



CLINICAL RESEARCH STUDY

Racial Differences in Blood Pressure Control: Potential Explanatory Factors

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ABSTRACT

PURPOSE: Poor blood pressure control remains a common problem that contributes to significant cardiovascular morbidity and mortality, particularly among African Americans. We explored antihypertensive medication adherence and other factors that may explain racial differences in blood pressure control.

METHODS: Baseline data were obtained from the Veteran's Study to Improve The Control of Hypertension, a randomized controlled trial designed to improve blood pressure control. Clinical, demographic, and psychosocial factors relating to blood pressure control were examined.

RESULTS: A total of 569 patients who were African American (41%) or white (59%) were enrolled in the study. African Americans were more likely to have inadequate baseline blood pressure control than whites (63% vs 50%; odds ratio = 1.70; 95% confidence interval [CI] 1.20-2.41). Among 20 factors related to blood pressure control, African Americans also had a higher odds ratio of being nonadherent to their medication, being more functionally illiterate, and having a family member with hypertension compared with whites. Compared with whites, African Americans also were more likely to perceive high blood pressure as serious and to experience the side effect of increased urination compared with whites. Adjusting for these differences reduced the odds ratio of African Americans having adequate blood pressure control to 1.59 (95% confidence interval 1.09-2.29).

CONCLUSIONS: In this sample of hypertensive patients who have good access to health care and medication benefits, African Americans continued to have lower levels of blood pressure control despite considering more than 20 factors related to blood pressure control. Interventions designed to improve medication adherence need to take race into account. Patients' self-reports of failure to take medications provide an opportunity for clinicians to explore reasons for medication nonadherence, thereby improving adherence and potentially blood pressure control. © 2006 Elsevier Inc. All rights reserved.

KEYWORDS: Racial disparity; Hypertension; Adherence

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Hypertension is the major modifiable risk factor for stroke and one of the major risk factors for coronary heart disease, congestive heart failure, and renal disease. There are approximately 65 million Americans with hypertension, and the prevalence of hypertension in adults 65 years of age and older exceeds 50%.¹ African Americans have a disproportionately large burden of cardiovascular morbidity and mortality in the United States compared with whites; half of the cardiovascular mortality disparity between African Americans and whites is directly attributable to hypertension.² The

prevalence of hypertension in African Americans is among the highest of any ethnic group in the world.^{3,4} Compared with whites, African Americans develop hypertension earlier in life and have higher average blood pressure. African Americans also have higher rates of more severe hypertension (>180 or >110 mm Hg) than whites, causing a greater burden of hypertension complications.^{5,6} This earlier onset, higher prevalence, and greater rate of severe hypertension in African Americans are accompanied by an 80% higher stroke mortality rate, a 50% higher heart disease mortality rate, and a 320% greater rate of hypertension-related end-stage renal disease than seen in the general population.^{3,4} Improvements in blood pressure control as well as the elimination of racial and ethnic disparities in health care have been established as national goals in the Healthy People 2010 initiative.⁷

There are a number of potential factors that may explain racial differences in blood pressure control; one important factor is medication adherence.⁸⁻¹¹ Adherent patients have better health outcomes, even when their medication is a placebo.¹² Up to 80% of patients who are prescribed medications fail to adhere to them at some point.^{13,14} As many as 60% of hypertensive patients discontinue their treatment within the first year of care,¹⁵⁻¹⁷ and less than 65% remain in therapy after 3 years.^{17,18} Of those remaining in treatment, antihypertensive medication adherence varies from 40% to 70%.¹⁹⁻²¹ Prior studies have documented lower medication adherence in hypertensive African Americans compared with whites.^{6,22-25} Thus, racial differences in adherence may be one factor that contributes to racial disparities in cardiovascular outcomes.

Veterans receiving treatment for hypertension represent a unique and scientifically important group for the study of racial disparities in health care. First, the Department of Veterans Affairs (VA) Healthcare System provides an opportunity to study racial disparities in health without having to control for health insurance status, because all veterans have essentially the same level of health insurance including coverage for medications.²⁶ Therefore, the VA setting provides an opportunity to examine racial differences in a health care setting where economic and access-to-care disparities are minimized. Second, veterans receiving health care in the VA setting include a significant proportion of minority patients with lower-than-average incomes.²⁷ Thus, we sought to determine the social, economic, and physical

factors that may explain racial differences in blood pressure control and determine the extent to which modifiable (ie, medication adherence) and nonmodifiable factors (ie, race) are related to blood pressure control.

CLINICAL SIGNIFICANCE

- Strong racial differences in blood pressure control exist in this sample of veterans with hypertension despite equal access and considering a number of clinical and psychosocial factors.
- Patients' reports of medication nonadherence provide an opportunity for clinicians to explore reasons for nonadherence, thereby improving adherence and blood pressure control.
- Integrating health beliefs into educational interventions may improve nonadherence rates and improve blood pressure control among African Americans.

METHODS

The setting for this study was the Durham Veterans Affairs Medical Center Primary Care Clinics, which involve two sites (hospital-based general medicine clinic and women's health clinic). There are 30 primary care providers who provide care in this continuity setting.

Patients were enrolled in an ongoing randomized controlled health services intervention trial to improve blood pressure control. The Veteran Study to Improve the Control of Hypertension is a 4-year trial that evaluates both a patient and a provider intervention in a primary care setting among diagnosed hypertensive veterans.^{28,29}

The patient study population for the Veteran Study to Improve the Control of Hypertension was drawn from 4017 potential subjects identified through the facility's information system. These individuals had a diagnosis of hypertension by an outpatient *International Classification of Disease, Ninth Revision* (ICD-9) code 401.0, 401.1, or 401.9 on outpatient encounter forms (primary or secondary hypertension) and had a filled prescription for hypertensive medication (angiotensin-converting enzyme inhibitors, beta-blockers, calcium channel blockers, diuretics, alpha₁ blockers, and/or central alpha₂ agonists) in the previous year.

The research assistants approached 816 patients from the large pool of potential subjects. Of these patients, 190 refused and 38 were excluded. Reasons for exclusion included being hospitalized for a stroke, myocardial infarction or coronary artery revascularization, diagnosis of metastatic cancer in the past 3 months, dementia diagnosis, resident in nursing home or receiving home health care, or severely impaired hearing or speech. For the current study, only African Americans and whites were included. A total of 569 patients were enrolled. All measures reported in this article were obtained at the baseline face-to-face interview, except for blood pressure, which was obtained from patients' medical records.

Outcome: Blood Pressure Control

Blood pressure was obtained from patients' electronic medical records on the day of enrollment into the study. Trained nurses using standard automated blood pressure devices

systematically obtain blood pressure values. Blood pressure values are obtained before the physician visit and entered into the VA computerized medical record system. In most cases, there was more than one reading. We used the minimum systolic and minimum diastolic for the baseline blood pressure when more than one blood pressure value was available. Blood pressure was defined as in or out of control based on goal values from the sixth report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.³⁰ This was the guideline available at the start of the study. For patients with diabetes, blood pressure control was defined as less than 130/85 mm Hg; for all other patients, control was defined as less than 140/90 mm Hg.

Mediating Variables

The Rapid Estimate of Adult Literacy in Medicine³¹ was used to measure health-related literacy and has high criterion-related validity compared with longer literacy measures.^{32,33} A single item based on the Hypertension Beliefs Questionnaire³⁴ was used to examine the patient's perceived risk associated with hypertension. The question included "how serious do you think having high blood pressure is." Medical regimen-specific memory was measured by reading a brief paragraph that describes a typical interaction involving a provider explaining a hypertension regimen and asking the patients to repeat the instructions (ie, take your medication once in the morning and once at night). Locus of control was assessed using an item from Wallston and Wallston's health-related locus of control measure.³⁵ Chance locus of control was measured by, "My control of high blood pressure is largely a matter of good fortune." Ten items from the modified hypertension beliefs questionnaire were used to assess knowledge and perceived risks.³⁴ Each of the 10 items is scored as either a 1, which indicates a correct response to the question, or a 0, which indicates an incorrect response. All 10 items are summed to calculate an overall hypertension knowledge score. Financial situation was assessed by asking patients to report whether they have enough money after paying bills for special things; enough to pay the bills, but not purchase extra things; enough money to pay bills by cutting back on things; or difficulty paying bills no matter what was done.³⁶

Health behaviors were assessed by previously piloted single-item questions asking participants if they exercise or smoke cigarettes.³⁷ Specifically, participants were asked if they exercise or participate in an active physical sport, such as walking, jogging, or bicycling; the responses are yes or no. The question assessing smoking was dichotomous and asked the participants if they currently smoke; the response choices were yes (1) or no (0).

Patients answered yes or no to a list of standard side effects that are associated with their antihypertensive medications. We looked at the total number of side effects and specific side effects, which included increased urination, lethargy, and dry mouth. Patients' view of their providers' communication behavior was assessed using the 3-item Par-

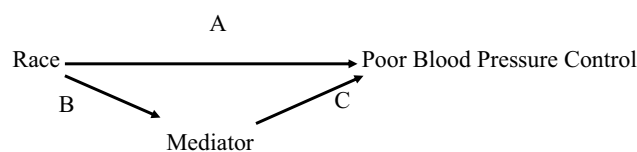


Figure Analytic model.

ticipatory Decision Making survey.³⁸ The amount of emotional social support patients receive was also assessed using a validated item.³⁹ Individuals were asked whether a parent or sibling was diagnosed with hypertension and whether they currently used a blood pressure monitor. Diabetes and length of time having hypertension were self-reported.

Self-reported adherence was assessed using a 4-item measure based on the Morisky scale⁴⁰ (ie, I sometimes forget to take my blood pressure medicine; I am sometimes careless about taking my blood pressure medicine; When I feel better, I sometimes stop taking my blood pressure medicine; If I feel worse when I take the blood pressure medicine, sometimes I stop taking it). Response options ranged from strongly agree (1) to strongly disagree (4). A summary binary variable was created by coding those who responded strongly agree or agree to any of the 4 questions as 1 (nonadherent); otherwise, patients received a value of 0 (adherent). The adherence measure did not specify a time period over which participants were supposed to report adherence; therefore, the measure assessed global, rather than specific, adherence.

We chose the Morisky scale because the measure had been previously shown to have reasonable operating characteristics; in a prior study, the scale had sensitivity (72%) and specificity (74%) for 80% or more adherence to tricyclic antidepressants based on microelectric event monitoring.⁴¹ Others have found that self-reported measures of medication adherence have a sensitivity of 55% and specificity of 87% compared with pill counts.⁴² In addition, the likelihood ratio of the Morisky measure is 2.7 (95% confidence interval [CI] 1.6-4.4).⁴³ That is, a patient with at least one positive answer (nonadherent) on the Morisky measure would have a positive result, suggesting that the likelihood of an adherence problem increases by 2.7 using microelectronic event monitoring.

ANALYSES

We conducted 3 sets of logistic regression analyses to assess possible mediating factors in the relationship between race and blood pressure control. The first set of analyses examined the direct association between race and blood pressure control (pathway a) (Figure). Second, the relationship between race and potential mediators of poor blood pressure control were examined using bivariable analyses (pathway b). Last, we examined the relationship between mediators and blood pressure control (pathway c). Variables that were significant at *P* less than .05 were included. For a variable to be a significant mediator, the odds ratio (OR) between

Table 1 Models explaining racial differences in blood pressure control

Dependent variable	Pathway B African American OR (CI 95%)	Pathway C Poor blood pressure control OR (CI 95%)	Final model Poor blood pressure control OR (CI 95%)
Independent variables			
African American			1.59 (1.09-2.29)
Demographics			
Low literacy (≤ 60 on REALM)	2.89 (2.04-4.10)	0.88 (0.63-1.25)	
Psychosocial factors			
How serious is having high blood pressure			
Very serious vs serious	1.75 (1.16-2.63)	1.16 (0.78-1.75)	0.89 (0.58-1.37)
Very serious vs a little or not at all serious	1.74 (0.95-3.16)	1.91 (1.06-3.46)	1.96 (1.04-3.71)
Serious vs a little or not at all serious	1.00 (0.51-1.94)	2.23 (1.16-4.28)	2.20 (1.09-4.43)
Clinical factors			
Medication nonadherence	1.81 (1.28-2.58)	1.47 (1.02-2.10)	1.35 (0.92-1.99)
Relative with hypertension	3.44 (1.77-6.71)	0.88 (0.50-1.55)	
Increased urination	1.63 (1.14-2.32)	1.98 (1.39-2.82)	1.79 (1.24, 2.57)

REALM = The Rapid Estimate of Adult Literacy in Medicine; OR = odds ratio; CI = confidence interval.

*Other independent variables examined as possible mediators. Demographics: education, income. Psychosocial factors: participatory decision making, hypertension knowledge, medical regimen specific memory, chance locus of control, social support. Clinical factors: use of home blood pressure monitor, length of time with hypertension, currently no exercise, currently smoking, diabetic, number of antihypertensive medications, comorbidities as measured by the Charlson comorbidity index,⁵³ total number of side effects, dry mouth side effect, and lethargy side effect.

pathways b and c had to be significant and the OR observed at pathway a was diminished.⁴⁴ The final model included race and significant mediators identified in pathway c.

RESULTS

Patient Sample

Patients' mean age was 63 years, 98% were male, 41% were African American, and 59% were white. The proportion of African Americans enrolled in the current study represent the proportion seen in the Durham Veterans Affairs Medical Center. A majority of the sample (68%) were married, and 22% lived alone. Half of the sample (51%) had a high school education or less, 21% reported having inadequate incomes, and 29% were employed. In terms of clinical information, 69% of the sample reported taking blood pressure medications for 5 or more years, and 66% had at least one family member with hypertension. A significant percentage of the sample did not report any exercise in the last week (45%), and 30% currently smoke; 40% of patients were diabetic. Baseline mean systolic blood pressure was 138.5 mm Hg (standard deviation = 18), and the mean diastolic blood pressure was 75.5 (standard deviation = 11). By using cutoffs suggested by Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure, 43% of the sample had their blood pressure under control at baseline ($<140/90$ mm Hg nondiabetic, and $<130/85$ mm Hg diabetic).

Results of the first logistic regression (pathway a) indicated that African Americans were more likely to have inadequate blood pressure control compared with whites (63% vs 50%; $P < .003$; OR = 1.70; 95% CI 1.20-2.41). The second step (pathway b) involved examining the association between race and potential mediators. African

Americans had a higher odds of being nonadherent with their medication (OR = 1.81; 95% CI 1.28-2.58) and were more likely to perceive high blood pressure as very serious versus serious (OR = 1.75; 95% CI 1.16-2.63), to report a parent or sibling with hypertension (OR = 3.44; 95% CI 1.77-6.71), to be illiterate (OR = 2.89; 95% CI 2.04-4.10), and to report increased urination (OR = 1.63; 95% CI 1.14-2.32) compared with whites.

Finally, we examined the association between potential mediators and blood pressure control (pathway c). Poor blood pressure medication adherence (OR = 1.47; 95% CI 1.02-2.1), increased perceived hypertension seriousness versus a little or not at all serious (OR = 1.91; 95% CI 1.06-3.46), and increased urination (OR = 1.98; 95% CI 1.39-2.82) were significantly related to poorer blood pressure control (Table 1). Literacy and having a relative with hypertension were not associated with blood pressure control.

In the final model, the odds of an African American having poor blood pressure control had decreased to an OR of 1.59 (95% CI 1.09-2.29) but remained significant. Increased urination also remained significant (OR = 1.79; 95% CI 1.24-2.57).

DISCUSSION

In this sample of veterans with hypertension and minimal financial barriers to medical care, there were strong racial differences in blood pressure control. This racial difference was not fully explained by more than 20 potential mediating factors. Our findings confirm previous reports of racial differences in blood pressure control. The findings also suggest that although poor medication adherence is an important component of poor blood pressure control, racial differ-

ences in blood pressure control can persist despite adequate access to care.

Understanding factors that explain racial disparities in blood pressure control are important given the decline in cardiovascular deaths in the United States has not been uniformly distributed across racial groups,^{45,46} and half of the mortality disparity between African Americans and whites is directly attributable to hypertension.² In our study, we found that after a number of clinical, psychosocial, and patient characteristics were controlled, African Americans were less likely to have blood pressure control than whites. The racial differences in blood pressure control observed in this relatively equal access system were comparable to prior studies.⁴⁷⁻⁴⁹ For example, data from the Multi-Ethnic Study of Atherosclerosis, a population-based study of adults without clinical cardiovascular disease, reported that after socioeconomic factors were controlled, African Americans continued to have significantly higher odds of uncontrolled hypertension than whites (OR 1.35; 95% CI, 1.07-1.71).⁴⁷ Similarly, the most recent National Health and Nutrition Examination Survey conducted in 1999 to 2000 noted significantly lower rates of hypertension control among African American (45%; $P < .05$) compared with whites (56%), despite equivalent rates of hypertension awareness and treatment.⁴⁸ A population-based survey of elderly men and women living in North Carolina noted that African Americans were 67% more likely than whites to have uncontrolled blood pressure after adjustment for multiple covariates,⁴⁹ similar to rates observed in our current study.

Similar to prior studies,^{6,8,9,22-25,50} our study found that African Americans report poorer medication adherence. Charles et al,⁸ in a veteran sample using administrative records, observed African American veterans were less adherent than white veterans for angiotensin-converting enzyme inhibitors, calcium-channel blockers, and statins. Other studies have found racial differences in adherence to medication in specialized populations, such as participating in randomized trials and those receiving Medicaid.^{9,50} Many of the prior studies have used self-reported diagnosis of hypertension⁵¹ and self-reported measures of antihypertensive use⁵¹ or medical records to define adherence.^{8,9} These studies are limited by their retrospective review of administrative databases^{8,9,52} or their lack of control for confounding factors such as access to care and prescription drug coverage.^{51,52} It is important to note that there were no racial differences in the number of prescribed antihypertensive medications or disease severity as measure by the Charlson comorbidity index.⁵³

Although we did not explicitly hypothesize a relationship with side effects, among the various side effects examined, only increased urination was related to poor blood pressure control. In a recent study, diuretic use was highest among African Americans compared with whites.⁴⁷ In the current study, African Americans also were significantly more likely to be prescribed diuretics compared with whites (61% vs 49%; $P < .006$). It is feasible that if African Americans

are being prescribed more diuretics than whites, this may contribute to poorer medication adherence and subsequent poorer blood pressure control because of this common side effect of diuretic therapy. Nevertheless, further investigation into why increased urination was reported to be a problem among African Americans needs to be examined.

Health beliefs about hypertension and its treatment have been commonly cited factors as hindering individuals from taking their blood pressure as prescribed.^{11,54} These prior studies have reported that participants perceived medication to be harmful and ineffective. Investigators have also reported distinct health beliefs among African Americans, including, for example, the perception that high blood pressure and hypertension fit two different disease models.⁵⁵ Thus, it is important to address patients' medication beliefs before prescribing antihypertensive medications. To reduce the nonadherence rate among African Americans and improve blood pressure control, it may also be necessary to integrate health beliefs into educational interventions.

We observed that increased perceived seriousness of hypertension was associated with poorer blood pressure control. We hypothesize 2 possible explanations for this finding. First, it may be that perceived risk is not always directly related to actual behavior. The probability that advice will be followed is a function of the patient's perceptions of susceptibility to the disease, the likely severity (clinical and social) of the disease, and the benefits and barriers likely to be encountered as a result of the recommended action. The salience of hypertension, however, is often difficult for patients to envision because of lack of substantial immediate benefits of antihypertensive medication and the asymptomatic nature of the disease. Patients must believe that by following a particular set of health recommendations, they will abolish or at least reduce the threat or severity of hypertension and its consequences. Second, we argue that individuals who perceive their hypertension as more serious are likely to have other significant comorbidities. Given an increased number of comorbidities it is more of a challenge to adhere to recommended treatments given likely increased number of medications and more physical disabilities.

Although trust in the health care and providers has been provided as an explanation for racial differences in health care,^{54,56-58} this seems to have been less of an issue in the current study. Participatory decision making, although not a direct measure of trust, did not explain any of the racial differences in poor blood pressure control. Participatory decision making has been found to be related to increased likelihood of adhering to recommendations.^{58,59} Furthermore, Kaplan et al⁶⁰ reported that hypertensive patients whose physicians were less controlling or who allowed more patient participation during the office visits had better functional status and lower follow-up blood pressure than patients of more controlling physicians. Thus, racial differences in perceived communication may be less of an issue in the VA health care system because it is difficult to change

primary care providers, and therefore it is important to improve and maintain communication with assigned providers.

This study has several potential limitations. The study population is a veteran patient population, and the treatment of hypertension may not be representative of those experienced by the general population. In particular, the population is comprised largely of men. Moreover, the context is one of an equal access health care system in which the impact of the patient's ability to pay for care is minimized. The observed effect of poor adherence and barriers to care may be more pronounced in those health care systems in which financial considerations are more important to the receipt of care. Although we examined a number of potential mediators of blood pressure control, other potentially significant factors may not have been identified. Adherence was assessed using a self-report measure that had reasonable psychometric properties; however, it is possible that the racial differences in self-reported adherence could be attributed to differences in interpretation of the measure. Furthermore, there lacks explicit racial validation of the self-report measure of medication adherence. To better understand racial disparities in hypertension, further work is needed to validate measures of medication adherence in different racial/ethnic populations.

The results of this study have both clinical and research implications. First, our results suggest that economic barriers and access to care are not the only contributors to racial differences in blood pressure control. Second, patient's self-report medication nonadherence may provide an opportunity for clinicians to explore reasons for nonadherence. However, despite examining more than 20 potential factors that potentially explain racial differences in blood pressure, there lacked a full explanation for these findings. Thus, programs to improve hypertension treatment and control should focus on a better understanding of differences in the prevalence of hypertension and determinants of hypertension control among minority groups in the United States. Strategies that address poor blood pressure control in African Americans, in particular, would contribute greatly to reduce the cardiovascular health disparities in the United States.

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