Clinical Outcomes by Race and Ethnicity in the Systolic Blood Pressure Intervention Trial (SPRINT): A Randomized Clinical Trial

Carolyn H. Still,[1] Carlos J. Rodriguez,[2] Jackson T. Wright Jr,[3,4] Timothy E. Craven,[5] Adam P. Bress,[6] Glenn M. Chertow,[7] Paul K. Whelton,[8] Jeffrey C. Whittle,[9] Barry I. Freedman,[10] Karen C. Johnson,[11] Capri G. Foy,[12] Jiang He,[8] John B. Kostis,[13] James P. Lash,[14] Carolyn F. Pedley,[15] Roberto Pisoni,[16] James R. Powell,[17] Barry M. Wall,[18] for the SPRINT Writing Group

BACKGROUND

The Systolic Blood Pressure Intervention Trial (SPRINT) showed that targeting a systolic blood pressure (SBP) of ≤ 120 mm Hg (intensive treatment) reduced cardiovascular disease (CVD) events compared to SBP of ≤ 140 mm Hg (standard treatment); however, it is unclear if this effect is similar in all racial/ethnic groups.

METHODS

We analyzed SPRINT data within non-Hispanic White (NHW), non-Hispanic Black (NHB), and Hispanic subgroups to address this question. High-risk nondiabetic hypertensive patients ($N = 9,361$; 30% NHB; 11% Hispanic) 50 years and older were randomly assigned to intensive or standard treatment. Primary outcome was a composite of the first

Correspondence: Carolyn H. Still (cwh11@case.edu).

Initially submitted April 28, 2017; date of first revision June 28, 2017; accepted for publication August 2, 2017; online publication August 23, 2017.

¹Frances Payne Bolton School of Nursing, Case Western Reserve University, Cleveland, Ohio, USA; ²Wake Forest School of Medicine/Department of Epidemiology and Prevention, Section on Cardiovascular Medicine, Winston-Salem, North Carolina, USA; ³School of Medicine, Case Western Reserve University, Cleveland, Ohio, USA; ⁴Division of Nephrology and Hypertension, University Hospitals Cleveland Medical Center, Cleveland, Ohio, USA; ⁵Division of Public Health Sciences, Department of Biostatistical Sciences, Wake Forest School of Medicine, Winston-Salem, North Carolina, USA; ⁶Division of Health System Innovation and Research, Department of Population Health Sciences, University of Utah School of Medicine, Salt Lake City, Utah, USA; ⁷Stanford University School of Medicine, Division of Nephrology, Palo Alto, California, USA; ⁸Department of Epidemiology, Tulane University School of Public Health and Tropical Medicine, New Orleans, Louisiana, USA; ⁹Department of Medicine, Medical College of Wisconsin, Milwaukee and Primary Care Division, Clement J. Zablocki Veterans Affairs Medical Center, Milwaukee, Wisconsin, USA; ¹⁰Department of Internal Medicine, Section on Nephrology, Wake Forest School of Medicine, Winston-Salem, North Carolina, USA; ¹¹Department of Preventive Medicine, University of Tennessee Health Science Center, Memphis, Tennessee, USA; ¹²Department Social Sciences and Health Policy, School of Medicine, Wake Forest University, Winston-Salem, North Carolina, USA; ¹³Cardiovascular Institute, Rutgers Robert Wood Johnson Medical School, New Brunswick, New Jersey, USA; ¹⁴Department of Medicine, University of Illinois Chicago, Chicago, Illinois, USA; ¹⁵Wake Forest Baptist Health, Winston-Salem, North Carolina, USA; ¹⁶Department of Medicine, Medical University of South Carolina, Charleston, South Carolina, USA; ¹⁷Division of General Internal Medicine, Brody School of Medicine, East Carolina University, Greenville, North Carolina, USA; ¹⁸Memphis Veterans Affairs Medical Center, Memphis, Tennessee, USA.

occurrence of a myocardial infarction, acute coronary syndrome, stroke, decompensated heart failure, or CVD death.

RESULTS
Average postbaseline SBP was similar among NHW, NHB, and Hispanics in both treatment arms. Hazard ratios (HRs) (95% confidence interval) (intensive vs. standard treatment groups) for primary outcome were 0.70 (0.57–0.86), 0.71 (0.51–0.98), 0.62 (0.33–1.15) (interaction P value = 0.85) in NHW, NHB, and Hispanics. CVD mortality HRs were 0.49 (0.29–0.81), 0.77 (0.37–1.57), and 0.17 (0.01–1.08). All-cause mortality HRs were 0.61 (0.47–0.80), 0.92 (0.63–1.35), and 1.58 (0.73–3.62), respectively. A test for differences among racial/ethnic groups in the effect of treatment assignment on all-cause mortality was not significant (Hommel-adjusted P value = 0.062) after adjustment for multiple comparisons.

CONCLUSION
Targeting a SBP goal of ≤ 120 mm Hg compared to ≤ 140 mm Hg led to similar SBP control and was associated with similar benefits and risks among all racial ethnic groups, though NHBs required an average of ~0.3 more medications.

Racial and ethnic differences in cardiovascular disease (CVD) remain a major public health challenge in the United States.[1–3] Hypertension is one of the most important, modifiable CVD risk factors leading to coronary heart disease, stroke, end-stage renal disease, and overall mortality.[4–6] Non-Hispanic Black (NHB) and Hispanic adults (compared to non-Hispanic Whites [NHWs]) have higher rates of uncontrolled blood pressure (BP) (50%, 54%, and 46%, respectively), and NHBs are at greater risk of hypertension-related CVD morbidity and mortality.[4] CVD age-adjusted death rates are 33% higher among NHBs when compared to the overall US population.[4,5] Hypertension-related age-adjusted mortality rates of adults aged 25 years and older are 127.2 vs. 135.9 per 100,000 populations for Hispanics vs. NHWs, respectively, though considerable heterogeneity in CVD risk is seen in Hispanics based on country of origin.[7,8] These disparities cost the US health care system an estimated $49 billion per year.[2,5,9] Therefore, BP control interventions to reduce CVD morbidity and mortality in underrepresented racial and ethnic groups are important at both the individual and population levels.

Over the past 2 decades, studies have demonstrated that lowering BP with antihypertensive medications reduces the risk of CVD morbidity and mortality, including in NHB and Hispanic populations.[10–14] Until recently, there was insufficient data to determine optimal BP targets for the treatment of hypertension in these populations.[2,7] Lowering systolic BP (SBP) with antihypertensive medications significantly reduced CVD morbidity and mortality in the Systolic Hypertension in the Elderly Program (SHEP), Systolic Hypertension in Europe (Syst-Eur) Trial, and the Hypertension in the Very Elderly Trial (HYVET).[15–17] However, SBP treatment goals in the more intensive treatment arms of these trials were between 150 and 160 mm Hg and only SHEP included African American (AA) participants (14%).[15,17] Two small trials (with limited statistical power) that compared a SBP target of <140 mm Hg to <160 mm Hg found no significant difference in CVD outcomes.[18,19] The Action to Control Cardiovascular Risk in Diabetes BP trial (ACCORD), which included a racially diverse population (24% NHBs and 7% Hispanics) of 4,733 high-risk hypertensives with type 2 diabetes mellitus treated to a SBP target <120 mm Hg (compared to SBP <140 mm Hg), identified no difference in the primary CVD composite outcome but a significant reduction in stroke risk in the <120 mm Hg group.[20]

More recently, random assignment to a SBP target <120 mm Hg compared to <140 mm Hg among people at high CVD risk (without diabetes or history of stroke) resulted in a 25% reduction in the primary outcome (a CVD composite) and a 27% reduction in all-cause mortality in the National Institutes of Health (NIH) sponsored Systolic Blood Pressure Intervention Trial (SPRINT).[13,21] Of the 9,361 SPRINT participants, 30% were NHBs and 11% were Hispanic.[13,22,23] Exploration of the trial results in non-Black compared to Black participants was a prespecified analysis. Thus, SPRINT provides a large database for the study of BP treatment targets in these diverse populations.[21] This report describes the major outcomes in SPRINT by race and Hispanic ethnicity.

METHODS

Patient selection

Details of the SPRINT study design and rationale have been previously reported and more extensive details of the study protocol and procedures are publicly available.[13,21,24] All participants gave written informed consent and the trial protocol was approved by the institutional review board at each participating site. The SPRINT cohort consisted of men and women, aged 50 years or older with a SBP between 130–180 mmHg on 0–4 antihypertensive medications and at high CVD risk. High CVD risk was defined by the presence of one or more of the following at study entry: clinical or subclinical CVD (other than stroke); chronic kidney disease (CKD) defined as an estimated glomerular filtration rate calculated with the 4-variable Modification of Diet in Renal Disease (MDRD) equation of 20–59 ml/min/1.73 m2 using the most recent serum creatinine drawn within the preceding 6 months; a Framingham Risk Score for 10-year CVD risk ≥15%; or age ≥75 years. Individuals with history of diabetes, stroke, polycystic kidney disease, or heart failure were excluded.[21]

Race was self-reported by participants as Black (or AA), White, Native American, Asian, Native Hawaiian or other Pacific Islander, and other; and ethnicity was based upon independent self-identification as Hispanic or non-Hispanic.

In this report, the 984 participants who self-identified as Hispanic were considered part of that group (regardless of self-identified race). Non-Hispanic participants who self-identified as AA alone were grouped as NHB ($n = 2802$). Non-Hispanic participants who self-identified as White alone were grouped as NHW ($n = 5399$). Participants who self-identified as belonging to other race categories, selected more than one race category or did not specify a race were excluded from this analysis ($n = 176$).

Intervention

SPRINT participants were randomly assigned to 1 of 2 SBP targets standard (SBP <140 mm Hg) or intensive (SBP <120 mm Hg) treatment. SPRINT investigators initiated and adjusted antihypertensive medications to achieve the assigned SBP targets according to the SPRINT step-care treatment algorithm using US Food and Drug Administration approved antihypertensive drugs provided by the study. At each visit, trained clinical staff measured BPs with an automated BP device (Omron-HEM-907 XL) using standardized procedures.[21,24] BP measurement requirements included measuring BP early in the visit and not following stressful exam components such as blood draws, proper positioning of the participant in a chair with back support, and proper cuff size determination. The SPRINT Manual of Procedures (MOP) stated that participants should be resting, not completing questionnaires, and not speaking with study staff during the 5-minute rest period or while BP measurements were being taken. The MOP also stated that staff should leave the room during the 5-minute rest period, and provided a script that staff could use to explain that they would be absent during the 5-minute rest period and would then enter the room and obtain the measurements without speaking to the participant.[24]

Study measures and outcomes

At baseline, information on sociodemographics, cardiovascular risk factors, concomitant medications, social and medical history, anthropometrics, dementia screening, and quality of life measurements were collected on all eligible patients. Routine follow-up visits were conducted at 1, 2, 3, and every 3 months thereafter during the trial. Specific laboratory data (e.g., serum creatinine, fasting serum glucose) were collected at baseline and every 3 months. Additional visits were scheduled as needed for management of adverse effects or SBP goal attainment.

The primary outcome was a composite of the first occurrence of a myocardial infarction, acute coronary syndrome not leading to a myocardial infarction, stroke, decompensated heart failure, or cardiovascular death. Major secondary outcomes included CVD mortality, all-cause mortality, and a composite of total mortality and the primary outcome. Other prespecified secondary outcomes analyzed in this report included decline in renal function or development of end-stage renal disease. Definitions of these outcomes were prospectively defined in the SPRINT protocol.[24] Self-reported study outcomes were ascertained quarterly by clinical site staff using structured interviews for both treatment groups. Medical records and other corroborating data were collected for each potential outcome; all study outcomes were reviewed and adjudicated by the trial's outcome committee using a prespecified protocol and blinded to treatment assignment.[21,24]

In contrast to study outcomes, adverse events, including serious adverse events (SAEs), could be reported at any visit. SAEs were defined as an adverse experience judged by an investigator to be life threatening and/or resulting in death, permanent disability, or hospitalization or prolongation of hospitalization, whether or not the event was thought to be related to study intervention. SPRINT considered any emergency visit for heart failure, bradycardia, stroke, transient ischemic attack, or electrolyte abnormalities, and any syncope or injurious falls as a reportable SAE. Clinical and laboratory variables (serum potassium, creatinine levels, and estimated glomerular filtration rate) were also examined as potential adverse effects. An independent Data and Safety Monitoring Board (DSMB) monitored unblinded study data and provided oversight of participant safety.

Statistical analysis

Descriptive statistics (means and SD for continuous variables; frequencies and percentages for categorical variables) of baseline characteristics were computed by race/ethnicity and by treatment group within each stratum of race/ethnicity. Pairwise comparisons (i.e., each race/ethnicity compared to the other) were made using 1-way analysis of variance with pairwise contrasts for continuous variables and separate chi-square tests for categorical variables. Mean and SE of follow-up SBP was estimated by race/ethnicity and treatment group using mixed linear models with unstructured variance-covariance to control for within-subject correlation. Effect of treatment arm assignment on time to the first event within race/ethnicity stratum (i.e., CVD outcomes, mortality, CKD outcomes, and SAEs) was analyzed based on the intention-to-treat approach using univariable Cox proportional-hazards regression models for treatment arm assignment with 2-sided tests at the 5% level of significance and stratification by clinical site. Two-way interactions between treatment effect and race/ethnicity group were assessed using likelihood-ratio tests and Hommel's technique to adjust for multiple comparisons. Since the subgroup definitions in this report differ from the prespecified race subgroup of Blacks vs. non-Blacks (in the prespecified comparison, the Black group included both Hispanic and non-Hispanic ethnicities who self-identified as Black while the non-Black group included both Hispanics and non-Hispanics who self-identified as White), outcome data for the prespecified race subgroups are presented in the Appendix (Supplementary Table S2). All analyses were performed using SAS version 9.4 software (SAS Institute, Cary, NC).

Following a recommendation by the trial's independent DSMB, the SPRINT BP intervention was halted on 20 August 2015 by the National Heart, Lung, and Blood Institute (NHLBI) Director after a mean follow-up of 3.26 years. Follow-up was censored at the date of last assessment for

a study event in each participant prior to 21 August 2015. This publication is based on a database that was frozen on 16 September 2016 and includes outcome events from baseline until the termination of the trial intervention on 21 August 2015.

RESULTS

Study participants

Figure 1 displays the CONSORT diagram for SPRINT by race/ethnicity group. Baseline characteristics by race/ethnicity and treatment assignment are provided in Table 1 and by race/ethnicity, pooled across treatment (Supplementary Table S1). After stratifying by race/Hispanic ethnicity, few significant differences in baseline characteristics and risk profile were noted between treatment groups. Significant differences in weight between randomized treatment groups were seen in the Hispanic subgroup, statin use in NHBs, and aspirin use in NHWs (Table 1).

Blood pressure

SBP levels were similar by race/ethnicity stratum and between treatment groups at baseline (Table 1). SBP over time is shown in Figure 2. Overall, SBP decreased substantially during the first year of the study in all race/ethnicity groups and showed only modest differences between racial/ethnic groups for both SBP. Average postbaseline mean ± SE follow-up SBP in the standard arm was 134.7 ± 0.1 mm Hg in NHW, 135.5 ± 0.2 mm Hg in NHB, and 134.8 ± 0.3 mm Hg in Hispanic participants; compared to intensive arm values of 121.8 ± 0.2, 122.6 ± 0.2, and 119.9 ± 0.4 in NHW, NHB, and Hispanic participants, respectively. The mean number of antihypertensive medications prescribed were significantly higher in NHB (mean ± SE intensive arm 3.01 ± 0.03, standard arm 1.99 ± 0.03) compared to in NHW (intensive arm 2.74 ± 0.02, standard arm 1.75 ± 0.02; P value <0.0001 vs. NHB, both arms), and in Hispanics (intensive arm 2.70 ± 0.05, standard arm 1.77 ± 0.05; P value <0.0001 vs. NHB, both arms) (Figure 2).
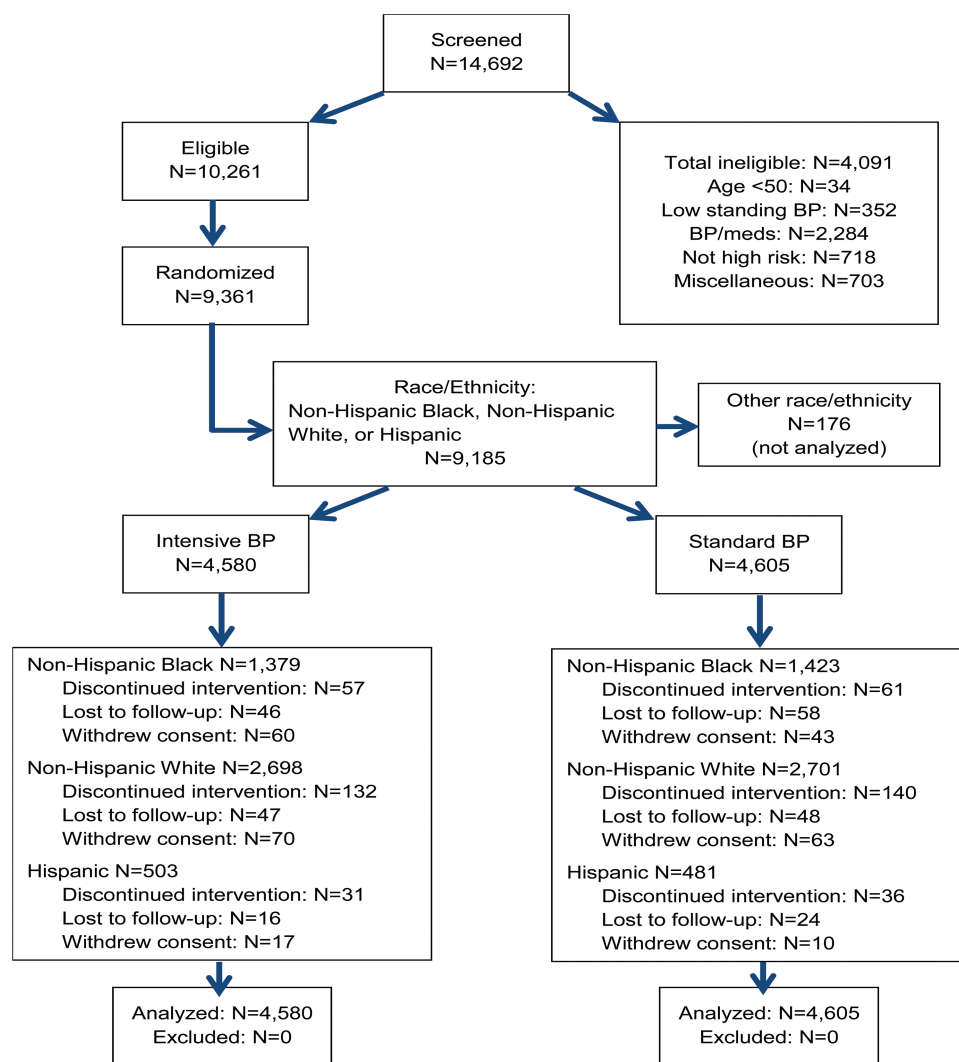

Figure 1. Consort diagram. Race/ethnicity was self-reported and participants were classified as: Hispanic regardless of self-identified race; non-Hispanic Black if self-identified as African American alone; and non-Hispanic White if self-identified as White alone.

Table 1. Baseline clinical characteristics of SPRINT participants stratified by race/ethnicity and randomized group

Characteristics	Non-Hispanic White (n = 5,399)[a]		Non-Hispanic Black (n = 2,802)[a]		Hispanic (n = 984)[a]	
	Intensive	Standard	Intensive	Standard	Intensive	Standard
No. randomized	2,698	2,701	1,379	1,423	503	481
Age						
50–64	782 (29.0)	813 (30.1)	824 (59.8)	831 (58.4)	267 (53.1)	247 (51.4)
65–74	939 (34.8)	901 (33.4)	329 (23.9)	366 (25.7)	147 (29.2)	149 (31.0)
≥75	977 (36.2)	987 (36.5)	225 (16.3)	226 (15.9)	89 (17.7)	85 (17.7)
Female gender	795 (29.5)	757 (28.0)	630 (45.7)	641 (45.1)	225 (44.7)	229 (47.6)
Chronic kidney disease[b]	885 (32.8)	893 (33.1)	325 (23.6)	312 (21.9)	94 (18.7)	96 (20.0)
Cardiovascular disease						
Clinical	526 (19.5)	507 (18.8)	135 (9.8)	144 (10.1)	65 (12.9)	63 (13.1)
Subclinical	207 (7.7)	222 (8.2)	121 (8.8)	120 (8.4)	47 (9.3)	48 (10.0)
Framingham 10-year CVD risk score (%)	26.8 ± 12.8	26.8 ± 12.6	21.7 ± 11.7	21.9 ± 11.8	23.0 ± 12.3	22.4 ± 11.8
Baseline blood pressure						
SBP, mm Hg	139.6 ± 15.5	139.2 ± 15.2	139.5 ± 16.7	140.0 ± 15.8	140.2 ± 14.5	141.2 ± 15.1
DBP, mm Hg	76.8 ± 11.4	76.5 ± 11.6	81.2 ± 12.5	81.3 ± 12.3	77.6 ± 11.2	77.3 ± 11.2
Pulse, bpm	65.2 ± 11.3	65.2 ± 11.5	68.7 ± 11.9	68.4 ± 11.9	65.4 ± 10.3	66.1 ± 10.7
# of BP Medications	1.78 ± 1.03	1.78 ± 1.05	1.99 ± 1.06	1.96 ± 1.05	1.79 ± 0.97	1.71 ± 0.93
Weight, lbs.	190.0 ± 40.9	191.2 ± 41.4	196.7 ± 42.7	195.7 ± 42.5	180.1 ± 36.3*	175.6 ± 35.3*
BMI, kg/m²	29.4 ± 5.5	29.4 ± 5.4	31.0 ± 6.4	30.8 ± 6.3	29.8 ± 5.3	29.3 ± 5.0
# of chronic diseases	3.02 ± 1.70	3.02 ± 1.74	2.18 ± 1.56	2.20 ± 1.53	2.24 ± 1.64	2.16 ± 1.47
Smoking status						
Current	238 (8.8)	230 (8.5)	324 (23.6)	315 (22.2)	68 (13.6)	45 (9.4)
Past	1,340 (49.8)	1,340 (50.0)	453 (33.0)	484 (34.2)	157 (31.3)	146 (30.5)
Statin use	1,311 (48.9)	1,338 (50.0)	430 (31.4)[†]	513 (36.3)[†]	193 (38.6)	198 (41.3)
Aspirin use	906 (33.8)[†]	805 (30.1)[†]	365 (26.7)	364 (25.8)	120 (24.0)	117 (24.4)
Baseline laboratory values						
Fasting glucose (mg/dl)	99.3 ± 13.2	99.5 ± 11.9	98.0 ± 15.3	97.6 ± 16.1	98.3 ± 11.6	98.5 ± 12.2
Cholesterol, total (mg/dl)	186.4 ± 40.9	186.3 ± 41.1	196.6 ± 42.2	195.2 ± 39.7	192.8 ± 40.3	194.9 ± 40.3
Cholesterol, LDL (mg/dl)	108.8 ± 34.5	108.2 ± 34.4	119.7 ± 36.4	118.5 ± 34.3	114.1 ± 35.2	115.0 ± 34.2
Cholesterol, HDL (mg/dl)	52.3 ± 14.1	41.9 ± 14.3	54.9 ± 15.2	55.3 ± 14.9	50.7 ± 12.3	50.6 ± 14.1
Triglycerides (mg/dl)	127.7 ± 79.3	131.7 ± 83.1	113.1 ± 102.1	110.0 ± 110.3	140.6 ± 68.6	149.8 ± 97.9
Potassium (mmol/l)	4.28 ± 0.43	4.27 ± 0.42	4.07 ± 0.41	4.08 ± 0.49	4.19 ± 0.43	4.21 ± 0.40
Sodium (mmol/l)	139.9 ± 2.6	140.0 ± 2.5	140.5 ± 2.3	140.4 ± 2.2	140.3 ± 2.2	140.2 ± 2.3
eGFR (ml/min/1.73 m2)	68.3 ± 18.1	68.0 ± 18.3	76.3 ± 23.4	76.7 ± 22.3	78.0 ± 22.3	77.2 ± 22.3
Creatinine (mg/dl)	1.06 ± 0.31	1.07 ± 0.31	1.14 ± 0.40	1.13 ± 0.38	0.96 ± 0.33	0.96 ± 0.34

Plus–minus values are means ± SD: *$P < 0.05$, †$P < 0.01$ Standard vs. intensive arms. SI conversion factors: to convert the values for creatinine to micromoles per liter, multiply by 88.4. To convert the values for cholesterol to millimoles per liter, multiply by 0.0259. To convert the values for triglycerides to millimoles per liter, multiply by 0.0113. To convert the values for glucose to millimoles per liter, multiply by 0.0555. Abbreviations: BMI, Body Mass Index; BP, blood pressure; CVD, cardiovascular disease primary outcome; DBP, diastolic blood pressure; eGFR, estimated glomerular filtration rate; HDL, high-density lipoprotein; LDL, low-density lipoprotein; SBP, systolic blood pressure; SPRINT, Systolic Blood Pressure Intervention Trial.

[a]Race/ethnicity was self-reported and participants were classified as: Hispanic regardless of self-identified race; non-Hispanic Black if self-identified as African American alone; and non-Hispanic White if self-identified as white alone.

[b]Chronic kidney disease was defined as an eGFR of less than 60 ml/min/1.73 m².
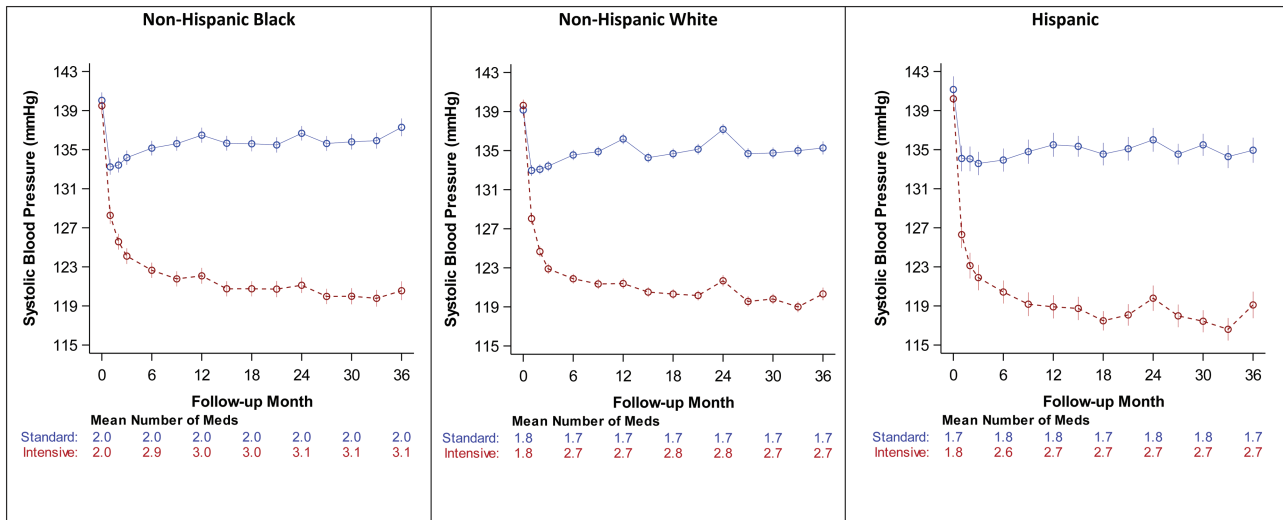
Figure 2. Follow-up SBP and mean number of antihypertensive meds by treatment arm and race/ethnicity. The SBP separation between treatment groups at year 12, 24, and 36 months was 14.4, 15.6, and 16.7 mm Hg, respectively in NHBs; 14.8, 15.5, and 15.0.

CVD outcomes

The HRs (95% confidence interval) (intensive vs. standard treatment groups) for the primary composite outcome were 0.70 (0.57–0.86), 0.71 (0.51–0.98), 0.62 (0.33–1.15) in NHWs, NHBs, and Hispanics, respectively (Table 2). For CV mortality, HRs were 0.49 (0.29–0.81) in NHW, 0.77 (0.37–1.57) in NHB, and 0.17 (0.01–1.08) in Hispanics, though for all-cause mortality they were 0.61 (0.47–0.80) in NHW, 0.92 (0.63–1.35) in NHB, 1.58 (0.73–3.62) in Hispanics. The effect of treatment arm assignment was homogenous with all interaction P values >0.05 across racial/ethnic groups for the primary CVD outcome, as well as the secondary outcomes of myocardial infarction, acute coronary syndrome, stroke, heart failure, CVD death, and primary outcome.

There appeared to be heterogeneity of effect for all-cause mortality and for non-CVD death (interaction P value = 0.008 and 0.006, respectively) (Table 2). However, after adjusting for multiple comparisons, the treatment by race/ethnicity interaction approached significance only for all-cause death (Hommel-adjusted P value = 0.062). CVD mortality was similarly reduced in all race/ethnic groups (treatment by race/ethnic interaction P value = 0.098), including in treatment comparisons by Blacks vs. non-Blacks (Supplementary Tables S2 and S3), or whether Hispanics resided in Puerto Rico ($n = 437$) or the US mainland ($n = 550$) (data not shown). Treatment by residence interaction P values were 0.40, 0.68, and 0.43 for primary outcome, CVD mortality, and all-cause mortality, respectively.

CKD outcomes

The effect of treatment arm assignment on CKD outcomes (stratified by baseline CKD vs. non-CKD subgroup) by race/ethnicity is shown in Table 3 and Supplementary Table S2. The numbers of events in the CKD subgroup were small, particularly for the primary composite renal outcome

of ≥50% reduction in estimated glomerular filtration rate or end-stage renal disease; treatment effects were similar across race/ethnicity groups for all 4 outcomes.

Serious adverse events

Results for SAEs are displayed in Table 4. Between the 2 treatment groups, no heterogeneity of effect was noted between the 3 racial ethnic groups in terms of overall SAEs or the 6 select SAEs: hypotension, syncope, bradycardia, electrolyte abnormality, injurious falls, or acute kidney injury.

DISCUSSION

We found that targeting a SBP <120 mm Hg compared to the currently recommended <140 mm Hg led to similar reductions in the relative risk for the primary outcome across major racial/ethnic groups—NHB (29%), NHW (30%), and Hispanics (38%). We also found that although NHBs required slightly more antihypertensive therapy to achieve this lower target, there was no difference in achieved SBP by race in the intensive arm.

Moreover, while statistically significant differences in baseline characteristics including cardiovascular risk profile (e.g., age, gender, cigarette smoking, prevalent CKD/CVD) were seen between the race/ethnic subgroups (Tables 1 and Supplementary Table S1), these differences were small. This suggests the benefit was unaffected by these population differences (though we had limited statistical power to detect such an effect). The population impact of implementing SPRINT may be even greater among NHBs given the higher prevalence of hypertension in this population and the fact that hypertension accounts for a greater proportion of CVD events among NHB and Hispanics.[9]

These findings are consistent with those in previous SPRINT publications[13,25] and extends the findings of previous studies.[26,27] In the Hypertension Detection Follow-up trial (HDFP) trial, Blacks (Hispanic ethnicity

Table 2. Primary and secondary outcomes stratified by treatment group and race/ethnicity

Outcome	Race/ethnicity	Intensive arm			Standard arm			Intensive vs. standard hazard ratio			Interaction P value
		N	Events	% per Year	N	Events	% per Year	HR	Lower 95% CI	Upper 95% CI	
Primary outcome[a]	(Non-Hispanic) White	2,698	167	1.9	2,701	229	2.7	0.70	0.57	0.86	0.85
	(Non-Hispanic) Black	1,379	64	1.5	1,423	93	2.1	0.71	0.51	0.98	
	Hispanic	503	20	1.2	481	26	1.7	0.62	0.33	1.15	
Myocardial infarction	(Non-Hispanic) White	2,698	69	0.8	2,701	88	1.0	0.77	0.56	1.05	0.63
	(Non-Hispanic) Black	1,379	22	0.5	1,423	35	0.8	0.64	0.36	1.09	
	Hispanic	503	9	0.6	481	13	0.8	0.48	0.18	1.18	
Acute coronary syndrome	(Non-Hispanic) White	2,698	30	0.3	2,701	26	0.3	1.15	0.68	1.95	0.35
	(Non-Hispanic) Black	1,379	7	0.2	1,423	9	0.2	0.86	0.30	2.33	
	Hispanic	503	3	0.2	481	5	0.3	0.57	0.11	2.34	
Stroke	(Non-Hispanic) White	2,698	44	0.5	2,701	49	0.6	0.87	0.58	1.32	0.38
	(Non-Hispanic) Black	1,379	14	0.3	1,423	22	0.5	0.66	0.33	1.28	
	Hispanic	503	6	0.4	481	5	0.3	1.05	0.31	3.69	
Heart failure	(Non-Hispanic) White	2,698	40	0.5	2,701	70	0.8	0.55	0.37	0.81	0.27
	(Non-Hispanic) Black	1,379	22	0.5	1,423	29	0.6	0.80	0.45	1.40	
	Hispanic	503	4	0.2	481	5	0.3	0.61	0.15	2.35	
Cardiovascular death	(Non-Hispanic) White	2,698	23	0.3	2,701	45	0.5	0.49	0.29	0.81	0.098
	(Non-Hispanic) Black	1,379	13	0.3	1,423	18	0.4	0.77	0.37	1.57	
	Hispanic	503	1	0.1	481	6	0.4	0.17	0.01	1.08	
Non-CVD death	(Non-Hispanic) White	2,698	57	0.6	2,701	82	0.9	0.69	0.49	0.97	0.006
	(Non-Hispanic) Black	1,379	30	0.7	1,423	26	0.6	1.16	0.68	1.98	
	Hispanic	503	12	0.7	481	4	0.3	3.28	0.98	14.77	
All-cause mortality	(Non-Hispanic) White	2,698	89	1.0	2,701	144	1.6	0.61	0.47	0.80	0.008
	(Non-Hispanic) Black	1,379	51	1.2	1,423	56	1.2	0.92	0.63	1.35	
	Hispanic	503	19	1.1	481	12	0.8	1.58	0.73	3.62	
Primary outcome or death	(Non-Hispanic) White	2,698	222	2.6	2,701	310	3.6	0.70	0.59	0.83	0.082
	(Non-Hispanic) Black	1,379	94	2.2	1,423	122	2.7	0.78	0.59	1.030	
	Hispanic	503	35	2.1	481	31	2.0	1.00	0.60	1.67	

Abbreviations: CI, confidence interval, CVD, cardiovascular disease primary outcome; HR, hazard ratio.
[a]The primary outcome includes the first occurrence of myocardial infarction, acute coronary syndrome, stroke, heart failure, or death from cardiovascular causes. Median follow-up of 3.26 years.

Table 3. CKD outcomes in the CKD and non-CKD subgroups, stratified by treatment group and race/ethnicity

| Outcome | Subgroup | Intensive arm | | | Standard arm | | | Intensive vs. standard hazard ratio | | | Interaction |
		N	Events	% per Year	N	Events	% per Year	HR	Lower 95% CI	Upper 95% CI	P value
CKD subgroup: composite renal outcome[a]	(Non-Hispanic) White	885	8	0.3	893	7	0.24	1.14	0.38	3.41	0.76
	(Non-Hispanic) Black	325	9	0.9	312	8	0.79	1.09	0.40	3.14	
	Hispanic	94	0	0.0	96	0	0.00	–	–	–	
CKD subgroup: incident albuminuria[b]	(Non-Hispanic) White	365	49	4.3	346	60	5.7	0.79	0.53	1.18	0.17
	(Non-Hispanic) Black	118	11	3.0	106	18	5.7	0.26	0.08	0.69	
	Hispanic	35	4	3.7	41	7	5.8	1.39	0.28	7.17	
Non-CKD subgroup: ≥30% eGFR reduction to CKD[c]	(Non-Hispanic) White	1,808	88	1.5	1,798	21	0.4	4.38	2.77	7.24	0.22
	(Non-Hispanic) Black	1,046	42	1.3	1,103	16	0.5	2.61	1.47	4.83	
	Hispanic	406	17	1.3	383	4	0.3	4.02	1.44	14.3	
Non-CKD subgroup: incident albuminuria	(Non-Hispanic) White	965	81	2.7	955	101	3.4	0.77	0.57	1.03	0.51
	(Non-Hispanic) Black	576	45	2.5	642	65	3.4	0.73	0.49	1.08	
	Hispanic	219	15	2.1	213	15	2.2	0.80	0.36	1.75	

Abbreviations: CI, confidence interval, CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate.

[a]For participants with CKD at baseline, composite renal outcome was the first occurrence of a reduction in eGFR by 50% (measure twice at least 90 days apart) or long-term dialysis or kidney transplant.

[b]Incident albuminuria denotes a urinary albumin to creatinine ratio of less than 10 mg/g at baseline and doubled to a creatinine ratio from less than 10 mg/g to 10 mg/g or greater (measured twice at least 90 days apart).

[c]Includes a 30% reduction in eGFR (measured twice at least 90 days apart) to an eGFR of less than 60 ml/min/1.73 m^2, dialysis, or a kidney transplant in participants without CKD at baseline.

was not reported), who made up 44% of study participants, had a significant reduction in all-cause mortality with more intensive "stepped" care compared to less intensive "referred" care.[28] While the BP target in HDFP was based on a DBP goal of <90 mm Hg, SBP decreased from a baseline of 159 mm Hg to 130 mm Hg by years 4 and 5.[29] In the ACCORD trial, the mean on-treatment intensive arm SBPs were 119.2 ± 0.2, 122.7 ± 0.4, and 121.7 ± 0.7 in the NHW, NHB, and Hispanic groups, respectively (written communication from P Byrington, November 2016). However, no benefit on the composite CVD outcome was seen with the <120 mm Hg target, either overall or in subgroups defined by race.

No racial or ethnic differences by treatment assignment were seen in renal outcomes or in SAEs in SPRINT. The AASK trial is the only other renal outcome trial with significant numbers of AAs and showed no benefit of more

intensive therapy in this population with hypertensive renal disease except in participants with proteinuria (protein-to-creatinine ratio of more than 0.22).[30,31] The small number of renal events in SPRINT make it unable to evaluate this finding.

Literature assessing incident CVD mortality in Hispanics and NHW found a statistically significant association between Hispanic ethnicity and lower CV and all-cause mortality despite having a worse CV risk profile when compared to NHW.[32] This has been referred to as the Hispanic paradox.[33] However, the risk profile of Hispanics in SPRINT was not greater than that seen in the other subgroups and did not result in an all-cause and cardiovascular-specific mortality advantage among Hispanics in SPRINT. Instead, we note a similar effect size on CV protection across NHWs, NHBs, and Hispanics. Though the sample sizes were small, SPRINT outcomes also did not

Table 4. Selected serious adverse events stratified by treatment group and by race/ethnicity

Outcome	Race/ethnicity	Intensive arm			Standard arm			Intensive vs. standard hazard ratio			Interaction P value
		N	Events	% per Year	N	Events	% per Year	HR	Lower 95% CI	Upper 95% CI	
Any SAE[a]	(Non-Hispanic) White	2,698	430	5.5	2,701	5.9	17.0	0.93	0.82	1.06	0.24
	(Non-Hispanic) Black	1,379	146	3.6	1,379	147	3.6	1.02	0.81	1.29	
	Hispanic	503	42	2.7	481	29	1.9	1.40	0.87	2.24	
Hypotension	(Non-Hispanic) White	2,698	38	0.4	2,701	27	0.3	1.40	0.86	2.30	0.28
	(Non-Hispanic) Black	1,379	11	0.3	1,379	11	0.3	1.03	0.45	2.38	
	Hispanic	503	2	0.1	481	0	0.0	–	–	–	
Syncope	(Non-Hispanic) White	2,698	39	0.5	2,701	31	0.4	1.24	0.77	1.99	0.94
	(Non-Hispanic) Black	1,379	9	0.2	1,379	7	0.2	1.32	0.49	3.56	
	Hispanic	503	5	0.3	481	3	0.2	1.59	0.38	6.66	
Bradycardia	(Non-Hispanic) White	2,698	32	0.4	2,701	29	0.3	1.10	0.66	1.81	0.30
	(Non-Hispanic) Black	1,379	4	0.1	1,379	8	0.2	0.51	0.15	1.70	
	Hispanic	503	1	0.1	481	3	0.2	0.32	0.03	3.05	
Electrolyte abnormality[b]	(Non-Hispanic) White	2,698	48	0.6	2,701	37	0.4	1.29	0.84	1.98	0.11
	(Non-Hispanic) Black	1,379	16	0.4	1,379	13	0.3	1.27	0.61	2.64	
	Hispanic	503	4	0.3	481	0	0.0	–	–	–	
Injurious fall[c]	(Non-Hispanic) White	2,698	93	1.1	2,701	115	1.4	0.80	0.61	1.05	0.11
	(Non-Hispanic) Black	1,379	26	0.6	1,379	21	0.4	1.28	0.72	2.27	
	Hispanic	503	6	0.4	481	2	0.1	2.88	0.58	14.3	
Acute kidney injury[d]	(Non-Hispanic) White	2,698	66	0.8	2,701	49	0.6	1.34	0.93	1.94	0.46
	(Non-Hispanic) Black	1,379	43	1.0	1,379	23	0.5	1.95	1.17	3.23	
	Hispanic	503	6	0.4	481	5	0.3	1.15	0.35	3.78	

Abbreviation: CI, confidence interval, SAE, serious adverse event.

[a]SAEs were defined as an adverse experience judged by an investigator to be life threatening and/or resulting in death, permanent disability, hospitalization, or prolongation of hospitalization, whether or not the event was thought to be related to the study intervention.

[b]Electrolyte abnormality were adverse laboratory measures detected on routine or unscheduled tests; routine laboratory tests were performed at 1 month, then quarterly during the first year, then every 6 months.

[c]An injurious fall was defined as a fall that resulted in evaluation in an emergency department or that resulted in hospitalization.

[d]Acute kidney injury or acute renal failure were based on a primary or secondary diagnosis listed in the hospital discharge summary and was believed by the safety officer to be 1 of the top 3 reasons for admission or continue.

differ between Hispanics residing on the US mainland vs. those in Puerto Rico.

The strengths of SPRINT include its large sample size, a diverse patient population, and its success in both implementing the protocol and achieving the SBP targets and difference in SBP between the 2 interventional groups throughout the trial, including in NHBs and Hispanics.

While by design SPRINT was not powered to specifically examine treatment effects of the lower SBP goal in these subgroups, this analysis supports the benefits of intensive BP lowering on the primary composite endpoint which was similar across these race/ethnicity groups. A somewhat surprising limitation was the baseline characteristics and CVD risk profile of the NHB and Hispanic populations in

SPRINT was not significantly higher than that of NHWs in SPRINT, which is not a representation of that found in the overall community. However, SPRINT assessment of race and ethnicity was through self-designation which also has its limitations.[34] NHBs and Hispanics are admixed populations, and the US concept of race being only White or Black is seen as confusing[35] and may have caused significant misclassification when trying to dichotomize White Hispanics and Black Hispanics.[36] Finally, the small sample size of Hispanics limited meaningful comparisons making the analysis of Hispanics underpowered and potentially unstable.

The clinical implications of the SPRINT results are substantial. Considering the high prevalence of hypertension and uncontrolled hypertension among NHBs and Hispanics, intensive SBP lowering is bound to have a greater public health impact among these populations.[4] Importantly, achieving lower SBP targets in NHB will require more antihypertensive therapy to achieve this goal. Our results indicate that most individuals above age 50 years with higher than average cardiovascular risk profile and SBP ≥130 mm Hg, including many above age 75 years old regardless of racial/ethnic origin benefit from treating to a SBP target of <120 mm Hg.

Overall, SPRINT findings showed benefit of a <120 mm Hg target (compared to one <140 mm Hg) in the NHB, Hispanic, and NHW populations and provide no evidence for heterogeneity of effect by race or ethnicity.

SUPPLEMENTARY MATERIAL

Supplementary data are available at *American Journal of Hypertension* online.

DISCLOSURE

The authors declared no conflict of interest.

REFERENCE

1. Whelton PK, Einhorn PT, Muntner P, Appel LJ, Cushman WC, Diez Roux AV, Ferdinand KC, Rahman M, Taylor HA, Ard J, Arnett DK, Carter BL, Davis BR, Freedman BI, Cooper LA, Cooper R, Desvigne-Nickens P, Gavini N, Go AS, Hyman DJ, Kimmel PL, Margolis KL, Miller ER 3rd, Mills KT, Mensah GA, Navar AM, Ogedegbe G, Rakotz MK, Thomas G, Tobin JN, Wright JT, Yoon SS, Cutler JA; National Heart, Lung, and Blood Institute Working Group on Research Needs to Improve Hypertension Treatment and Control in African Americans. Research needs to improve hypertension treatment and control in African Americans. *Hypertension* 2016; 68:1066–1072.
2. Borrell LN, Crawford ND. Disparities in self-reported hypertension in Hispanic subgroups, non-Hispanic Black and non-Hispanic White adults: the National Health Interview Survey. *Ann Epidemiol* 2008; 18:803–812.
3. Carson AP, Howard G, Burke GL, Shea S, Levitan EB, Muntner P. Ethnic differences in hypertension incidence among middle-aged and older adults: the multi-ethnic study of atherosclerosis. *Hypertension* 2011; 57:1101–1107.
4. Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, Das SR, de Ferranti S, Després JP, Fullerton HJ, Howard VJ, Huffman MD, Isasi CR, Jiménez MC, Judd SE, Kissela BM, Lichtman JH, Lisabeth LD, Liu S, Mackey RH, Magid DJ, McGuire DK, Mohler ER 3rd, Moy CS, Muntner P, Mussolino ME, Nasir K, Neumar RW, Nichol G, Palaniappan L, Pandey DK, Reeves MJ, Rodriguez CJ, Rosamond W, Sorlie PD, Stein J, Towfighi A, Turan TN, Virani SS, Woo D, Yeh RW, Turner MB; American Heart Association Statistics Committee; Stroke Statistics Subcommittee. Heart disease and stroke statistics-2016 update: a report from the American Heart Association. *Circulation* 2016; 133:e38–360.
5. 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; 1–8.
6. Gu A, Yue Y, Desai RP, Argulian E. Racial and ethnic differences in antihypertensive medication use and blood pressure control among US adults with hypertension: the National Health and Nutrition Examination Survey, 2003 to 2012. *Circulation: Cardiovascular Quality and Outcomes* 2016; 10:e003166.
7. Balfour PC Jr, Ruiz JM, Talavera GA, Allison MA, Rodriguez CJ. Cardiovascular disease in Hispanics/Latinos in the United States. *J Lat Psychol* 2016; 4:98–113.
8. Sorlie PD, Allison MA, Avilés-Santa ML, Cai J, Daviglus ML, Howard AG, Kaplan R, Lavange LM, Raij L, Schneiderman N, Wassertheil-Smoller S, Talavera GA. Prevalence of hypertension, awareness,

treatment, and control in the Hispanic Community Health Study/Study of Latinos. *Am J Hypertens* 2014; 27:793–800.

9. Balfour PC Jr, Rodriguez CJ, Ferdinand KC. The role of hypertension in race-ethnic disparities in cardiovascular disease. *Curr Cardiovasc Risk Rep* 2015; 9:18.

10. James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J, Lackland DT, LeFevre ML, MacKenzie TD, Ogedegbe O, Smith SC Jr, Svetkey LP, Taler SJ, Townsend RR, Wright JT Jr, Narva AS, Ortiz E. 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; 311:507–520.

11. Guzman NJ. Epidemiology and management of hypertension in the Hispanic population: a review of the available literature. *Am J Cardiovasc Drugs* 2012; 12:165–178.

12. Margolis KL, Piller LB, Ford CE, Henriquez MA, Cushman WC, Einhorn PT, Colon PJ Sr, Vidt DG, Christian R, Wong ND, Wright JT Jr, Goff DC Jr; Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial Collaborative Research Group. Blood pressure control in Hispanics in the antihypertensive and lipid-lowering treatment to prevent heart attack trial. *Hypertension* 2007; 50:854–861.

13. Wright JT Jr, Williamson JD, Whelton PK, Snyder JK, Sink KM, Rocco MV, Reboussin DM, Rahman M, Oparil S, Lewis CE, Kimmel PL, Johnson KC, Goff DC Jr, Fine LJ, Cutler JA, Cushman WC, Cheung AK, Ambrosius WT; SPRINT Research Group. A randomized trial of intensive versus standard blood-pressure control. *N Engl J Med* 2015; 373:2103–2116.

14. Wright JT Jr, Dunn JK, Cutler JA, Davis BR, Cushman WC, Ford CE, Haywood LJ, Leenen FH, Margolis KL, Papademetriou V, Probstfield JL, Whelton PK, Habib GB; ALLHAT Collaborative Research Group. Outcomes in hypertensive Black and nonblack patients treated with chlorthalidone, amlodipine, and lisinopril. *JAMA* 2005; 293:1595–1608.

15. 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; 265:3255–3264.

16. Still CH, Ferdinand KC, Ogedegbe G, Wright JT Jr. Recognition and management of hypertension in older persons: focus on African Americans. *J Am Geriatr Soc* 2015; 63:2130–2138.

17. Beckett NS, Peters R, Fletcher AE, Staessen JA, Liu L, Dumitrascu D, Stoyanovsky V, Antikainen RL, Nikitin Y, Anderson C, Belhani A, Forette F, Rajkumar C, Thijs L, Banya W, Bulpitt CJ; HYVET Study Group. Treatment of hypertension in patients 80 years of age or older. *N Engl J Med* 2008; 358:1887–1898.

18. JATOS Study Group. Principal results of the Japanese trial to assess optimal systolic blood pressure in elderly hypertensive patients (JATOS). *Hypertens Res* 2008; 31:2115–2127.

19. Ogihara T, Saruta T, Rakugi H, Matsuoka H, Shimamoto K, Shimada K, Imai Y, Kikuchi K, Ito S, Eto T, Kimura G, Imaizumi T, Takishita S, Ueshima H; Valsartan in Elderly Isolated Systolic Hypertension Study Group. Target blood pressure for treatment of isolated systolic hypertension in the elderly: valsartan in elderly isolated systolic hypertension study. *Hypertension* 2010; 56:196–202.

20. Cushman WC, Evans GW, Byington RP, Goff DC Jr, Grimm RH Jr, Cutler JA, Simons-Morton DG, Basile JN, Corson MA, Probstfield JL, Katz L, Peterson KA, Friedewald WT, Buse JB, Bigger JT, Gerstein HC, Ismail-Beigi F; ACCORD Study Group. Effects of intensive blood-pressure control in type 2 diabetes mellitus. *N Engl J Med* 2010; 362:1575–1585.

21. SPRINT Research Group. Systolic blood pressure intervention trial (SPRINT) protocol. <https://www.sprinttrial.org/public/Protocol_Current.pdf> Updated 2012. Accessed 1 November 2016.

22. Still CH, Craven TE, Freedman BI, Van Buren PN, Sink KM, Killeen AA, Bates JT, Bee A, Contreras G, Oparil S, Pedley CM, Wall BM, White S, Woods DM, Rodriguez CJ, Wright JT Jr; SPRINT Study Research Group. Baseline characteristics of African Americans in the Systolic Blood Pressure Intervention Trial. *J Am Soc Hypertens* 2015; 9:670–679.

23. Rodriguez CJ, Still CH, Garcia KR, Wagenknecht L, White S, Bates JT, Del Cid MV, Lioudis M, Lopez Barrera N, Moreyra A, Punzi H, Ringer RJ, Cushman WC, Contreras G, Servilla K, Rocco M; SPRINT Research Group. Baseline blood pressure control in Hispanics: characteristics of Hispanics in the Systolic Blood Pressure Intervention Trial. *J Clin Hypertens (Greenwich)* 2017; 19:116–125.

24. Ambrosius WT, Sink KM, Foy CG, Berlowitz DR, Cheung AK, Cushman WC, Fine LJ, Goff DC Jr, Johnson KC, Killeen AA, Lewis CE, Oparil S, Reboussin DM, Rocco MV, Snyder JK, Williamson JD, Wright JT Jr, Whelton PK; SPRINT Study Research Group. 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). *Clin Trials* 2014; 11:532–546.

25. Williamson JD, Supiano MA, Applegate WB, Berlowitz DR, Campbell RC, Chertow GM, Fine LJ, Haley WE, Hawfield AT, Ix JH, Kitzman DW, Kostis JB, Krousel-Wood MA, Launer LJ, Oparil S, Rodriguez CJ, Roumie CL, Shorr RI, Sink KM, Wadley VG, Whelton PK, Whittle J, Woolard NF, Wright JT Jr, Pajewski NM; SPRINT Research Group. Intensive vs standard blood pressure control and cardiovascular disease outcomes in adults aged ≥75 years: a randomized clinical trial. *JAMA* 2016; 315:2673–2682.

26. ALLHAT Officers and Coordinators for the ALLHAT Collaborative Research Group. Major outcomes in high-risk hypertensive patients randomized to angiotensin-converting enzyme inhibitor or calcium channel blocker vs diuretic: the antihypertensive and lipid-lowering treatment to prevent heart attack trial (ALLHAT). *JAMA* 2002; 288:2981–2997.

27. Julius S, Alderman MH, Beevers G, Dahlöf B, Devereux RB, Douglas JG, Edelman JM, Harris KE, Kjeldsen SE, Nesbitt S, Randall OS, Wright JT Jr. Cardiovascular risk reduction in hypertensive black patients with left ventricular hypertrophy: the LIFE study. *J Am Coll Cardiol* 2004; 43:1047–1055.

28. 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.

29. Abernethy J, Borhani NO, Hawkins CM, Crow R, Entwisle G, Jones JW, Maxwell MH, Langford H, Pressel S. Systolic blood pressure as an independent predictor of mortality in the Hypertension Detection and Follow-up Program. *Am J Prev Med* 1986; 2:123–132.

30. Wright JT Jr, Bakris G, Greene T, Agodoa LY, Appel LJ, Charleston J, Cheek D, Douglas-Baltimore JG, Gassman J, Glassock R, Hebert L, Jamerson K, Lewis J, Phillips RA, Toto RD, Middleton JP, Rostand SG; African American Study of Kidney Disease and Hypertension Study Group. Effect of blood pressure lowering and antihypertensive drug class on progression of hypertensive kidney disease: results from the AASK trial. *JAMA* 2002; 288:2421–2431.

31. Appel LJ, Wright JT Jr, Greene T, Agodoa LY, Astor BC, Bakris GL, Cleveland WH, Charleston J, Contreras G, Faulkner ML, Gabbai FB, Gassman JJ, Hebert LA, Jamerson KA, Kopple JD, Kusek JW, Lash JP, Lea JP, Lewis JB, Lipkowitz MS, Massry SG, Miller ER, Norris K, Phillips RA, Pogue VA, Randall OS, Rostand SG, Smogorzewski MJ, Toto RD, Wang X; AASK Collaborative Research Group. Intensive blood-pressure control in hypertensive chronic kidney disease. *N Engl J Med* 2010; 363:918–929.

32. Xu J, Murphy SL, Kochanek KD, Bastian BA. Deaths: final data for 2013. *Natl Vital Stat Rep* 2016; 64:1–119.

33. Cortes-Bergodgeri M, Goel K, Murad MH, Allison T, Somers VK, Erwin PJ, Sochor O, Lopez-Jimenez F. Cardiovascular mortality in Hispanics compared to non-Hispanic Whites: a systematic review and meta-analysis of the Hispanic paradox. *Eur J Intern Med* 2013; 24:791–799.

34. Kaufman JS, Cooper RS. Commentary: considerations for use of racial/ethnic classification in etiologic research. *Am J Epidemiol* 2001; 154:291–298.

35. Rodriguez CJ, Allison M, Daviglus ML, Isasi CR, Keller C, Leira EC, Palaniappan L, Piña IL, Ramirez SM, Rodriguez B, Sims M; American Heart Association Council on Epidemiology and Prevention; American Heart Association Council on Clinical Cardiology; American Heart Association Council on Cardiovascular and Stroke Nursing. Status of cardiovascular disease and stroke in Hispanics/Latinos in the United States: a science advisory from the American Heart Association. *Circulation* 2014; 130:593–625.

36. Bryc K, Durand EY, Macpherson JM, Reich D, Mountain JL. The genetic ancestry of African Americans, Latinos, and European Americans across the United States. *Am J Hum Genet* 2015; 96:37–53.