Racial Differences in Blood Pressure Control: Potential Explanatory Factors

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OBJECTIVE: The objective of the study was to identify potential explanatory factors for racial differences in blood pressure (BP) control.

DESIGN: The design of the study was a cross-sectional study

PATIENTS/PARTICIPANTS: The study included 608 patients with hypertension who were either African American (50%) or white (50%) and who received primary care in Durham, NC.

MEASUREMENTS AND MAIN RESULTS: Baseline data were obtained from the Take Control of Your Blood pressure study and included clinical, demographic, and psychosocial variables potentially related to clinic BP measures. African Americans were more likely than whites to have inadequate baseline clinic BP control as defined as greater than or equal to 140/90 mmHg (49% versus 34%; unadjusted odds ratio [OR] 1.8; 95% confidence interval [CI] 1.3–2.5). Among factors that may explain this disparity, being older, reporting hypertension medication nonadherence, reporting a hypertension diagnosis for more than 5 years, reporting high levels of stress, being worried about hypertension, and reporting an increased number of medication side effects were related to inadequate BP control. In adjusted analyses, African Americans continue to have poor BP control relative to whites; the magnitude of the association was reduced (OR=1.5; 95% CI 1.0–2.1). Medication nonadherence, worries about hypertension, and older age (>70) continued to be related to poor BP control.

CONCLUSIONS: In this sample of hypertensive patients, there were a number of factors associated with poor BP control that partially explained the observed racial disparity in hypertension control including age, medication nonadherence, and worry about BP. Medication nonadherence is of particular interest because it is a potentially modifiable factor that might be used to reduce the racial disparity in BP control.

KEY WORDS: racial disparity; hypertension; adherence; psychosocial.

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INTRODUCTION

Hypertension affects 65 million U.S. adults, and another 45 million are prehypertensive.¹ It has been estimated that among adults more than 50 years of age, the lifetime risk of developing hypertension approaches 90%.² Hypertension is the major modifiable risk factor for stroke and is 1 of the major risk factors for coronary heart disease, congestive heart failure, and renal disease.^{3–5} Because hypertension is 1 of the major contributing factors to a host of cardiovascular diseases, even small racial/ethnic differences in its optimum management have large implications for outcomes.

African Americans suffer a disproportionately large burden of cardiovascular morbidity and mortality in the United States compared to white patients; half of the cardiovascular mortality disparity between African Americans and whites is directly attributable to hypertension.⁶ Although blood pressure (BP) treatment and control rates for both whites and African Americans have increased significantly from 1988–1994 to 1999–2002, African Americans continue to lag behind whites in achieving BP goals.⁷ Furthermore, the disparity in BP control among treated cases has grown, with an increased BP control of 24% among whites and only an increased BP control of 18% among African Americans during this time period.

The explanation for the persisting racial differences in hypertension control and in cardiovascular and renal outcomes is not fully known but may include biological, cultural, social, and health care provider and system factors.⁸ Whereas historically, there have been significant racial disparities in the accessibility of health care, improved access to care and medications does not necessarily ensure better hypertension control for African Americans.^{9,10} These observations suggest that in addition to equal access, patient, provider, and health care system characteristics contribute to racial disparities.¹¹ Accurate identification of these variables is essential in allocating resources to support effective solutions. We examined various demographic, clinical, behavioral, and psychosocial factors that may explain these racial differences in BP

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control among a sample of individuals with hypertension recruited from 2 large primary care clinics.

MATERIALS AND METHODS

We used baseline data from the Take Control of Your Blood pressure trial, a 2 by 2 factorial design testing 2 interventions (tailored behavioral intervention and BP self-monitoring). Potentially eligible individuals were selected through a medical electronic database from a pool of 7,646 unique patients who were diagnosed with hypertension (International Classification of Diseases-9 codes 401.9, 401.0, and 401.1), seen in 1 of the 2 community primary care clinics for at least 1 year before enrollment, and were currently using a medication for hypertension (angiotensin-converting enzyme inhibitors, beta blockers, calcium channel blockers, diuretics, alpha₁ blockers, and central alpha₂ agonists) at baseline.¹²

The trial occurred in 2 Duke University Health System primary care clinics: (1) Duke General Internal Medicine, where most patients have private insurance or Medicare and are cared for by General Internists, and (2) Duke Outpatient Clinic, a hospital-based primary care clinic committed to underserved patients with limited financial resources and where primary care providers are predominantly residents in the Duke Department of Medicine residency training program.

Research assistants mailed letters that explained the study from patients' doctors to 1,501 potentially eligible patients with upcoming appointments. Six hundred and thirty-six patients were enrolled, 630 refused, and 235 were excluded for the following reasons: not prescribed or using a hypertension medication; spouse participating in the study; did not live in a surrounding 8 county catchment area; receiving kidney dialysis; received an organ transplant; planning a pregnancy; arm measurements outside the BP monitor parameters (>43 cm); hospitalized for stroke, myocardial infarction, or coronary artery revascularization or received a diagnosis of metastatic cancer in the prior 3 months; diagnosed with dementia; residing in a nursing home or receiving home health care; or severely impaired hearing or speech. An additional 28 individuals were not included in the current analyses because their race was not African American or white or because they were missing clinic BP readings, resulting in a final sample size of 608 subjects. Participants were reimbursed \$25 each for the study visit. The Duke Institutional Review Board approved this study. Data used in the current study were collected before implementation of the intervention.

MEASURES

Outcome—Blood Pressure Control

Clinic BP readings taken on the day the patient completed the baseline interview were obtained from patients' medical records. Registered nurses used standard automated BP devices to systematically obtain BP values before the physician visit and entered them into a computerized medical record system. Lack of BP control was defined as BP greater than or equal to 140/90 mmHg.

Potential Explanatory Variables

Whereas there are a number of potential variables that may explain disparities in BP control, we used the revised health decision model⁸ to guide the selection of the various measures/items we assessed in our analyses. The measures and items we chose to assess, along with their definitions and categorizations, are listed below.

Demographic

We evaluated sex using male as the referent category. Financial situation was assessed by asking patients to report whether they had 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 is done.¹³ The latter 2 categories were categorized as inadequate income. Age was categorized into the following groups: 25–50, 51–60, 61–70, and greater than 70.

Psychosocial

The Rapid Estimate of Adult Literacy in Medicine (REALM)¹⁴ was used to measure health-related literacy. The REALM has high criterion-related validity as compared to longer literacy measures.^{15,16} Health literacy was evaluated as a dichotomous variable with low literacy defined as REALM score, 0–60 (less than 9th grade level) and adequate literacy defined as REALM score 61–66 (greater than or equal to 9th grade level). This operationalization was based on prior convention and is consistent with findings correlating low literacy and mortality using this categorization.¹⁷ Medical regimen-specific recall was measured by asking subjects to read and repeat aloud a sentence that represented typical instructions that a provider would give to patients to help reduce hypertension. (i.e., take your medication once in the morning and once at night). The number of correctly remembered phrases (out of 10) were recorded and summed to create a recall variable. Seven items were used to assess barriers to medication treatment (e.g., side effects, confusion about how many pills to take, keeping track of pills). These items are a subset of the 56-item barriers to adherence checklist.¹⁸ Responses were recoded and ranged from 1 (definitely true) to 4 (definitely false), where lower scores indicated more barriers. The internal consistency for this scale was acceptable (Cronbach's alpha=0.75). A summary score was created by summing across the individual scores such that the higher the score, the fewer the barriers.

Self-reported medication adherence was assessed using a 4-item measure based on Morisky's scale¹⁹ (i.e., I sometimes forget to take my BP medicine; I am sometimes careless about taking my BP medicine; When I feel better, I sometimes stop taking my BP medicine; If I feel worse when I take the BP medicine, sometimes I stop taking it). Response options ranged from strongly agree (1) to strongly disagree (4). The internal consistency of these variables was acceptable (Cronbach's alpha=0.85). A summary binary variable was created by coding those who responded strongly agree, agree, don't know, or refuse to any of the 4 questions as nonadherent; otherwise, patients were coded as 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.²⁰ Seven items from the modified hypertension beliefs questionnaire were used to assess knowledge and perceived risks.²¹ Each of the items was scored with a 1 for a correct response or a 0 for an incorrect response. Using a prior scoring algorithm,^{20,22,23} all 7 items were summed to calculate an overall hypertension knowledge score and then categorized into high (7) versus low (0–6) knowledge. Perceived stress was assessed by asking participants to report how often in the past month they felt stressed (never, almost never, sometimes, fairly often, very often). Fairly often and very often were categorized as “Often feel stressed.” Patients’ views of their providers’ communication behaviors were assessed using the revised 3-item Participatory Decision Making survey.²⁴ Patients rated how likely, on the scale of 1 (never/unlikely) to 10 (always/very likely) their doctor was to: (1) involve them in treatment decisions, (2) ask them to take some responsibility in their care, and (3) give them a sense of control over their medical care. The ratings for these 3 questions were summed to create a participatory decision-making score ranging from 3 to 30 when all questions were completed (Cronbach’s alpha=0.74). Worry about hypertension was assessed by asking individuals how worried they were about their high BP, using a 10-point scale (1=definitely not worried to 10=extremely worried). A single question assessed whether individuals perceived that health professionals controlled one’s health. Responses of strongly agree and agree were categorized as “lack personal control of health,” and disagree and strongly disagree were categorized as “have personal control of health.” The amount of emotional social support patients receive was also assessed using a validated item.²⁵ The respondents were asked “Do you have someone you feel close to, someone you can trust and confide in?” Responses were yes or no.

Clinical

Subjects were classified according to whether they had a home BP monitor (yes/no). Time since hypertension diagnosis was examined as 0–5 years versus greater than 5 years. Individuals were asked whether a parent or sibling was diagnosed with hypertension (yes/no). Patients answered yes or no to whether they experienced a list of 15 standard side effects that are associated with antihypertensive medication use, including increased urination, lethargy, and dry mouth among others. The total number of “yes” responses was summed to create a side effects score.

Health behaviors were assessed utilizing single-item questions asking participants if they exercise or smoke cigarettes.²⁶ Specifically, participants were asked how much time per week they spent on aerobic or body movement activities such as brisk walking, jogging, or running that elevated their heart rate for 20 minutes and made them sweat/perspire. Subjects who reported that they never did this during a week were classified as having no weekly exercise. The question assessing smoking was dichotomous and asked the participants whether or not they currently smoked. Diabetes (yes/no) was self-reported by patients in response to the question, “Has a doctor ever told you that you had diabetes, high blood sugar, or sugar in your urine?” Subjects who reported having a blood relative (parent, brother, or sister) with high BP were classified as having a family history of hypertension.

ANALYSES

To assess potential explanations for racial disparities in BP control, we first verified that a racial disparity existed in our sample by using unadjusted logistic regression to calculate odds ratios (ORs) for the association between lack of BP control and race (African American versus white [referent]). We then used logistic regression analyses to calculate unadjusted ORs and 95% confidence intervals (CIs) for the association between lack of BP control and each candidate’s explanatory variable. Candidate explanatory variables that changed the OR for the association between lack of BP control and race by greater than or equal to 10%^{27,28} were included in the final multivariable model. We tested for interactions between race and each of the candidate explanatory variables from the multivariable model, but none were significant. SAS version 9.1 (Cary, NC, USA) was used for all analyses.

RESULTS

Patient Sample

Patients’ mean age was 61 years (range 25–92 years), 66% were female, and 50% were African American (see Table 1).

Table 1. Patient Sample Characteristics, Overall and Stratified by Race

	Overall (%) or Mean (SD) (n=608)	African American (n=306)	White (N=302)
Poor BP control ($\geq 140/90$ mmHg)	42%	49%	34%
Demographic			
Female	66%	74%	59%
≤ 12 grade education	36%	50%	22%
Inadequate income	18%	28%	9%
Age	61 (12)	59 (13)	63 (12)
Insurance type			
Commercial	39%	33%	44%
Medicaid	17%	27%	6%
Medicare	42%	35%	48%
Uninsured	3%	5%	2%
Psychosocial			
Health literacy (<9th grade)	27%	45%	8%
Recall score	7.0 (2.3)	6.6 (2.1)	7.3 (2.3)
Medication barriers score	24.1 (3.7)	23.7 (4.3)	24.5 (3.0)
Medication nonadherent	36%	50%	21%
Low hypertension knowledge	64%	72%	56%
Often feel stressed	38%	39%	36%
Participatory decision making score	25.7 (5.5)	25.6 (5.8)	25.8 (5.1)
Hypertension worry Score (1–10 higher)	6.2 (2.6)	7.1 (2.4)	5.3 (2.5)
Lack personal control of health	58%	48%	68%
Have emotional support	94%	94%	93%
Clinical			
Have home BP monitor	44%	29%	58%
>5 years since high BP diagnosis	66%	70%	61%
Number of medication side effects	3.9 (3.2)	4.4 (3.2)	3.4 (3.2)
No weekly exercise	23%	25%	20%
Diabetes	36%	45%	26%
Current smoker	16%	21%	12%
Family history of hypertension	77%	85%	69%

About half the sample (50%) was married, 36% had a high school education or less, 18% reported having inadequate incomes, and 61% were employed. In terms of clinical information, 66% of the sample reported having been diagnosed with high BP for 5 or more years, and 77% had at least 1 family member with hypertension. Based upon the REALM literacy measure, 27% of the sample had an 8th grade or less literacy level. Twenty-three percent of the sample did not report any exercise lasting 20 or more minutes during the last week, and 16% were currently using tobacco products.

As shown in Table 1, 45% of African-American and 26% of white patients were diabetic. Baseline clinic systolic BP was 139.5 mmHg (SD=21.9) for African Americans and 131.1 mmHg (SD=17.4) for whites. The diastolic BP was 80.1 (SD=11.7) for African Americans and 75.5 (SD=10.0) for whites. Fifty-one percent of African Americans and 66% of whites had their BP under control at baseline (<140/90 mmHg).

Associations Between Race, Potential Explanatory Variables, and Lack of Blood Pressure Control

African Americans were significantly more likely to have poor BP control relative to whites (49% versus 34%; unadjusted OR=1.8; 95% CI, 1.3–2.5). Potential explanatory variables were relatively consistently related to BP control in unadjusted and adjusted models with the exception that low health literacy and poor hypertension knowledge were only significant in unadjusted models (Table 2). After adjusting for race, a number of potential explanatory variables were significantly associated with BP control for the full sample: increased age greater than 70 (OR=2.1; 95% CI 1.2–3.4), medication nonadherence (OR=1.6; 95% CI 1.1–2.2), experience stress fairly

or very often (OR=1.4; 95% CI 1.0–1.9), increased worry about hypertension (OR=1.1; CI 95% 1.0–1.2), greater than 5 years since hypertension diagnosis (OR=1.5; 95% CI 1.0–2.1), and increased number of medication side effects (OR=1.1; 95% CI 1.0–1.1; see Table 2).

Final Multivariable Model

The variables that modified the association between race and BP control by greater than 10% included age, worry about hypertension, and medication nonadherence. There were no significant interactions detected between race and any of these 3 explanatory variables. The ORs for the associations between lack of BP control and these variables were: age (>70 versus 25–50 year olds; OR=2.5; 95% CI 1.5–4.3), worry about hypertension (for each, 1 unit increase on a 10-point response scale, OR=1.1; CI 95% 1.0–1.2), and medication nonadherence (OR=1.6; 95% CI 1.1–2.3). In this final model, after accounting for these explanatory variables, African Americans remained significantly more likely to have inadequate BP control relative to whites; however, the magnitude of this association was diminished from OR=1.8 (95% CI 1.3–2.5) to OR=1.5 (95% CI 95% 1.0–2.2).

DISCUSSION

In this diverse sample of primary care patients with hypertension, we observed a significant difference in odds of BP control between white and African-American patients. After accounting for psychosocial, clinical, and demographic factors, including medication nonadherence, age, and worry about

Table 2. Unadjusted and Race-adjusted Associations Between Lack of Blood Pressure Control and Demographic, Psychosocial, and Clinical Factors

	Unadjusted OR	95% CI	Race-adjusted OR	95% CI
Demographic				
Gender (female vs. male [reference])	0.9	(0.6, 1.2)	1.0	(0.7, 1.5)
Inadequate income	1.3	(0.9, 2.0)	1.1	(0.7, 1.7)
Age				
>70 vs. 25–50	1.7	(1.0, 2.8)	2.1	(1.2, 3.4)
61–70 vs. 25–50	1.0	(0.6, 1.7)	1.2	(0.7, 2.0)
51–60 vs. 25–50	1.0	(0.6, 1.6)	1.1	(0.7, 1.8)
Psychosocial				
Health literacy (<9th grade)	1.4	(1.0, 2.0)	1.0	(0.7, 1.6)
Recall*	1.0	(0.9, 1.0)	1.0	(0.9, 1.0)
Medication barriers score*	1.0	(0.9, 1.0)	1.0	(0.9, 1.0)
Medication nonadherent	1.8	(1.3, 2.5)	1.6	(1.1, 2.2)
Low hypertension knowledge	1.3	(1.0, 1.9)	1.2	(0.9, 1.7)
Often feel stressed	1.4	(1.0, 2.0)	1.4	(1.0, 1.9)
Participatory decision-making score*	1.0	(0.9, 1.0)	1.0	(0.9, 1.0)
Hypertension worry score*	1.1	(1.0, 1.2)	1.1	(1.0, 1.2)
Lack personal control of health	1.3	(0.9, 1.8)	1.1	(0.8, 1.6)
Have emotional support	1.0	(0.5, 2.0)	0.9	(0.5, 1.9)
Clinical				
Have home BP monitor	1.0	(0.7, 1.4)	1.2	(0.9, 1.7)
>5 years since high BP diagnosis	1.6	(1.1, 2.2)	1.5	(1.0, 2.1)
Number of Medication side effects*	1.1	(1.0, 1.1)	1.1	(1.0, 1.1)
No weekly exercise	0.8	(0.6, 1.2)	0.8	(0.5, 1.2)
Diabetes	1.1	(0.8, 1.6)	1.0	(0.7, 1.4)
Current smoker	0.9	(0.6, 1.4)	0.8	(0.5, 1.2)
Family history of hypertension	1.2	(0.8, 2.0)	1.1	(0.7, 1.8)

*ORs are for a 1 unit increase in the level of this variable

hypertension, we could explain some but not all of the racial differences in BP control. The explanation for the persistent racial differences in hypertension control is not fully known, but the current study provides some explanations for these differences. Specifically, worry about hypertension and hypertension medication nonadherence partly explained racial disparities in BP control. An accurate assessment of variables contributing to health disparities is essential for allocating resources to support effective solutions.

Understanding factors that explain racial disparities in hypertension control is important given that the decline in cardiovascular deaths in the United States has not been uniformly distributed across racial groups.^{29,30} In our study, we found that African Americans were less likely to have BP control than whites. It is interesting to note that our inability to account for racial differences in BP control is consistent with prior studies^{31–33} including 1 we conducted in a VA system, a relatively equal access system.²² Thus, despite adjusting for a number of potential explanatory factors, African Americans continued to have significantly higher odds of having poor BP control relative to whites. Despite examining hypertension control in 2 different samples (e.g., VA setting with equal access and university primary care setting), unadjusted ORs for the association between the African-American race and lack of BP control were similar (OR=1.70; OR=1.80, respectively), and whereas there were more factors that explained these differences in the current study, the overall levels of disparities in adjusted models remained relatively consistent (OR=1.59, OR=1.50, respectively).

We observed that African Americans were more worried about their BP than whites and that an increase in worry about one's BP was associated with worse BP control. Worry and higher perceived vulnerability for a disease have been associated with an increase in preventive health behavior,³⁴ making these findings somewhat surprising. It is possible that the poor BP control precedes and directly causes the increased worry; however, it is difficult to determine in our cross-sectional design. It is also possible that despite potentially accurately worrying more about their hypertension, African Americans may have fewer resources than whites to reduce their BP, thus providing a possible explanation for our counterintuitive finding of a positive relationship between worry and poor BP control.

Medication adherence in patients with treated hypertension is estimated at between 50% and 70%.^{35–37} These rates are comparable to what was observed in the current study (64% of the current sample reported being adherent with their medication). Fifty percent of African Americans reported they were adherent, whereas 79% whites reported being adherent. These racial differences in medication adherence are similar to prior studies.^{22,38–45} Consequently, it has been suggested that patients and their physicians be targeted for interventions to identify and remediate adherence barriers as well as other factors leading to the disparity in health outcomes.^{46,47} Whereas this racial difference in adherence is striking, it did not completely explain differences in BP control.

Other studies have found an association between age and BP control, although there are inconsistencies between studies. In patients more than 60 years old, a decrease in arterial compliance results in systolic BP rising, whereas diastolic BP may fall.⁴⁸ This widened pulse pressure potentially makes hypertension more difficult to control in the elderly because of the risk of harm from excessive lowering of diastolic BP.⁴⁹ The 1999–2004

National Health and Nutrition Examination Survey analyses of BP control suggests that among the greater than or equal to 60 age group, awareness, treatment, and control rates of hypertension have all increased significantly over the last 4–5 years and were better than in younger adults.⁵⁰ In a large comparative study, investigators showed comparable screening rates across age groups (>90%) but did not report actual differences in BP control.⁵¹ However, a national population sample that included adequate numbers of older adults found a decrease in BP control with increasing age (e.g., 75% among 45–64 and 61% among those 75–84).⁵² We observed a higher percent of hypertension control in younger people. Clinically, with increasing comorbidities and other clinical manifestations of hypertension in older adults, the control tends to be hard to achieve.

This study has several potential limitations. The study population is a university-affiliated general Internal Medicine clinic and a community outpatient clinic, and the treatment of hypertension may not be representative of those experienced by the general population. However, the sample represented a diverse group of hypertensive patients in terms of race, literacy levels, and socioeconomic status. Related, there were some population differences between the 2 clinics sites, but available measures that may account for these differences (e.g., insurance status, literacy levels) were examined. Second, although we examined a number of factors that could potentially explain racial disparities in BP control, other relevant factors may not have been identified. Another limitation of this study was the inability to assess physician-related variables, including practice patterns, physician race, and the role that physician/patient racial discordance may have on patient outcomes.⁵³ However, it is important to note that participatory decision making, an indication of the patient–physician interaction, was not associated with racial disparities in BP control. There were also participation differences in terms of race and age (e.g., 55% of the total clinic population versus 48% of the total enrolled sample were African American; 57% of the clinic population were older than 66 years of age compared to 63% in the total enrolled sample from which the current study population was drawn). Finally, we did not examine insurance status because it was correlated with age. Nevertheless, only 20 (3%) of the sample reported that they were uninsured.

The results of this study have both clinical and research implications. Our results suggest that before implementing more intensive hypertensive treatments to improve BP control among African Americans, more attention to hypertension medication adherence may be required. Poor adherence may be influenced by barriers to care like cost and access to care. Thus, the improvement of hypertension treatment and control requires 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 BP control may contribute greatly to reducing the cardiovascular health disparities in the United States.

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Conflict of Interest: None disclosed.

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