report prior myocardial infarction, congestive heart failure, stroke, or renal failure. Further research is required to understand this geographic difference, particularly as it relates to potential residual differences in access to care.

An interesting finding of our study was the association of continuity of care, and regular access to care, with poor HTN control, and HTN-related target organ damage. Our findings suggest

that participants with uncontrolled HTN may be followed more diligently by healthcare providers, yet remain poorly controlled, despite the more frequent follow up. Our findings are supported by a prior study conducted among patients receiving care in Veterans Affairs hospitals, where only approximately 25% of hypertensive patients provided with a regular source of care and frequent provider visits (averaging 6 visits in 2 years) were found to have controlled blood pressure levels (less than 140/90).²¹

The International Collaborative Study of Hypertension in Blacks (ICSHIB) has reported significantly lower rates of HTN among West Indian and African Blacks, compared to US Blacks.⁹ We found that BAIs tended to have a lower prevalence of age-adjusted HTN, compared to US-born African Americans; however, this difference was non-significant. One possible reason for this difference may be that BAIs have already resided in the United States by the time of the survey, and, therefore, have been exposed to environmental factors similar to those experienced by US-born African Americans. This exposure could have conceivably led to higher rates of HTN among West Indian or African immigrants. Among other populations, data suggest that the longer immigrants from a low prevalence area reside in a high prevalence area, the greater their likelihood of developing both HTN and HTN-related mortality.^{22,23} The prevalence of HTN among the BAIs in our study was also higher than that found among either West Indian or African ICSHIB participants. This difference may result from the lifestyle and environmental exposures of US immigrants; however, another study observed HTN rates among West Africans that were higher than those reported in ICSHIB.²⁴

There are several potential limitations to our study. The number of BAI participants in NHANES III may have been insufficient to achieve statistical

Table 4. Adjusted odds ratios for significant predictors of target-organ damage†

Variable	Adjusted Odds Ratio (N=1215)	95% CI
Southern African Americans*		
Men	0.56	[0.37–0.87]
Women	0.80	[0.48–1.35]
Black American immigrants*		
Men	0.69	[0.25–1.93]
Women	0.34	[0.07–1.66]
Below poverty level		
Men	3.56	[1.92–6.59]
Women	1.48	[0.75–2.94]
Private insurance (%)		
Men	0.53	[0.30–0.94]
Women	0.74	[0.49–1.13]
Doctors visit within 1 year		
Men	12.66	[3.79–42.28]
Women	2.47	[0.80–7.62]
Regular doctor or health center		
Men	1.41	[0.56–3.53]
Women	3.72	[1.02–13.55]
>12 gm/day of alcohol (%)		
Men	0.40	[0.20–0.79]
Women	0.48	[0.14–1.62]
Body mass index >27 kg/m ²		
Men	0.40	[0.24–0.65]
Women	0.62	[0.42–0.91]
Diabetes		
Men	3.75	[2.14–6.59]
Women	2.20	[1.33–3.64]

* Northern African Americans used as reference group.

† Adjusted for age, income, insurance status, annual doctor’s visit, regular physician or site of care, alcohol intake, amount of table salt added to meals, body mass index, and diabetes using SUDAAN to account for the complex survey design and weighted data.

significance in HTN prevalence, rates of HTN control, or the risk of HTN-related target organ damage, compared to NAAs. However, despite having only 215 BAIs in our sample, we noted significant differences in the age-adjusted risk for HTN-related target-organ damage among BAI women, compared to US-born NAAs. The small sample of BAIs in our sample prevented us from testing the association of region of residence with HTN, and its related outcomes among BAIs. It will be necessary to conduct future research with a larger sample of BAIs from throughout the United States in order to ascertain whether the regional differences in HTN and HTN control noted among US-born African Americans, also occur among foreign-born African Americans.

There was no specific information

available about the birthplace of participants, other than the country in which they were born (United States vs abroad). As a result, we are unable to test the association of the geographic regions in which the participants were born with risk for HTN. Prior work examining death certificate data in New York City, suggest that African Americans born in the South are at a higher risk of dying from cardiovascular-related disease.¹³ However, if there is an increased risk of HTN among NAAs who migrated from the southern United States, our findings may underestimate the true difference in risks for HTN based on geographic region.

We were unable to assess the impact of perceptions or experiences of racism, or job-related stress, on the prevalence of HTN among groups. Studies have

Our findings suggest that participants with uncontrolled HTN may be followed more diligently by healthcare providers, yet remain poorly controlled, despite the more frequent follow up.

shown that increased sympathetic nervous system activity, secondary to socioeconomic and psychological stress, may play a role in the increased rate of HTN among African Americans, compared to Whites.^{25,26} The impact of occupational class, and the pressure for high work performance, has been shown to be associated with HTN, among both African-American^{27,28} and African populations.²⁹ We adjusted for income level as a marker of socioeconomic status; however, we were limited by the available data, and had no means of adjusting for the amount of psychological stress participants may experience.

There are several limitations to using survey data to assess the association of region of residence and immigrant status with HTN-related outcomes. Given that this analysis used cross-sectional data, we are able to test associations, but unable to establish causality. Patients also may differ in their ability to recall prior myocardial infarction, stroke, or CHF, and we did not have data on left ventricular hypertrophy as another important measure of target organ damage.

In conclusion, we found differences in the age-adjusted prevalence of HTN, control of HTN, and HTN-related target-organ damage among Blacks, based on geographic region and immigrant status. Not only race, but also region of residence and country of origin, may influence the risk a hypertensive patient

has of experiencing uncontrolled HTN, and HTN-related target-organ damage. The quality of care for HTN should be studied to determine whether African-American patients are treated differently by region of residence. Future studies should also assess the influence of job-related stress, racism, and other psychosocial factors, in the development and outcomes of HTN among Blacks in the United States.

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REFERENCES

1. Adams JM. Some racial differences in blood pressure and morbidity in groups of White and colored workmen. *Am J Med Sci.* 1932; 184:342.
2. Master BJ, Reda DJ, Cushman WC, et al, for the Department of Veterans Affairs Cooperative Study Group on Antihypertensive Agents. Single-drug therapy for hypertension in men: a comparison of six antihypertensive agents with placebo. *N Engl J Med.* 1993;328: 914–921.
3. The Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. The sixth report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Arch Intern Med.* 1997; 157:2413–2446.
4. He J, Klag MJ, Caballero B, Appel LJ, Charleston J, Whelton PK. Plasma insulin

- levels and incidence of hypertension in African Americans and Whites. *Arch Intern Med.* 1999;159:498–503.
5. Calhoun DA. Hypertension in Blacks: socioeconomic stress and sympathetic nervous system activity. *Am J Med Sci.* 1992;304:306–311.
6. Calhoun DA, Mutinga M, Collins AS, Wyss JM, Oparil S. Normotensive Blacks have heightened sympathetic response to cold pressor test. *Hypertension.* 1993;22:801–805.
7. Kimura M, Cho JH, Lasker N, Aviv A. Differences in platelet calcium regulation between African Americans and Caucasians: implications for the predisposition of African Americans to essential hypertension. *J Hypertens.* 1994;12:199–207.
8. Weder AB, Toretti BA, Julius S. Racial differences in erythrocyte cation transport. *Hypertension.* 1984;6:115–123.
9. Cooper R, Rotimi C, Ataman S, et al. The prevalence of hypertension in seven populations of West African origin. *Am J Public Health.* 1997;87:160–168.
10. Kiefe CI, Williams OD, Bild DE, Lewis CE, Hilner JE, Oberman A. Regional disparities in the incidence of elevated blood pressure among young adults: the CARDIA study. *Circulation.* 1997;96:1082–1088.
11. Gillum RF, Ingram DD. Relation between residence in the southeast region of the United States and stroke incidence: the NHANES I epidemiologic follow-up study. *Am J Epidemiol.* 1996;144:665–672.
12. Rocella EJ, Lenfant C. Regional and racial differences among stroke victims in the United States. *Clin Cardiol.* 1989;12:IV-18–IV-22.
13. Fang J, Madhavan S, Alderman MH. The association between birthplace and mortality from cardiovascular causes among Black and White residents of New York City. *N Engl J Med.* 1996;335:1545–1551.
14. Burt VL, Whelton P, Rocella EJ, et al. Prevalence of hypertension in the US adult population. Results from the Third National Health and Nutrition Examination Survey, 1988–1991. *Hypertension.* 1995;25:305–313.
15. Frane J. *SUDAAN: Professional Software for Survey Data Analysis.* Research Triangle Park, NC: Research Triangle Institute; 1989.
16. Hyman DJ, Pavlik VN. Characteristics of patients with uncontrolled hypertension in the United States. *N Engl J Med.* 2001;345:479–486.
17. Bruce NG, Cook DG, Shaper AG, Thomson AG. Geographical variations in blood pressure in British men and women. *J Clin Epidemiol.* 1990;43:385–398.

18. Howard BV, Lee ET, Yeh JL, et al. Hypertension in adult American Indians: the Strong Heart Study. *Hypertension.* 1996;28:256–264.
19. Kotchen JM, Shakoor-Abdulla B, Walker WE, Chelius TH, Hoffmann RG, Kotchen TA. Hypertension control and access to medical care in the inner city. *Am J Public Health.* 1998;88:1696–1699.
20. McNagny SE, Ahluwalia JS, Clark WS, Resnicow KA. Cigarette smoking and severe uncontrolled hypertension in inner-city African Americans. *Am J Med.* 1997;103:121–127.
21. Berlowitz DR, Ash AS, Hickey EC, et al. Inadequate management of blood pressure in a hypertensive population. *N Engl J Med.* 1998; 339:1957–1963.
22. He J, Klag M, Whelton P, et al. Migration, blood pressure pattern, and hypertension: the Yi Migrant Study. *Am J Epidemiol.* 1991;134: 1085–1101.
23. Salmond CE, Prior IA, Wessen AF. Blood pressure patterns and migration: a 14-year cohort study of adult Tokelauans. *Am J Epidemiol.* 1989;130:37–52.
24. Giles WH, Pacque M, Greene BM, et al. Prevalence of hypertension in rural West Africa. *Am J Med Sci.* 1994;308:271–275.
25. Calhoun DA, Oparil S. Racial differences in the pathogenesis of hypertension. *Am J Med Sci.* 1995;310(suppl 1):S86–S90.
26. Murphy JK, Albert BS, Moes DM, Somes GW. Race and cardiovascular reactivity: a neglected relationship. *Hypertension.* 1986;8: 1075–1083.
27. Waitzman NJ, Smith KR. The effects of occupational class transitions on hypertension: racial disparities among working-age men. *Am J Public Health.* 1994;84:945–950.
28. James SA, Strogatz DS, Wing SB, Ramsey DL. Socioeconomic status, John Henryism, and hypertension in Blacks and Whites. *Am J Epidemiol.* 1987;126:664–673.
29. Markovic N, Bunker CH, Ukoli FA, Kuller LH. John Henryism and blood pressure among Nigerian civil servants. *J Epidemiol Community Health.* 1998;52:186–190.

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Manuscript draft: Hicks, Ayanian
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Acquisition of funding: Hicks
Administrative, technical, or material assistance: Hicks
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