**ORIGINAL ARTICLE**

**Self-Reported Antihypertensive Medication Class and Temporal Relationship to Treatment Guidelines**

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**ABSTRACT:** The greater antihypertensive responses to initial therapy with calcium channel blockers (CCBs) or thiazide-type diuretics than renin-angiotensin system blockers as initial therapy in non-Hispanic Black (NHB) adults was recognized in the US High BP guidelines from 1988 to 2003. The 2014 Report from Panel Members Appointed to the Eighth Joint National Committee (2014 aJNC8 Report) and the 2017 American College of Cardiology/American Heart Association High Blood Pressure Guideline were the first to recommend CCBs or thiazide-type diuretics rather than renin-angiotensin system blockers as initial therapy in NHB. We assessed the temporal relationship of these recommendations on self-reported CCB or thiazide-type diuretics monotherapy by NHB and NHW adults with hypertension absent compelling indications for β-blocking or renin-angiotensin system blockers in National Health and Nutrition Examination Surveys 2015 to 2018 versus 2007 to 2012 (after versus before 2014 aJNC8 Report). CCB or thiazide-type diuretics monotherapy was unchanged in NHW adults (17.1% versus 18.1%, P=0.711) and insignificantly higher after 2014 among NHB adults (43.7% versus 38.2%, P=0.204), although CCB monotherapy increased (29.5% versus 21.0%, P=0.021) and renin-angiotensin system blocker monotherapy fell (44.5% versus 31.0%, P=0.008). Although evidence-based CCB monotherapy increased among NHB adults in 2015 to 2018, hypertension control declined as untreated hypertension and monotherapy increased. While a gap between recommended and actual monotherapy persists, evidence-based monotherapy appears insufficient to improve hypertension control in NHB adults, especially given evidence for worsening therapeutic inertia. Initiating treatment with single-pill combinations and timely therapeutic intensification when required to control hypertension are evidence-based, race-neutral options for improving hypertension control among NHB adults. (Hypertension. 2022;79:338–348. DOI: 10.1161/HYPERTENSIONAHA.121.17102.) • Supplemental Material

**Key words:** adult ■ calcium channel blockers ■ diuretics ■ hypertension ■ thiazide

In the United States, prevalent hypertension is greater, control lower, and clinical complications higher in Black than White adults.1–3 Racial disparities in clinical events from hypertension are significantly mitigated by better blood pressure (BP) control.4,5 In 2014, the Panel Members Appointed to the Eighth Joint National Committee on High BP Report (2014 aJNC8 Report) recommended initial antihypertensive treatment with a thiazide-type diuretic (TTD) or calcium channel blocker (CCB) in the general Black population (Grade B), including those with diabetes (Grade C). Subsequently, the National Heart Lung and Blood Institute designated successor panel in the 2017 American College of Cardiology/American Heart Association (ACC/AHA) High Blood Pressure Clinical Practice Guideline recommended TTDs and CCBs as initial therapy in Black adults without heart failure or chronic kidney disease, including those with diabetes (Class I). TTDs, CCBs, and renin-angiotensin system blockers...
blockers (RASBs) were recommended for other adults with hypertension (Class 1).2,3.

These recommendations were based on data from randomized trials including the 33 357 total and 11 792 Black participants in the ALLHAT (Antihypertensive and Lipid Lowering to Prevent Heart Attack Trial).5 As single medications and selected combinations, TTDs and CCBs reduced BP and cardiovascular events more in Black adults than ACE (angiotensin-converting enzyme) inhibitor-based therapy, a difference not seen in non-Black adults.1–3,6–8 Of note, the second antihypertensive medication in ALLHAT was a \( \beta \)-blocker for approximately one-third of all adults and 26% of Black participants uncontrolled on initial monotherapy.7 Both RASB and \( \beta \)-blockers are long recognized as less effective monotherapy options than CCBs and TTDs in Black adults. Nevertheless, later trials confirmed that differences in BP responses to suboptimal initial therapy were not overcome with add-on therapy\(^9,10\) and led to disparate cardiovascular outcomes.10 A plurality of adults with uncontrolled hypertension reports taking monotherapy, which is consistent with therapeutic inertia.11 This study assessed the temporal relationship of self-reported CCB or TTD monotherapy in non-Hispanic Black (NHB) adults with hypertension absent compelling indications for RASB or \( \beta \)-blockers to the 2014 aJNC8 Report and 2017 ACC/AHA High BP Guideline. Given persistence of suboptimal clinical practice\(^12,13\) and the value of prompt BP reduction,\(^14,15\) selecting effective initial therapy is important,\(^1–3,6–10\) while renewed efforts promote higher quality care.\(^16\)

**Nonstandard Abbreviations and Acronyms**

| Abbreviation | Description                                     |
|--------------|-------------------------------------------------|
| ACC          | American College of Cardiology                  |
| ACE          | angiotensin-converting enzyme                    |
| AHA          | American Heart Association                      |
| ALLHAT       | Antihypertensive and Lipid Lowering to Prevent Heart Attack Trial |
| ARB          | angiotensin receptor blocker                     |
| CCB          | calcium channel blocker                          |
| NHANES       | National Health and Nutrition Examination Survey |
| NHB          | non-Hispanic Black                               |
| RASB         | renin-angiotensin system blocker                 |
| SPC          | single-pill combination                          |
| TTD          | thiazide-type diuretic                           |

**What Is New?**

- Self-reported calcium channel blocker monotherapy rose among non-Hispanic Black adults with hypertension in 2015 to 2018 following the 2014 aJNC8 Report and 2017 American College of Cardiology/American Heart Association High BP Guideline recommendations for these changes, yet hypertension control declined as untreated hypertension and monotherapy increased.

**What Is Relevant?**

- Race-informed initial monotherapy in non-Hispanic Black adults appears insufficient to improve hypertension control.

**Summary**

In addition to addressing adverse structural determinants, greater use of initial single-pill combinations and timely intensification of antihypertensive medications when initial therapy fails to control blood pressure may improve hypertension control in NHB adults.

**METHODS**

Anonymized data and materials are publicly available from the National Center for Health Statistics and can be accessed at the Centers for Disease Control and Prevention Website.

**Participants**

National Health and Nutrition Examination Surveys (NHANES) are conducted by the Centers for Disease Control and Prevention, National Center for Health Statistics, with informed consent.17 NHB adults are oversampled relative to NHW adults to provide more stable estimates for the former group. Given study objectives, only self-identified NHB and NHW adults were included with treated hypertension who were 18 years and older in the 3 2-year cycles of NHANES before the 2014 aJNC8 Report, that is, 2007 to 2008 through 2011 to 2012, and 2 2-year cycles following 2014, that is, 2015 to 2016 and 2017 to 2018.

BP (mm Hg) was measured by trained professionals using sphygmomanometer and appropriately sized arm cuffs in participants after 5 minutes seated rest. The first BP was excluded in estimating mean systolic and diastolic values for individuals with >1 value as recommended in NHANES procedure manuals.18 Hypertension was defined as systolic BP \( \geq 140 \), or diastolic BP \( \geq 90 \), or self-reported use of prescription medications to lower BP in the previous 30 days, that is, treated hypertension.18 Treatment effectiveness was defined as the percentage of adults on treatment who attained control. Hypertension control was defined as systolic BP <140 and diastolic BP <90.

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Antihypertensive medications were identified by patients’ reporting drugs taken in the prior 30 days and confirmed by medication bottles at the examination. Antihypertensive medications were classified according to the 2003 JNC7 Report and 2017 ACC/AHA High BP Guideline including ACEI, angiotensin receptor blocker (ARB), β-blocker, dihydroprinidine CCB, nondihydropyridine CCB, TTD, loop diuretic, aldosterone antagonist (Aldo antag), potassium sparing diuretic, and other. When determining the number of medications for each participant, those in the same class were counted once. For some analyses, ACEI, ARB, and direct renin inhibitors were combined as RASBs.

The following analytic variables were assessed including:

- Body mass index (kg/m²). Obesity was defined by body mass index ≥30.
- Diabetes was defined by fasting glucose ≥126 mg/dl, glycated hemoglobin ≥6.5%, self-reported diagnosis of diabetes or medications to treat diabetes in the past 30 days.
- Myocardial infarction, congestive heart failure, and stroke were defined by participant’s endorsing a physician told them they had one or more of these events.
- Chronic kidney disease was defined by an estimated glomerular filtration rate <60 mL/1.73 m² per minute or urine albumin >300 mg/d.
- Income was assessed by the ratio of income to federal poverty level from data for each NHANES 2-year cycle. Data to calculate income were missing on 729 subjects and missing values were not imputed. Given substantial missing data, income was not included in the primary multivariable adjustments but was included in sensitivity analysis.
- Education was assessed by self-report and classified as less than high school, high school completion, or at least some college.
- Linkage to health care was defined by affirmative responses to health insurance, a usual source of care, and one or more health care visits annually.

**Data Analysis**

SAS 9.4 (Cary, NC) survey procedures were used for within survey analyses employing sample weights recommended in the NHANES analytic guidelines to provide results representative of the NHB and NHW noninstitutionalized civilian population. NHANES reporting guidelines were followed. To compare NHW to NHW adults, data for 2007 to 2008 through 2011 to 2012 and data for 2015 to 2016 and 2017 to 2018 were pooled. The pooled data for 2007 to 2012 and 2015 to 2018 were analyzed separately or time period was included as an indicator in multivariate analysis. Comparisons were performed using the Rao-Scott χ² test for categorical variables and the F-test for continuous variables. Multivariate logistic models were used to estimate the odds ratios of race and ethnicity associated with self-reported use of various antihypertensive medication classes. Crude, age-adjusted and fully adjusted models (age, sex, obesity, diabetes, education, linkage to care, and time-period) were employed with addition of federal poverty level in a sensitivity analysis. A potential interaction between race and time period on BP drug class(es) was assessed. P≤0.05 were accepted as significant.

**RESULTS**

The process is shown for deriving the study sample of 5902 NHB and NHW adults with treated hypertension from the total sample of 30,467 adults during 2007 to 2008 through 2011 to 2012 and 2015 to 2016, 2017 to 2018 (Figure 1).

Descriptive characteristics of the study population are provided for the 2 time periods before and after the 2014 aJNC8 Report (Table 1). Differences by race and ethnicity were generally similar for the 2 time periods. NHB adults were younger and the proportion of females greater than NHW adults. NHB adults had lower incomes and educational attainment than NHW adults. More NHW than NHB adults reported having a myocardial infarction. The prevalence of diabetes was greater and systolic and diastolic BP were higher in NHB than NHW adults.

NHB adults reported taking more antihypertensive medications than NHW adults. In both time periods, there were no racial differences in self-reported ACEI, ARB, nondihydropyridine CCB, loop diuretic, or aldosterone antagonist use, β-blocker use was greater in NHW than NHB adults, whereas dihydropyridines CCBs, TTD, and other antihypertensive medication classes were reported more often by NHB than NHW adults.

Percentages of various antihypertensive medication classes are reported for all NHB and NHW adults on monotherapy and subdivided by presence or absence of compelling indications for β-blockers or RASBs (Table 2/Figure 2). During 2007 to 2012 and 2015 to 2018, CCB or TTD monotherapy was greater for NHB than NHW adults with and without compelling indications. Self-reported β-blocker monotherapy in both time periods was greater in NHW than NHB adults with and without compelling indications. RASB monotherapy was similar.

Among NHB adults without compelling indications, TTD or CCB monotherapy showed a nonsignificant increase from 38.2% in 2007 to 2012 to 43.7% in 2015 to 2018 (P=0.204) but did not change in NHW adults (P=0.711). As monotherapies, CCBs increased, TTDs did not change, and RASBs declined in NHB adults. β-blocker monotherapy increased in NHW adults.

The relationship between race and medication class for adults on monotherapy was expressed as odds ratios and 95% CIs with NHW adults as the reference group (Table 3). Among all adults on monotherapy and those without compelling indications for β-blockers or RASBs, NHB adults were more likely than NHW adults to report TTDs and CCBs and less likely to report β-blockers and RASB in adjusted, age-adjusted, and fully adjusted regression models. Adding federal poverty level as a covariate to the fully adjusted model among all adults did not significantly alter results. Among adults with compelling indications for β-blockers or RASB, NHB adults
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were more likely to report taking CCBs and TTDs and less likely to report taking β-blockers and RASBs than NHW adults in the unadjusted, age-adjusted, and fully adjusted analyses. There were no significant interactions between race and time-period for any of the 4 monotherapies ($P > 0.20$; data not shown).

Among adults that self-reported taking one of 3 dual antihypertensive drug regimens studied in the comparison of 3 combination therapies in lowering BP in Black Africans (CREOLE) study,26 NHBs were more likely to report taking a CCB-TTD and a RASB-CCB combination than NHW adults in unadjusted and adjusted models (Table 4). Self-reported RASB-TTD combination therapy was similar in NHB and NHW adults.

Table S1 summarizes recommendation for initial pharmacotherapy of hypertension in NHB adults and initial combination drug therapy irrespective of race sequentially from the 1980 JNC Report to the 2017 ACC/AHA High BP Guideline.

Table S2, which includes diabetes with compelling indications, is similar to Table 2 (monotherapy) and Table S2 (2 or 3 BP medications) except that diabetes mellitus was grouped with compelling indications for drug classes β-blockers or RASB. Results were directionally similar to Table 2 and Table S2, except for lower percentages of NHB and NHW adults reporting CCBs and TTDs and higher percentages reporting β-blockers and RASB. Racial differences in medication classes reported were also similar to Table 2 and Table S2.

Among adults without compelling indications on 2 or 3 BP medications, NHB adults were more likely to report taking CCBs or TTDs and less likely to report taking β-blockers than NHW adults (Table S3). In adults with compelling indications reporting 3 medications, NHB adults were less likely to report taking β-blockers than NHW adults in 2007 to 2012.

Among adults on 2 BP medications irrespective of compelling indications, NHB adults were less likely to report β-blockers and more likely to report CCBs than NHWs with and without adjustment for confounders (Table S4). Of adults on 3 BP meds, NHB adults were less likely to report β-blockers irrespective of compelling indications and more likely to report CCBs without compelling indications than NHW adults with and without adjustment for confounders.

**Two-Drug Antihypertensive Regimens**

For NHB adults, the top 6 combinations all included a CCB or TTD and the fourth had both a CCB and diuretic Table S5. Of the top 7 regimens for NHW adults, 5 included a CCB or TTD and 2 included neither of these 2 classes but rather a β-blocker and either ACEI (second) or ARB (fourth).

**Three-Drug Antihypertensive Regimens**

ACEI-CCB-TTD and ARB-CCB-TTD combinations were the first and the second most often reported triple-therapy regimens in NHBs, but sixth and tenth, respectively, in NHW. In NHW adults, the ACEI or ARB-β-blocker-diuretic combination were the first and second the most common 3-drug regimen, respectively.

**DISCUSSION**

Non-Hispanic Black adults with hypertension but without compelling indications for RASBs or β-blockers
reported taking CCB monotherapy more often and RASB monotherapy less often in 2015 to 2018 than 2007 to 2012. Although the majority of NHB adults on monotherapy absent compelling indications were not taking recommended CCBs or TTDs, the increase in CCB and decrease in RASB monotherapy would not have been expected to significantly reduce hypertension control as observed during 2015 to 2018.\(^{1–3,6,7}\) Y et, hypertension control fell across race-ethnicity and age groups during 2015 to 2018 compared with 2009 to 2014.\(^{18,27}\) The fall in hypertension control reflected an increase in untreated hypertension and monotherapy, despite a rise in obesity and diabetes that typically require more antihypertensive medication to attain control.\(^{11}\) These observations suggest worsening therapeutic inertia,\(^{18,28}\) which coincides with the decline in treatment effectiveness, that is, fewer adults treated for hypertension attained control.

Current monotherapy options are insufficient to control BP in most adults with hypertension.\(^{29–31}\) Moreover, the mean return visit interval is roughly 14 weeks for adults with uncontrolled hypertension in the United States.\(^{12}\) Of further concern, antihypertensive medication is added on only about 1 in 7 visits when BP is uncontrolled.\(^{12}\) Thus, selection of effective initial monotherapy is an important intermediate step, while quality improvement initiatives focus on improving initial single-pill combination therapy and reducing delays in follow-up and appropriate treatment intensification.

### Table 1. Selected Characteristics of Adults With Treated Hypertension by Race

|                  | NHANES 2007–2008, 2009–2010, 2011–2012 | P value | NHANES 2015–2016, 2017–2018 | P value |
|------------------|----------------------------------------|---------|-----------------------------|---------|
| NHANES, n        | 1323                                   |         | 874                         |         |
| Pop est., n      | 7389364                                |         | 5441500                     |         |
| Age, y           | 57.2                                   | <0.0001 | 58.7 (57.4–60.0)            | <0.0001 |
| Sex, F (%)       | 61.7                                   | <0.0001 | 60.3 (57.4–63.2)            | 0.0006  |
| Income: FPL      | 2.4 (2.3–2.6)                          | <0.0001 | 2.5 (2.3–2.7)               | <0.0001 |
| BMI, kg/m²       | 33.2                                   | <0.0001 | 32.6 (32.0–33.2)            | 0.0023  |
| Diabetes, %      | 38.1                                   | <0.0001 | 35.4 (31.9–38.8)            | 0.011   |
| MI, %            | 6.3 (5.2–7.4)                          | <0.0001 | 6.7 (5.3–8.1)               | 0.0002  |
| CHF, %           | 7.5 (5.9–9.1)                          | 0.9346  | 9.1 (6.4–11.7)              | 0.2913  |
| CKD, %           | 18.7                                   | 0.1951  | 175 (14.2–20.7)             | 0.1666  |
| SBP, mm Hg       | 132.3 (130.9–133.7)                    | <0.0001 | 136.4 (134.7–138.0)         | <0.0001 |
| DBP, mm Hg       | 73.4 (72.2–74.5)                       | <0.0001 | 73.7 (72.2–75.3)            | 0.0001  |
| BP <140/<90, %   | 64.6 (62.0–67.2)                       | <0.0001 | 59.6 (56.4–62.8)            | <0.0001 |
| BP Med, n        | 2.1 (2.0–2.2)                          | <0.0001 | 1.9 (1.8–2.0)               | 0.0005  |
| ACE inhibitor, % | 40.9 (37.2–44.6)                       | 0.8503  | 25.5 (21.1–29.9)            | 0.6117  |
| ARB, %           | 24.2 (20.7–27.8)                       | 0.6337  | 28.5 (25.1–32.0)            | 0.9731  |
| β-blocker, %     | 31.2 (27.8–34.5)                       | <0.0001 | 32.3 (28.9–35.8)            | <0.0001 |
| dCCB, %          | 32.5 (29.7–35.4)                       | <0.0001 | 36.5 (32.1–40.9)            | <0.0001 |
| ndCCB, %         | 6.1 (4.5–7.8)                          | 0.0774  | 4.8 (2.9–6.8)               | 0.6367  |
| TTD, %           | 44.1 (41.1–47.0)                       | <0.0001 | 38.1 (34.2–42.1)            | <0.0001 |
| Loop, %          | 10.2 (8.6–11.8)                        | 0.6622  | 9.7 (7.3–12.1)              | 0.5826  |
| Aldo antag, %    | 3.3 (2.4–4.2)                          | 0.244   | 3.5 (1.9–5.2)               | 0.7756  |
| K+-sparing, %    | 6.8 (5.1–8.5)                          | 0.1031  | 4.2 (2.5–5.9)               | 0.0401  |
| Other, %         | 9.5 (7.8–11.1)                         | 0.0113  | 11.4 (9.6–13.1)             | <0.0001 |

Data are means or relative frequency and 95% CI. ACE indicates angiotensin-converting enzyme; Aldo Antag, aldosterone antagonist; ARB, angiotensin receptor blocker; BMI, body mass index; BP, blood pressure; Care Link, Linkage to health care (health insurance, usual source of care, ≥1 health care visit past year); CKD, chronic kidney disease; D, diastolic; dCCB, dihydropyridine calcium channel blocker; DBP, diastolic blood pressure; F, female; Income FPL, income to federal poverty level ratio (missing data on 729 participants); K+, potassium sparing; MI, myocardial infarction; nd, nondihydropyridine; NHANES, National Health and Nutrition Examination Survey; NHB, non-Hispanic Black; NHW, non-Hispanic White; Pop est, population estimate; SBP, systolic BP; and TTD, thiazide-type diuretic.
NHB adults were more likely than their NHW counterparts to report taking CCBs or TTD monotherapy in 2007 to 2012 and 2015 to 2018. The findings suggest clinicians considered evidence that CCBs and TTDs were more effective than RASB and β-blocker monotherapy in NHB adults pre-2014. The delay between guideline publication and clinical implementation is often a decade or longer. The 2014 aJNC8 Report and 2017 ACC/AHA High BP Guideline recommending CCBs or TTDs as initial therapy for hypertension in NHB adults, are temporally associated with greater use of CCBs. Yet, the increase in CCB monotherapy during 2015 to 2018 could also reflect impact of the 2003 JNC7 or earlier JNC Reports and the 2010 Update on High BP in Blacks. Initial SPCs were an efficient means to achieve this goal irrespective of race. Support for initial SPC therapy includes evidence that a plurality of treated adults with uncontrolled hypertension is on antihypertensive monotherapy. Individuals started on monotherapy are much less likely to receive combination therapy 3 years after treatment initiation than those begun on combination therapy. Moreover, initial combination as compared with monotherapy facilitates more timely hypertension control and higher rates of control. Other evidence links SPCs to better cardiovascular outcomes than initial monotherapy or the same medication classes as separately pills.

Our study also assessed antihypertensive medication classes reported by adults on combination therapy. In fact, most adults begun on monotherapy and many initiated on combination therapy require additional antihypertensive medications. Combining a CCB or TTD with a RASB or β-blocker essentially eliminates racial differences in BP responses seen with RASB or β-blocker monotherapy. For NHB adults taking 2 antihypertensive medications, a CCB or TTD with a RASB or β-blocker was included in 6 of the 7 most common regimens and a CCB and TTD was fourth most common. The TTD-CCB and CCB-RASB combinations, which were more effective than a TTD-RASB combination in Black adults, were more often reported by NHB adults with hypertension, especially in Black adults. That recommendation reflected the fact that most adults, especially Black adults, require combination therapy to attain control, and was not made in the context of initial therapy.

The European Hypertension Guidelines approach was predicated on evidence that a 10 mm Hg or greater decline in systolic BP reduced cardiovascular morbidity and mortality consistently across age, sex, and race and ethnicity groups. Initial SPCs were an efficient means to achieve this goal irrespective of race. Support for initial SPC therapy includes evidence that a plurality of treated adults with uncontrolled hypertension is on antihypertensive monotherapy. Individuals started on monotherapy are much less likely to receive combination therapy 3 years after treatment initiation than those begun on combination therapy. Moreover, initial combination as compared with monotherapy facilitates more timely hypertension control and higher rates of control. Other evidence links SPCs to better cardiovascular outcomes than initial monotherapy or the same medication classes as separately pills.

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than NHW adults in this study. In NHW adults, ACEI-β-blocker and ARB-β-blocker combinations, which often have less than additive antihypertensive effects,1–3,19 were the second and fourth most common 2-drug combinations, respectively. In 3 medication regimens, the RASB-β-blocker-TTD combination was more commonly reported by NHW than NHB adults, while RASB-CCB-TTD combination, which is recommended and effective,1–3,19 was more often reported by NHB than NHW adults. Despite opportunities for improvement, clinicians seem to be prescribing effective combination antihypertensive therapy for many NHB adults they serve.

For clinicians committed to race-conscious health care as a pathway to health equity,37,38 there is compelling rationale for initial SPCs, recognizing that in the United States, many SPCs under-dose hydrochlorothiazide, few SPCs contain chlorthalidone, and none contain indapamide. In the Systolic Blood Pressure Intervention Trial where chlorthalidone was the recommended TTD, no difference in BP control was noted between Black, White, or Hispanic adults, even in the <120 mm Hg treatment arm.39 Biochemical and genetic test-guided options for selecting effective monotherapy exist but will not eliminate the need for combination therapy in most adults.40–42

The growing resistance to race-based guidelines reflects the definition of race as a social construct and not a biological construct.47–49 There is growing agreement that health equity requires addressing social determinants including housing and neighborhood safety, clean water and air, healthy food and excellent education, well-paying job opportunities, and readily available and culturally appropriate clinical care.43–46 In fact, a theoretical link exists between adverse social determinants and lesser efficacy of RASB monotherapy in NHB adults. A higher allostatic load in NHB adults, partly reflecting adverse neighborhood characteristics, is linked with accelerated aging and hypertension.51–53 Aging contributes to salt-sensitive hypertension more responsive to CCBs or TTDs than RASB.1–3,33,54–55 Structural racism may reduce diet quality and potassium intake,43–46,56,57 enhancing salt sensitivity57,58 and increasing psychological stress linked with sodium retention.59 Potassium supplements in Black adults lessen racial differences in plasma renin and salt sensitivity.60,61

Advocates for removing race from evidence-based guidelines have stated that race-based care perpetuates health disparities.43–46 This does not seem appropriate currently for initial antihypertensive monotherapy1–3,6–8,62–67 given well-documented delays in follow-up and treatment intensification when hypertension is uncontrolled.12 For clinicians who remain committed to initial monotherapy, some biochemical and genetic-guided options exist but may not be routinely available or affordable.40–42 Until better and widely available predictors of risk and treatment

**Table 1.** Differences in the frequencies of various antihypertensive medication classes in NHW and NHB adults on monotherapy without indications for drug classes other than calcium channel blockers (CCBs) and diuretics. P-value for group and time-period comparisons in Figure 2. RASB indicates renin-angiotensin system blocker.

![Figure 2. The percentages of non-Hispanic Black (NHB) and non-Hispanic White (NHW) adults with pharmacologically treated (Rx) hypertension that self-reported various classes of antihypertensives as monotherapy in 2007 to 2012 and 2015 to 2018 are shown.](image)
outcomes are documented, exclusion of all data by race seems ill-advised for clinicians committed to beginning antihypertensive treatment with monotherapy. In addition, better definition of specific social determinants influencing risk and outcomes by race and the social efforts to effectively address them are obviously indicated.

Limitations of our analysis include repeated cross-sectional, single time-point sampling of the US civilian population for NHANES, that is, longitudinal implications are derived. The study design does not provide clear information on relative antihypertensive effectiveness of various medication classes or combinations. Race and ethnicity are obtained by self-report and not independently validated. Medications taken in the past 30 days are determined by self-report and examination of pill bottles and serve as a proxy for clinician prescribing. Comorbid conditions including heart disease are determined by self-report, which could lead to errors. The NHANES database does not identify who began antihypertensive therapy with >1 medication, either as SPCs or separate pills. Untreated hypertension increased during 2015 to 2018 in all adults combined, although the decline was statistically significant in NHW but not NHB adults. However, differences in untreated hypertension by age and other sociodemographic characteristics within racial group were not addressed in this article.

### Table 3. Crude and Adjusted ORs (95% CI) for NHB adults and Associations With Antihypertensive Monotherapy Drug Class in the Prior 30 d Stratified by Presence or Absence of Compelling Indications for Medications Other Than CCBs or Diuretics

| 1 BP medication (monotherapy) | RASB | β-B | CCB | TTD |
|-------------------------------|------|-----|-----|-----|
| All adults (with and without compelling indications for RASB or β-blocker) | | | | |
| NHW (reference)               | 1.0  | 1.0 | 1.0 | 1.0 |
| Crude OR                      | 0.76 (0.6–1.0)* | 0.37 (0.3–0.5)* | 3.23 (2.5–4.2)* | 2.14 (1.6–2.9)* |
| Age-adjusted OR               | 0.72 (0.6–0.9)* | 0.39 (0.3–0.5)* | 3.91 (2.9–5.3)* | 2.10 (1.6–2.8)* |
| Fully adjusted OR             | 0.65 (0.5–0.8)* | 0.44 (0.3–0.6)* | 4.01 (2.9–5.6)* | 2.35 (1.7–3.2)* |
| No compelling indication for RASB or β-blocker | | | | |
| NHW (reference)               | 1.0  | 1.0 | 1.0 | 1.0 |
| NHB                           | | | | |
| Crude OR                      | 0.71 (0.5–0.9)* | 0.39 (0.3–0.5)* | 3.29 (2.4–4.5)* | 2.01 (1.4–2.9)* |
| Age-adjusted OR               | 0.69 (0.5–0.9)* | 0.39 (0.3–0.5)* | 3.93 (2.8–5.5)* | 2.06 (1.5–2.9)* |
| Fully adjusted OR             | 0.60 (0.5–0.8)* | 0.45 (0.3–0.6)* | 3.91 (2.7–5.6)* | 2.41 (1.7–3.4)* |

BP indicates blood pressure; CCB, calcium channel blocker; CKD, chronic kidney disease; MI, myocardial infarction; NHANES, National Health and Nutrition Examination Survey; NHB, non-Hispanic Black; OR, odds ratio; RASB, renin-angiotensin system blocker; and TTD, thiazide-type diuretic.

*Statistically significant odds ratios.
†Fully adjusted model includes age, sex, obesity, diabetes, education, linkage to care, NHANES time period.
‡Fully adjusted model include age, sex, obesity, diabetes, education, linkage to care, NHANES time period, and income-to-federal poverty level ratio.

### Table 4. Odds Ratios for Reporting 2 BP Medication Regimens in CREOLE in NHB Adults in NHANES 2007 to 2012 and 2015 to 2018 Combined

| 1 BP Medication Regimen | RASB+TTD | CCB+TTD | RASB+β-B |
|-------------------------|----------|---------|---------|
| All adults (with and without compelling indications for RASB or β-blocker) | | | |
| NHW (reference)         | 1.0      | 1.0     | 1.0     |
| Crude OR                | 2.45 (1.6–3.8)* | 1.21 (1.0–1.5) | 1.49 (1.1–2.0)* |
| Age-adjusted OR         | 2.42 (1.5–3.9)* | 1.04 (0.8–1.3) | 1.53 (1.1–2.1)* |
| Fully adjusted OR       | 2.46 (1.5–4.0)* | 1.06 (0.8–1.3) | 1.49 (1.1–2.1)* |

Data are reported as odds ratios (OR) and 95% CI. BP indicates blood pressure; CCB, calcium channel blocker; CKD, chronic kidney disease; MI, myocardial infarction; NHANES, National Health and Nutrition Examination Survey; NHB, non-Hispanic Black; OR, odds ratio; RASB, renin-angiotensin system blocker; and TTD, thiazide-type diuretic.

*Statistically significant odds ratios.
†Fully adjusted model includes age, sex, obesity, diabetes, education, linkage to care, NHANES time period.
‡Fully adjusted model include age, sex, obesity, diabetes, education, linkage to care, NHANES time period, and income-to-federal poverty level ratio.

### PERSPECTIVE

NHB adults seem to have a greater antihypertensive response and better cardiovascular outcomes when treatment is initiated with CCB or TTD than RASB monotherapy. Clinical trial observations led to recommendations...
for CCBs and TTDs as preferred initial monotherapy for hypertension in NHBs since 2014. The percentage of NHB adults with hypertension absent compelling indications who self-reported taking CCB monotherapy increased during 2015 to 2018; yet, the majority did not report taking either a CCB or TTD. Despite the increase in CCB monotherapy, hypertension control declined among NHB and other adults in 2015 to 2018 as untreated hypertension and monotherapy rose, and treatment effectiveness fell. Given persistence of initial monotherapy, infrequent follow-up and treatment intensification, selecting more effective initial monotherapy is important, while quality improvement efforts focus on optimizing clinical care for uncontrolled hypertension. Concurrent efforts to better understand and address adverse social and structural determinants that lead to suboptimal health care and clinical outcomes are important in the quest for equity in hypertension control.

**ARTICLE INFORMATION**

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