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Baseline Characteristics of African Americans in the Systolic Blood Pressure Intervention Trial (SPRINT)

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Abstract

The Systolic Blood Pressure Intervention Trial (SPRINT) will compare treatment to a systolic blood pressure goal of <120 mmHg to treatment to the currently recommended goal of <140 mmHg for effects on incident cardiovascular, renal, and neurologic outcomes including cognitive decline.

Objectives—The objectives of this analysis are to compare baseline characteristics of African American (AA) and non-AA SPRINT participants and explore factors associated with uncontrolled blood pressure (BP) by race.

Methods—SPRINT enrolled 9,361 hypertensive participants over age 50. This cross-sectional analysis examines sociodemographics, baseline characteristics, and study measures among AAs compared to non-AAs.

Results—AAs made up 31% of participants. AAs (compared to non-AAs) were younger and less frequently male, had less education, and were more likely uninsured or covered by Medicaid. In addition, AAs scored lower on the cognitive screening test when compared to non-AAs. Multivariable logistic regression analysis found BP control rates to <140/90 mmHg were higher for AAs who were male, had higher number of chronic diseases, were on diuretic treatment, and had better medication adherence.

Conclusion—SPRINT is well poised to examine the effects of SBP targets on clinical outcomes as well as predictors influencing BP control in AAs.

Keywords

Hypertension; Clinical Trials; and African Americans

Introduction

Hypertension remains an important public health concern that affects millions in the U.S. [1, 2] The prevalence of hypertension among U.S. adults is 29.1% and is estimated to affect 68 million individuals.[1] Hypertension is more prevalent in African Americans (42.1%) than non-African Americans (28.0%).[1] Moreover, hypertension in African Americans begins earlier, is more severe, and more frequently associated with premature morbidity and mortality from its complications including coronary heart disease, heart failure, stroke, and end-stage renal disease (ESRD).[2-6] Racial/ethnic disparities in hypertension and related outcomes continue to pose immense challenges for affected individuals and the healthcare system.

Background

Substantial data are available on the treatment and management of hypertension, with marked improvement in recent years in BP control rates, including incorporation in several

guidelines.[3, 5, 7-14] Despite recommendations on prescription of antihypertensive therapies, achieving BP control remains problematic and data on optimal BP targets remain controversial.[1, 2, 6] The 2011-2012 National Health and Examination Survey (NHANES III) data suggested that 76% of US adults with hypertension were taking antihypertensives, with a higher percentage of African Americans (79.7%) than European Americans (76.6%).[1] Despite antihypertensive treatment, nearly 50% of U.S. adults with hypertension were not controlled to the currently recommended target of <140/90 mmHg.[1, 4, 6] Among treated hypertensive African Americans, 49.5% achieved BP control compared to 53.9% of European Americans.[1]

Several large-scale clinical trials demonstrated that lowering BP using antihypertensive agents reduces the risk of cardiovascular morbidity and mortality, including in African Americans.[6, 15-18] However, findings have been reported to differ by racial/ethnic groups, and African Americans were often underrepresented in clinical trials.[18, 19] Some have advocated for lower BP targets and lower thresholds for initiating BP medications for African Americans compared to the rest of the population.[20] Clinical outcome trial data examining antihypertensive therapies and their ability to lower risk of cardiovascular morbidity and mortality, especially in African Americans, are desperately needed. In addition, detailed description of the African American cohort in large multi-ethnic studies is often lost in the description of the larger study population.

SPRINT successfully recruited a large cohort of ethnically diverse participants, including a large number of African Americans.[21] This manuscript expands on information presented in the SPRINT baseline paper by providing a more detailed description of the data by race and compares baseline characteristics of African American participants to non-African Americans in this cohort.[21] The major objectives of this manuscript are:

1. Provide a detailed description of the baseline characteristics of African Americans in the Systolic Blood Pressure Intervention Trial (SPRINT).
2. Compare the baseline characteristics of African American and non-African American participants within SPRINT.
3. Explore factors associated with poor BP control (>140/90 mmHg) at study entry among African Americans and non-African Americans.

Methods

Design

The design and rationale of SPRINT have been reported previously and are summarized briefly.[21] SPRINT is a two-armed, multicenter, randomized, open label, clinical trial designed to test whether a strategy to treat SBP to <120 mmHg will reduce cardiovascular disease (CVD) outcomes among non-diabetic hypertensive participants compared to treating to the currently recommended SBP target of <140 mmHg. In addition, the SPRINT Memory and cognition IN Decreased hypertension (SPRINT MIND) sub-study will test whether the lower SBP goal influences the rate of incident dementia and mild cognitive impairment, global and domain-specific cognitive function, and cerebral small vessel ischemic disease.

Analysis by race (African Americans vs non-African Americans) is pre-specified in the protocol.

The primary endpoint is incident CVD events defined by the first on-study occurrence of a myocardial infarction (MI), acute coronary syndrome (ACS), stroke, heart failure (HF), or CVD death. Secondary outcomes include all-cause mortality, ≥50% decline in kidney function (from baseline estimated glomerular filtration rate [eGFR]) or development of end-stage renal disease (ESRD) among participants with baseline eGFR 20-59 mL/min/1.73 m^2, dementia, decline in cognitive function, and small vessel cerebral ischemic disease on magnetic resonance imaging (MRI).[21]

Study Population

Participants are men and women aged ≥50 years with SBP between 130-180 mm Hg on 0-4 antihypertensive medications with at least one additional CVD risk factor. The SPRINT recruitment target was 9,250, including additional targets of enrolling 50% women and 40% minorities. The protocol was designed to enroll three high risk subgroups: participants with CKD (eGFR 20-59 ml/min/1.73m^2) (target enrollment of 4,300), those with clinical or subclinical CVD (3,700), and seniors who were at least 75 years of age (goal of 3,250). High risk was defined by clinical CVD (>3 month history) which included: MI, ACS, coronary revascularization, carotid endarterectomy/stenting, and/or peripheral artery disease (PAD) with revascularization. Subclinical CVD criteria for enrollment within the past 2 years included left ventricular hypertrophy (LVH); ≥50% stenosis of a coronary, carotid or lower extremity artery; abdominal aortic aneurysm (AAA) >5 cm with or without repair; ankle brachial index (ABI) ≤0.90; and/or coronary artery calcium score ≥400 Agatston units. Patients with Framingham Risk Score >15, age ≥75 years, and/or CKD who met the BP eligibility criteria were automatically eligible for enrollment. Individuals with diabetes, proteinuria ≥1 g/day, history of stroke, eGFR <20 ml/min/1.73m^2, symptomatic heart failure (HF) (within past 6 months), or left ventricular ejection fraction <35% were excluded.

Participants were recruited from 102 clinical sites across the U.S. and Puerto Rico between November 11, 2010 and March 15, 2013. All clinics obtained institutional review board approval and each participant provided written informed consent. Planned follow-up is 3-6 years.

Baseline Visits and Procedures

BP measurements (sitting and standing), pulse, and BP-related information were collected using a standard automated BP device (the OMRON HEM-907 XL Professional Digital Blood Pressure Monitor). The average of three seated blood pressures and pulse readings were measured after 5 minutes, with back supported and feet flat on the floor. A single standing BP and pulse measurement was obtained, followed by questioning the participant for symptoms of orthostatic hypotension.

A detailed physical exam, anthropometric measures (height and weight), fasting blood and urine samples, and a 12-lead electrocardiogram (ECG) were obtained. Participants aged ≥75 years completed a timed 4 meter walk to assess physical function. All participants completed dementia screening (e.g., Montreal Cognitive Assessment [MoCA], Logical

Memory -Immediate and Delayed Recall [LMI and LMII respectively] and Digit Symbol Coding [DSC]). In addition, participants completed several self-administered questionnaires (i.e., Health-Related Quality of Life [HRQOL], Patient Health Questionnaire-9 [PHQ-9], Treatment Satisfaction Questionnaire for Medication [TSQM], and the Morisky Medication Adherence Scale) that queried them about their sociodemographics, general health and quality of life, smoking/alcohol use, concomitant medications, adherence to medications and medical history, including querying participants specific chronic diseases. The list of chronic diseases includes: history of heart disease (atrial fib, angina, heart attack, CHF, irregular heart beat); cancer (any cancer or skin cancer); cerebrovascular disease (stroke, TIA); endocrine disease (thyroid disease, diabetes); gastrointestinal disease (ulcer, Crohn's disease, diverticulitis, hepatitis, gall bladder disease); genitourinary disease (kidney infections, BPH, prostatitis); muscular/inflammatory disease (osteoarthritis, rheumatoid arthritis, gout, other arthritis, hip problems, lower back pain); mental disorder (schizophrenia, bipolar disorder, depression, anxiety disorder, PTSD, alcoholism); other diseases/conditions (seizures, anemia, cataracts).

Clinical laboratory measurements were performed at the study's Central Laboratory to ensure uniformity of test methods and procedures for all samples. Estimated GFRs were calculated using the Modification of Diet in Renal Disease equation modified for creatinine methods using IDMS-traceable calibration.[22]

Statistical Analysis

Baseline measurements taken prior to randomization were analyzed for this report. Descriptive statistics were computed overall and by race group (African American and non-African American), including means and standard deviations for continuous measures, and frequencies and percentage for categorical factors. Significance of differences between groups was assessed using two-sample t-tests (with Satterthwaite's adjustment for unequal variances when warranted) for continuous factors, and chi-squared tests for categorical. Logistic regression analysis was used to examine sociodemographic, clinical and study measures predictive of poor BP control (>140/90 mmHg) at baseline. Models were fitted and stratified by race group, and then a model was fitted with two-way interactions between race and each potential predictor to test for differential odds ratios (ORs) between the two groups. Statistical significance was assessed at the nominal two-sided 0.05 alpha level: no explicit multiplicity adjustments were made. All analyses were performed using SAS® version 9.4 (SAS Institute Inc., Cary, NC).

Results

Baseline and Clinical Characteristics

Table 1 presents sociodemographic characteristics by race. Of the 9,361 participants enrolled in SPRINT, 30% (n = 2,947) are African Americans. Individual sample sizes are specified for variables with greater than 50 observations (0.5%) missing. African Americans (compared to non-African Americans) were younger with mean age 64 vs. 70 years old, less likely male (54% vs 69%), less educated (36% vs 21% ≤ high school and 23% vs. 46% ≥

college graduate respectively), and more likely uninsured or covered by Medicaid (29% vs. 12%).

Among the SPRINT cohort, mean SBP was similar at ∼140 mmHg in both race subgroups (Table 2). Mean DBP was higher in African Americans (81.1 ± 12.3 mmHg vs. 76.8 ± 11.5 mmHg, p<0.0001). BP at study entry was >140/90 mmHg in 51% of African Americans and 49% of non-African Americans (p = 0.03) and the number of prescribed antihypertensives at baseline were significantly higher (p < 0.0001) among African Americans (1.96 ± 1.05) compared to non-African Americans (1.78 ± 1.03). Among participants receiving antihypertensive treatment, the frequency of prescribed drug classes differed for African Americans compared to non-African Americans among most drug classes. African Americans were more likely to be prescribed a diuretic (48% vs 36%), calcium channel blocker (CCB) (44% vs 31%), vasodilator (2.5% vs 1.1%), alpha 2 agonist (2.9% vs 1.8%) or alpha blockers (9.9% vs 8.4%); and were less likely to be prescribed a beta blocker (BBB) (32.5% vs 36.5%). Angiotensin-converting enzyme inhibitors (ACEIs) or Angiotensin Receptor Blockers (ARBs) use for hypertension treatment was similar in African Americans and non-African Americans.

The distributions of cardiovascular risk factors also differed by race (Table 2). Compared to non-African Americans, African Americans were more likely to have left ventricular hypertrophy by electrocardiogram (21% vs 12%), and currently smoke cigarettes (23% vs 9%). However, African Americans were less likely to have a history of CVD (16% vs 22%) or concomitant health conditions (the sum total of chronic diseases), but had significantly higher levels of both high-density lipoprotein and total cholesterol, and lower serum glucose compared to non-African Americans. The mean eGFR was also slightly higher in African Americans than non-African Americans (77.4 ± 23.2 vs. 69.2 ± 18.8, p < 0.0001) with a non-significant trend toward more albuminuria.

Baseline Study Measures

The health related quality of life (HRQOL) measures and its three subscales that assessed general health Status (Veterans RAND 12 [VR-12]), health utility (EQ-5D), and depressive symptoms (PHQ-9) are shown in Table 3. The mean score for the VR-12 across the entire SPRINT cohort was 2.65 (SD ± 0.85), and was slightly higher in African Americans (2.87±0.82) compared to non-African Americans (2.54 ± 0.84). In addition, African Americans reported poorer health perception as analyses revealed that African Americans (compared to non-African Americans) had a higher mean score on the EQ-5D and were more likely to report higher depressive symptomology on PHQ-9. African American participants also reported greater dissatisfaction with their medical care and prescribed treatment regimen, and had lower compliance to their prescribed treatment regimen than non-African Americans.

Baseline Cognitive Measures

Regardless of age or education, African Americans scored 2-3 points lower on the MoCA than non-African American participants (Table 4). For example, African Americans aged 65-74 years old with high school or better education had an average MoCA of 22.7 ± 3.6

(SD) compared to 24.7 ± 3.1 in non-African American participants, p<0.001. Similarly, scores on the Logical Memory test (both immediate and delayed recall) as well as backward digit span were lower for African Americans than non-African Americans at every age and education stratum. However, consistent differences in performance between African Americans and non-African Americans on the forward digit span, a test of concentration and working memory, were not observed.

Predictors of Failure to Achieve Blood Pressure Control at Baseline

After controlling for sociodemographics, clinical measures, and study measures, poor BP control (>140/90 mmHg) in African Americans was significantly lower among males (OR, 0.80; 95% confidence interval [CI], 0.67-0.95), participants treated with a diuretic (OR, 0.70; 95% CI, 0.58-0.85), those with increased number of chronic diseases (OR, 0.93; 95% CI, 0.88-0.99 for each additional disease), and those with increased medication adherence (OR, 0.93; 95% CI, 0.89-0.99 per unit increase in Morisky scale) (Table 5). In addition, poor BP control at baseline was associated with general health status score (OR, 1.16; 95% CI, 1.04-1.30 per unit increase) and participant dissatisfaction with their medical care and prescribed treatment regimen (OR, 1.21; 95% CI, 1.10-1.33 per unit increase in Morisky satisfaction subscale).

Among non-African American participants, poor BP control >140/90 mmHg was also lower among males (OR, 0.74; 95% CI, 0.65-0.84), persons employed outside the home (OR, 0.85; 95% CI 0.75-0.97), those with a history of CVD (OR, 0.86; 95% CI, 0.75-0.98), higher body mass index (OR, 0.94; 95% CI, 0.88-1.00 per 6 kg/m^2 increase), and higher EQ-5D health utility scores (OR, 0.95; 95% CI, 0.90-0.99 per unit increase). Hypertension treated with an ACEI or ARB (OR, 0.81; 95% CI, 0.72-0.91), or diuretic (OR, 0.77; 95% CI, 0.68-0.88) was associated with better BP control in non-African Americans. Increased age (OR for 65-74 vs. 50-64, 1.15; 95% CI, 0.99-1.34; OR for >75 vs. 50-64, 1.48; 95% CI, 1.24-1.77) and participant dissatisfaction with care prior to study enrollment (OR, 1.32; 95% CI, 1.23-1.41) was associated with poor BP control >140/90 mmHg in non-African Americans.

Despite apparent differences between race groups in factors predicting BP control, a model including two-way interactions between race (African Americans or non-African Americans) and individual predictors showed only the Digit Symbol score had significant differential effects (i.e., a significant interaction term at the nominal 5% alpha-level). However, the OR for Digit Symbol score in each of the stratified models was non-significant (OR per 15-unit increase among African Americans 1.08, 95% CI 0.98-1.19; OR among non-African Americans 0.94, 95% CI 0.88-1.01).

Discussion

The purpose of this study was to describe the baseline characteristics of African Americans in SPRINT, compare the clinical and study measures with those in non-African Americans, and explore factors associated with poor BP control (>140/90 mmHg) at study entry. Because of the impact of hypertension on African Americans, the goal of SPRINT was inclusion of a high risk population and to enroll a large percentage of minorities, especially

African Americans, as well as women and those 75 years and older. SPRINT successfully enrolled such a diverse sample, including 31% (n = 2947) African Americans.

African Americans enrolled in SPRINT were younger, less likely to be male, and had lower educational attainment compared to non-African Americans. SPRINT eligibility criteria were designed to facilitate the inclusion of high risk population for major trial endpoints, specifically including individuals that are at risk for CVD, CKD, cognitive decline, and dementia. Our findings suggest the race subgroups did not differ substantially for most baseline risk factors. In fact, though African Americans tend to manifest hypertension at an earlier age, and have higher burden of hypertension-related complications such as stroke, kidney disease, and target organ damage,[1, 4, 20] we found that African Americans recruited into SPRINT were less likely to qualify for enrollment based on CVD history or CKD, though were more likely to be enrolled based on left ventricular hypertrophy on ECG. When compared to non-African Americans, higher body mass index, cigarette use, total cholesterol, and Framingham Risk Scores were observed in African Americans. Importantly, African Americans recruited into research studies may be healthier than community-based cohorts, especially when the sample is truncated by the exclusion of those with higher BP levels as in SPRINT. Except for modestly higher prevalence of diabetes, the African American cohort recruited into the ALLHAT study (which excluded patients with more severe hypertension) also had a lower CVD risk profile and lower rates of many CVD outcomes compared to rates in non-blacks.[23] Thus, SPRINT should provide important data on the effects of aggressive BP control on the differences in CVD outcomes by racial subgroups.

Baseline SBP within SPRINT did not differ by race subgroups. However, DBP was significantly higher in African Americans. Higher DBP in patients over 55 years old is inversely related to adverse cardiovascular morbidity and mortality.[24-26] Despite similarities in SBP at baseline by race, African Americans were more likely to have BP >140/90 mmHg at study entry than non-African Americans (51% vs 49%), despite being prescribed slightly more anti-hypertensive medications. African Americans (compared to non-African Americans) were more likely to be prescribed a diuretic (48% vs 36%) or CCB (44% vs 31%), as well as other antihypertensive classes, consistent with most national guidelines.[7, 10, 11] However, a significant number of African Americans were also prescribed either an ACEI or ARB as first-line agents without a diuretic or CCB and without any compelling indicators such as proteinuria or CKD. In the ALLHAT study, the ACEI (e.g., lisinopril) was associated with higher rates of stroke and multiple CVD outcomes in African Americans compared to those on the diuretic chlorthalidone.[15] Of importance, the benefits of multi-drug antihypertensive regimens, especially in African Americans, have been demonstrated in the Avoiding Cardiovascular Events through Combination Therapy in Patients Living with Systolic Hypertension (ACCOMPLISH) trial,[27] including the efficacy of BP lowering and reduction in cardiovascular morbidity and mortality. Africans Americans (compared to non-African Americans) were more likely dissatisfied with their medical care and less likely to adhere to prescribed care; which may, in part, be responsible for the observed difference in uncontrolled hypertension at study entry.

African Americans enrolled in SPRINT generally had lower performance on cognitive tests than non-African Americans of similar age and education. Though adjusted for educational level, differences in quality of education are more difficult to assess (e.g. insurance status data suggest lower socioeconomic status for African Americans). These data, like baseline characteristics associated with blood pressure control (discussed below) should be interpreted some caution. Enrollment in SPRINT was highly selective and populations were not recruited as a population-based sample. Neurologic disease burden may be another cause of differences (though prevalence of comorbidities, CKD, and CVD were actually lower in African Americans than in non-African Americans). Analysis of baseline MRI data from SPRINT-MIND is pending. The relationship between cognitive function and BP is an area of active research, and longitudinal observational studies to date have yielded mixed results.[28] An important objective of SPRINT is to assess the impact of more intensive SBP reduction on the incidence of dementia, cognitive decline and small vessel ischemic disease; analysis of changes in the cognitive and MRI data by race overtime should provide important information in African Americans.

Despite the sampling limitations indicated above, logistic regression analyses revealed lower perceived health status scores, dissatisfaction with their medical care, and prescribed treatment regimen were associated with poor BP (>140/90 mmHg) in African Americans; whereas in non-African Americans it was associated with younger age and participant dissatisfaction with medical care. BP control (<140/90 mmHg) at study entry was inversely related to male gender, multiple chronic health condition, and hypertension treated with a diuretic in African Americans. In comparison, for non-African Americans, BP control was inversely associated with male gender, employed status, history of CVD, higher BMIs, and hypertension managed with a diuretic. Though SBP means were similar for both groups, African Americans (vs non-African American) were younger in age and presented with higher DBP at baseline leading to their BP “control” (<140/90 mm Hg) appearing worse.

Conclusion

Epidemiological data suggest that African Americans are aware of their hypertension and are more often treated compared to non-African Americans, yet more than 50% had BP >140/90 mmHg.[1] This finding parallels baseline results in SPRINT, with 51% of African Americans having poor BP control, >140/90 mmHg at study entry. Importantly, the current U.S. guideline (amid much controversy) is now recommending a more conservative approach for initiation and management of hypertension by raising the SBP target to <150 mmHg, in hypertensive patients 60 years and older, regardless of race or other CVD risk factors.[7] In conclusion, the SPRINT trial is ongoing and has the potential to provide a better understanding of predicators that might influence poor BP control (>140/90 mmHg) to improve hypertension control rates as well as the effects of lower SBP targets on clinical outcomes in this understudied population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Nwankwo T, Yoon SS, Burt V, Gu Q. Hypertension among adults in the United States: National Health and Nutrition Examination Survey, 2011–2012. NCHS Data Brief. 2013; 133:1–8. [PubMed: 24171916]
2. Go A, Mozaffarian D, Roger V, Benjamin E, Berry J, Blaha M, et al. Heart Disease and Stroke Statistics—2014 Update: A Report from the American Heart Association. Circulation. 2014 Jan 21; 129(3):e28–e292.10.1161/01.cir.0000441139.02102.80 [PubMed: 24352519]
3. Aronow WS, Fleg JL, Pepine CJ, Artinian NT, Bakris G, Brown AS, et al. ACCF/AHA 2011 expert consensus document on hypertension in the elderly: a report of the American College of Cardiology Foundation Task Force on Clinical Expert Consensus documents developed in collaboration with the American Academy of Neurology, American Geriatrics Society, American Society for Preventive Cardiology, American Society of Hypertension, American Society of Nephrology, Association of Black Cardiologists, and European Society of Hypertension. J Am Coll Cardiol. 2011 May 17; 57(20):2037–114.10.1016/j.jacc.2011.01.008 [PubMed: 21524875]
4. Center for Disease Control and Prevention. Racial/Ethnic disparities in the awareness, treatment, and control of hypertension - United States, 2003-2010. MMWR Morb Mortal Wkly Rep. 2013; 62:351–355. [PubMed: 23657109]
5. Ferdinand KC. Management of high blood pressure in African Americans and the 2010 ISHIB consensus statement: meeting an unmet need. J Clin Hypertens (Greenwich). 2010 Apr 1; 12(4): 237–239.10.1111/j.1751-7176.2010.00272.x [PubMed: 20433543]
6. Still CH, Ferdinand KC, Ogedegbe G, Wright JT JR. Recognition and management of hypertension in older person: Focus on African Americans. Journal of American Geriatrics Society. 2015 Feb 5. Manuscript accepted for publication.
7. James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J, et al. 2014 Evidence-Based Guideline for the Management of High Blood Pressure in Adults: Report From the Panel Members Appointed to the Eighth Joint National Committee (JNC 8). JAMA. 2014 Feb 5; 311(5):507–520.10.1001/jama.2013.284427 [PubMed: 24352797]
8. Canadian Hypertension Education Program. 2012 Canadian Hypertension Education Program Recommendations. 2012. http://www.hypertension.ca/chep-recommendations
9. Eckel R, Jakicic J, Ard J, Miller N, Hubbard V, Nonas C, et al. 2013 AHA/ACC Guideline on Lifestyle Management to Reduce Cardiovascular Risk: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Journal of American College of Cardiology. 2014; 63(25_PA):2960–2984.10.1016/j.jacc.2013.11.003

10. Mancia G, Fagard R, Narkiewicz K, Redon J, Zanchetti A, Bohm M, et al. 2013 ESH/ESC Practice Guidelines for the Management of Arterial Hypertension. Journal of Hypertension. 2013; 31:1281–1357. [PubMed: 23817082]
11. Weber MA, Schiffrin EL, White WB, Mann S, Lindholm LH, Kenerson JG, et al. Clinical practice guidelines for the management of hypertension in the community: a statement by the American Society of Hypertension and the International Society of hypertension. J Hypertens. 2014 Jan; 32(1):3–15.10.1097/HJH.0000000000000065 [PubMed: 24270181]
12. Veterans Administration Cooperative Study Group on Antihypertensive Agents. Effects Morbidity of Treatment on in Hypertension II. Results in Patients With Diastolic Blood Pressure Averaging 90 Through 114 mm Hg. Morbidity on Hypertension. 1970; 213(7):1143–1152.
13. Hypertension Detection and Follow-up Program Cooperative Group. Five-year findings of the hypertension detection and follow-up program. I. Reduction in mortality of persons with high blood pressure, including mild hypertension. Hypertension Detection and Follow-up Program Cooperative Group. JAMA. 1979; 242:2562–2571. [PubMed: 490882]
14. SHEP Cooperative Research Group. Prevention of stroke by antihypertensive drug treatment in older persons with isolated systolic hypertension. Final results of the Systolic Hypertension in the Elderly Program (SHEP). SHEP Cooperative Research Group. JAMA. 1991; 265(24):3255–3264. [PubMed: 2046107]
15. Wright JT Jr, Probstfield JL, Cushman WC, Pressel SL, Cutler JA, Davis BR, et al. ALLHAT findings revisited in the context of subsequent analyses, other trials, and meta-analyses. Arch Intern Med. 2009 May 11; 169(9):832–42.10.1001/archinternmed.2009.60 [PubMed: 19433694]
16. Beckett NS, Peters R, Fletcher AE, Staessen JA, Liu L, Dumitrascu D, et al. Treatment of hypertension in patients 80 years of age or older. N Engl J Med. 2008 May 1.358:1887–1898.10.1056/NEJMoa0801369 [PubMed: 18378519]
17. Jamerson K, Weber MA, Bakris GL, Dahlof B, Pitt B, Shi V, et al. Benazepril plus amlodipine or hydrochlorothiazide for hypertension in high-risk patients. N Engl J Med. 2008 Dec 4; 359(23): 2417–28.10.1056/NEJMoa0806182 [PubMed: 19052124]
18. Banach M, Bromfield S, Howard G, Howard VJ, Zanchetti A, Aronow WS, et al. Association of systolic blood pressure levels with cardiovascular events and all-cause mortality among older adults taking antihypertensive medication. International Journal of Cardiology. 2014 Sep 1.176:219–226. [PubMed: 25085381]
19. Park IU, Taylor AL. Race and ethnicity in trials of antihypertensive therapy to prevent cardiovascular outcomes: a systematic review. Ann Fam Med. 2007; 5:444–452. [PubMed: 17893387]
20. Flack J, Sica DA, Bakris G, Brown AL, Ferdinand KC, Grimm RH Jr, et al. Management of high blood pressure in African Americans: An update of the ISHIB Consensus Statement. Hypertension. 2010 Nov; 56(5):780–800.10.1161/HYPERTENSIONAHA.110.152892 [PubMed: 20921433]
21. Ambrosius WT, Sink KM, Foy CG, Berlowitz DR, Cheung AK, Cushman WC, et al. The design and rationale of a multicenter clinical trial comparing two strategies for control of systolic blood pressure: The Systolic Blood Pressure Intervention Trial (SPRINT). Clinical Trials. 2014 Jun 5. pii. 10.1177/1740774514537404
22. Levey A, Coresh J, Greene T, Marsh J, Stevens LA, Kusek JW, et al. Expressing the modification of diet in renal disease study equation for estimating glomerular filtration rate with standardized serum creatinine values. Clinical Chemistry. 2007:53, 766–772.
23. Wright JT Jr, Dunn JK, Cutler JA, Davis BR, Cushman WC, Ford CE, et al. Outcomes in hypertensive black and nonblack patients treated with chlorthalidone, amlodipine, and lisinopril. JAMA. 2005 Apr 26; 293(13):1595–1608. [PubMed: 15811979]
24. Madhavan S, Ooi WL, Cohen H, Alderman MH. Relation of Pulse Pressure and Blood Pressure Reduction to the Incidence of Myocardial Infarction. Hypertension. 1994; 23:395–401. [PubMed: 8125567]
25. Duprez DA, Jacobs DR Jr, Lutsey PL, Bluemke DA, Brumback LC, Polak JF, et al. Association of small artery elasticity with incident cardiovascular disease in older adults: the multi-ethnic study of atherosclerosis. Am J Epidemiol. 2011 Sep 1; 174(5):528–536.10.1093/aje/kwr120 [PubMed: 21709134]

26. Franklin SS, Khan SA, Wong ND, Larson MG, Levy D. Is pulse pressure useful in predicting risk for coronary heart Disease? The Framingham heart study. Circulation. 1999; 100:354–360. [PubMed: 10421594]

27. Jamerson K, Bakris GL, Dahlof B, Pitt B, Velazquez E, Gupte J, et al. Exceptional early blood pressure control rates: the ACCOMPLISH trial. Blood Pressure. 2007; 16:80–86. [PubMed: 17612905]

28. Duron E, Hanon O. Vascular risk factors, cognitive decline, and dementia. Vascular HealthRisk Management. 2008; 4(2):363–381.

Table 1

Sociodemographics of randomized SPRINT Participants, Stratified by Race. Entries are N, mean±SD for continuous factors; N, frequency (%) for categorical factors

	Overall (*N* = 9361)	African American (*n* = 2947)	Non-African American (*n* = 6414)	P-value
Characteristics				
Age, years Mean (*SD*)	67.9 (9.4)	64.2 (9.0)	69.6 (9.1)	<.0001
50-64	3805 (40.7)	1736 (58.9)	2069 (32.3)	
65-74	2908 (31.1)	741 (25.2)	2167 (33.78)	<.0001
>75	2647 (28.3)	469 (15.9)	2178 (34.0)	
Gender				
Men	6028 (64.4)	1587 (53.9)	4441 (69.2)	<.0001
Living Status				
Alone	2713 (29.1)	1048 (35.7)	1665 (26.0)	<.0001
Education				
< High school graduate	877 (9.4)	435 (14.8)	442 (6.9)	
High school graduate	1520 (16.3)	609 (20.7)	911 (14.2)	
Some post high school	3312 (35.5)	1210 (41.2)	2102 (32.8)	<.0001
College degree or more	3634 (38.9)	686 (23.3)	2948 (46.0)	
Employment				
Employed	3213 (34.4)	1006 (34.2)	2207 (34.5)	0.8
Health Insurance				
Uninsured	973 (10.4)	530 (18.0)	443 (6.9)	<.0001
Medicare	5160 (55.1)	1229 (41.7)	3931 (61.3)	<.0001
Medicaid	657 (7.0)	331 (11.2)	326 (5.1)	<.0001
VA	1884 (20.1)	475 (16.1)	1409 (22.0)	<.0001
Private/Other	3989 (42.5)	1089 (37.0)	2891 (45.1)	<.0001
Primary Care Provider				
Has no provider	363 (3.9)	143 (4.9)	220 (3.4)	0.0009
Engages in Vigorous Physical Activity				
≥15 min/day	6793 (73.0)	2047 (70.0)	4746 (74.3)	<.0001

Table 2
Baseline Clinical Characteristics of SPRINT Participants Stratified by Race

Characteristics	Overall (N=9361)	African American (N=2947)	Non-African American (N=6414)	P-value
SBP, mmHg	139.7±15.6	139.8±16.2	139.6±15.3	0.5*
DBP, mmHg	78.1 ±11.9	81.1 ±12.3	76.8±11.5	<.0001*
Pulse	66.3±11.6	68.4±11.8	65.3±11.3	<.0001*
# BP Medications	1.83±1.04	1.96±1.05	1.78±1.03	<.0001
Prescribed Medication Classes				
Diuretic	3690 (39.4)	1402 (47.6)	2288 (35.7)	<.0001
Ace Inhibitor or Angiotensin Receptor Blocker	3970 (42.4)	1251 (42.5)	2719 (42.4)	0.9
Calcium Channel Blocker	3265 (34.9)	1296 (44.0)	1969 (30.7)	<.0001
Beta Blocker	3299 (35.2)	959 (32.5)	2340 (36.5)	0.0002
Vasodilators	146 (1.6)	74 (2.5)	72 (1.1)	<.0001
Alpha 2 Agonist	199 (2.1)	84 (2.9)	115 (1.8)	0.0010
Alpha Blockers	828 (8.9)	291 (9.9)	537 (8.4)	0.017
# of Chronic Diseases	2.67±1.70	2.17±1.55	2.90±1.72	<.0001*
Weight†, lbs	190.5±41.5	195.4±42.6	188.3±40.7	<.0001*
BMI†, kg/m^2	29.9±5.8	30.9±6.4	29.4±5.4	<.0001*
Clinical/Subclinical CVD History				
CVD History	1877 (20.1)	465 (15.8)	1412 (22.0)	<.0001
ECG Left Ventricular Hypertrophy	1371 (14.7)	614 (20.8)	757 (11.8)	<.0001
Smoking Status				
Current	1240 (13.3)	670 (22.8)	570 (8.9)	<.0001
Past	3978 (42.6)	967 (32.9)	3005 (47.0)	
Cholesterol, total (mg/dL)	190.1±41.2	195.9±40.7	187.5±41.1	<.0001
Cholesterol, HDL (mg/dL)	52.9±14.5	55.1±15.0	51.9±14.1	<.0001*
Framingham Risk Score	17.4±2.5	17.5±2.6	17.3±2.5	<.0001*
Baseline labs				
Fasting Glucose (mg/dL)	98.8±13.5	97.6±15.5	99.3±12.5	<.0001*
Potassium (mmol/L)	4.21 ±0.44	4.08 ±0.45	4.27±0.43	<.0001*
Sodium (mmol/L)	140.1±2.4	140.4±2.3	140.0±2.5	<.0001*
Renal Function				
Proteinuria or CKD	3553 (38.0)	965 (32.8)	2588 (40.4)	<.0001
eGFR (ml/min/1.73^2)	71.8±20.6	77.4±23.2	69.2±18.8	<.0001*
eGFR <45 ml/min/1.73^2	890 (9.6)	236 (8.1)	654 (10.3)	
eGFR 45-60 ml/min/1.73^2	1758 (18.9)	408 (13.9)	1350 (21.2)	<.0001
eGFR >60 ml/min/1.73^2	6662 (71.6)	2286 (78.0)	4377 (68.6)	
Creatinine (mg/dL)	1.08±0.34	1.12±0.39	1.05±0.31	<.0001*
Urine albumin:creatinine ratio (UACR)†	42.6±166.3	46.4±177.5	40.8±160.8	0.15*

Characteristics	Overall (N=9361)	African American (N=2947)	Non-African American (N=6414)	P-value
UACR < 30 mg/g	7191 (80.7)	2270 (80.1)	4921 (81.0)	
UACR >30-300 mg/g	1474 (16.5)	470 (16.6)	1004 (16.5)	0.11
UARC >300 mg/g	248 (2.8)	94 (3.3)	154 (2.5)	
Uncontrolled HTN				
SBP≥140 or DBP≥90	4647 (49.7)	1510 (51.4)	3137 (49.0)	0.034

*P-value for t-test using Satterthwaite correction for unequal variances.

†Sample sizes: weight, 9295 (2931 AA); BMI, 9282 (2929 AA); UACR, 8913 (2834 AA).

Table 3
Means and Standard Deviations of Study Measures at Baseline in SPRINT

Study Measures (Variable)	Overall (N = 9361)	American (N = 2947)	American (N = 6414)	P-value
Health Related Quality of Life				
General health status	2.65±0.85	2.87 ±0.82	2.54±0.84	<.0001*
EQ-5D (Health Utility)	6.52±1.50	6.72±1.64	6.42±1.42	<.0001*
Patient Health Questionnaire-9 (depressive symptoms)	3.07±4.16	3.63±4.81	2.81 ±3.80	<.0001*
Patient Satisfaction†	1.67±0.82	1.72±0.85	1.64 ±0.81	<.0001*
Morisky Medication Adherence†	6.95±1.28	6.57±1.50	7.14±1.12	<.0001*

*P-value for t-test using Satterthwaite correction for unequal variances.

†Sample sizes: patient satisfaction, 9278 (2933 AA); Morisky medication adherence, 8432 (2707 AA).

Table 4

Means and Standard Deviations of SPRINT Participant Cognitive Baseline Measures for African Americans vs. Non-African Americans, Stratified by Age and Education

	Education 0-12 years			Education 12+ years		
Cognitive Measures	**African American**	**Non-African American**	**P-Value**	**African American**	**Non-African**	**P-Value**
Age Group 50-64 years old						
Dementia Screening						
Digit Symbol†	45.4±14.0	50.4±15.6	<.0001*	54.7±13.6	60.8±13.5	<.0001
Montreal Cognitive Assessment (MOCA)†	20.8±4.1	22.2±4.0	<.0001	23.5±3.3	25.3±2.9	<.0001*
Logical Memory I (0-28) †	17.0±4.6	17.9±4.8	0.0014	19.9±4.0	21.6±4.1	<.0001
Logical Memory II (0-14) †	6.81 ±3.09	7.69±3.29	<.0001	8.43±3.01	9.79±2.85	<.0001
Age Group 65-74 years old						
Dementia Screening						
Digit Symbol	38.4±13.9	46.6±16.2	<.0001*	48.0±12.1	56.5±12.7	<.0001
Montreal Cognitive Assessment†	19.4±4.3	21.8±4.5	<.0001	22.7±3.6	24.7±3.1	<.0001*
Logical Memory I (0-28) †	16.4±4.6	17.8±5.1	<.0001*	19.1±4.2	21.1 ±4.2	<.0001
Logical Memory II (0-14) †	5.98±3.32	7.45±3.49	<.0001	7.75±3.18	9.28±3.05	<.0001
Age Group ≥75 years old						
Dementia Screening						
Digit Symbol	29.7±12.5	41.0±14.6	<.0001*	40.0±11.5	49.5±12.0	<.0001
Montreal Cognitive Assessment†	17.4±4.2	20.2±4.3	<.0001	20.6±3.8	23.2±3.5	<.0001
Logical Memory I (0-28) †	14.7±4.7	15.9±5.3	0.0018	17.4±4.4	19.3±4.8	<.0001
Logical Memory II (0-14) †	5.14±3.28	6.55±3.39	<.0001	6.28±3.01	8.36±3.22	<.0001

*P-value for t-test using Satterthwaite correction for unequal variances.

†Sample sizes: Digit symbol 9271 (2923 AA); MOCA, 9295 (2390 AA); logical memory I, 9301 (2932 AA); logical memory II, 9284 (2704 AA).

Table 5

Logistic Regression of Models to Assess Factors Associated With Failed Blood Pressure Control (>140/90 mmHg) at Baseline Among African American (N=2639) and Non-African American (N=5570) SPRINT Participants

	African American Participants			Non-African Americans Participants		
Predictor Variables	**OR**	**95% CI**	**P-value**	**OR**	**95% CI**	**P-value**
Social Demographics						
Age (in categories)						
65-74 years vs. 50-64 years	0.97	0.78-1.20	0.2	1.15	0.99-1.34	<.0001
>75 years vs. 50-64 years	1.23	0.93-1.62		1.48	1.24-1.77	
Male vs. female	0.80	0.67-0.95	0.011	0.74	0.65-0.84	<.0001
Lives with others vs. lives alone	1.08	0.92-1.27	0.4	0.95	0.83-1.08	0.4
< High School vs. high graduate or higher	1.13	0.89-1.45	0.3	0.97	0.77-1.23	0.8
Employed vs. not employed	1.05	0.88-1.26	0.6	0.85	0.75-0.97	0.015
Health insurance vs. no health insurance	0.83	0.65-1.05	0.11	0.82	0.64-1.06	0.12
No primary care provider vs. has primary care provider	1.10	0.70-1.73	0.7	0.95	0.65-1.37	0.8
Smoking history						
Current vs. never smoker	1.17	0.93-1.46	0.11	1.07	0.86-1.32	0.8
Former vs. never smoker	0.91	0.76-1.09		1.01	0.90-1.13	
Participates in 15 min/week vigorous physical activity (vs. <15 min/week vigorous activity)	1.15	0.97-1.38	0.11	0.99	0.86-1.13	0.9
Clinical Measures						
CVD History vs. No CVD History	1.01	0.81-1.25	0.9	0.86	0.75-0.98	0.025
Number of chronic diseases (unit increase)	0.93	0.87-0.98	0.012	0.99	0.95-1.03	0.6
Diuretic treatment	0.70	0.58-0.85	0.0002	0.77	0.68-0.88	0.0001
Calcium channel blocker treatment	0.87	0.72-1.06	0.16	0.91	0.80-1.04	0.2
ACE-inhibitor or angiotensin receptor blocker treatment	0.92	0.77-1.11	0.4	0.81	0.72-0.91	0.0005
Number of Prescribed BP medications (unit increase)	1.06	0.95-1.20	0.3	1.06	0.97-1.14	0.2
Weight: BMI (6 kg/m^2 [1 SD])	0.94	0.86-1.02	0.11	0.94	0.88-1.00	0.048
eGFR (23 $mL/min/1.73m^2$ [1 SD])	1.07	0.99-1.16	0.11	1.05	0.98-1.13	0.16
General health status	1.16	1.04-1.30	0.010	1.03	0.96-1.12	0.4
EQ-5D (Health utility)	1.02	0.95-1.09	0.6	0.95	0.90-0.99	0.028
PHQ-9 (depressive symptoms)	0.99	0.97-1.01	0.3	1.00	0.98-1.02	0.7

	African American Participants			Non-African Americans Participants		
Predictor Variables	**OR**	**95% CI**	**P-value**	**OR**	**95% CI**	**P-value**
Patient Satisfaction	1.21	1.10-1.33	0.0001	1.32	1.23-1.41	<.0001
Dementia Screening						
Digit Symbol (15 unit increase [1 SD])	1.08	0.98-1.19	0.13	0.94	0.88-1.01	0.077
Logical Memory I (unit increase)	1.01	0.98-1.03	0.7	1.00	0.98-1.01	0.7
Logical Memory II (unit increase)	0.99	0.96-1.02	0.4	1.00	0.98-1.02	0.9
Montreal Cognitive Assessment (unit increase)	1.02	0.99-1.04	0.2	0.99	0.97-1.01	0.4
Morisky Medication Adherence	0.93	0.89-0.99	0.014	0.99	0.94-1.04	0.7