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## CARDIOVASCULAR DISEASE AND MORTALITY IN ADULTS AGED 60 YEARS ACCORDING TO RECOMMENDATIONS BY THE ACC/AHA AND ACP/AAFP

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### Abstract

In 2017, the American College of Cardiology/American Heart Association (ACC/AHA) and the American College of Physicians/American Academy of Family Physicians (ACP/AAFP) published blood pressure (BP) guidelines. Adults recommended antihypertensive medication initiation or intensification by the ACP/AAFP guideline receive the same recommendation from the ACC/AHA guideline. However, many adults 60 years old are recommended to initiate or intensify antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline. We compared atherosclerotic cardiovascular disease event rates according to antihypertensive treatment recommendations in the ACC/AHA and ACP/AAFP guidelines among adults 60 years old with systolic BP 130 mmHg or diastolic BP 80 mmHg in the REasons for Geographic And Racial Differences in Stroke study and the Jackson Heart Study. Among 4,311 participants not taking antihypertensive medication at baseline, 11.4%, 61.2%, and 27.4% were recommended

antihypertensive medication initiation by neither guideline, the ACC/AHA but not the ACP/AAFP guideline, and both guidelines, respectively. Atherosclerotic cardiovascular disease event rates (95% confidence interval) for these groups were 3.4 (1.6,5.2), 18.0 (16.1,19.8), and 25.3 (21.9,28.6) per 1,000 person-years, respectively. Among 7,281 participants taking antihypertensive medication at baseline, 57.9% and 42.1% were recommended antihypertensive medication intensification by the ACC/AHA but not the ACP/AAFP guideline and both guidelines, respectively. Atherosclerotic cardiovascular disease event rates (95% confidence interval) for these groups were 18.2 (16.7,19.7) and 33.0 (30.5,35.4) per 1,000 person-years, respectively. In conclusion, adults recommended initiation or intensification of antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline have high atherosclerotic cardiovascular disease risk that may be reduced through treatment initiation or intensification.

## Keywords

antihypertensive agents; blood pressure; coronary heart disease; hypertension; stroke

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In March 2017, the American College of Physicians (ACP) and the American Academy of Family Physicians (AAFP) published a guideline for the treatment of hypertension in adults 60 years of age.<sup>1</sup> Initiation of antihypertensive medication is recommended by the ACP/AAFP guideline for adults 60 years of age with systolic blood pressure (SBP) 150 mm Hg or with SBP 140 mm Hg among those with high cardiovascular risk based on an individualized assessment (e.g., based on the presence of diabetes, known vascular disease, prior stroke or transient ischemic attack, metabolic syndrome, chronic kidney disease [CKD], or for older adults). For adults 60 years of age taking antihypertensive medication, treatment intensification is recommended to achieve an SBP goal < 150 mm Hg (<140 mm Hg for those with high cardiovascular risk).

In November 2017, the American College of Cardiology (ACC) and the American Heart Association (AHA) published a guideline for classification of blood pressure (BP) and treatment of high BP in adults of all ages, including those 60 years of age.<sup>2</sup> Initiation of antihypertensive medication is recommended by the ACC/AHA guideline for adults with SBP 140 mm Hg or diastolic BP (DBP) 90 mm Hg. Additionally, initiation of antihypertensive medication is recommended for adults with SBP of 130 to 139 mm Hg or DBP of 80 to 89 mm Hg who have high cardiovascular risk (i.e., those with a history of cardiovascular disease [CVD], a 10-year predicted atherosclerotic CVD [ASCVD] risk 10%, diabetes, CKD, or age 65 years with an SBP 130 mm Hg). Treatment intensification is recommended to achieve an SBP goal < 130 mm Hg with a DBP goal < 80 mm Hg also recommended for all adults < 65 years of age and those 65 years of age with high CVD risk.

All adults recommended antihypertensive medication initiation or intensification by the ACP/AAFP guideline are also recommended treatment initiation or intensification by the ACC/AHA guideline. However, based on differences in the ACC/AHA and ACP/AAFP guidelines, many adults 60 years of age may be recommended to initiate or intensify antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline.<sup>3</sup> In the

current study, we determined the percentage of adults  $\geq 60$  years of age for whom initiation or intensification of antihypertensive medication is recommended by neither the ACC/AHA nor the ACP/AAFP guideline, by the ACC/AHA but not the ACP/AAFP guideline, and by both guidelines. Additionally, we estimated the rates of ASCVD events and all-cause mortality among adults  $\geq 60$  years of age in these three groups. To accomplish these aims, we analyzed data from the REasons for Geographic And Racial Differences in Stroke (REGARDS) study and the Jackson Heart Study (JHS).<sup>4, 5</sup>

## METHODS

Requests to access the dataset from qualified researchers trained in human subject confidentiality protocols may be submitted to the REGARDS and JHS executive committees at <https://www.jacksonheartstudy.org> and <http://regardsstudy.org>, respectively.

### Study Populations

The REGARDS study was designed to investigate reasons underlying the higher rate of stroke mortality among blacks compared with whites, and among residents of the Southeastern US compared with other US regions.<sup>4</sup> A total of 30,239 adults from all 48 contiguous US states and the District of Columbia were enrolled between January 2003 and October 2007. The JHS is a population-based prospective cohort study designed to examine the etiology of CVD and related risk factors among blacks.<sup>5</sup> For the JHS, 5,306 black adults were recruited from the Jackson, Mississippi metropolitan area between 2000 and 2004. We excluded participants from each study who were [1]  $< 60$  years of age, [2] had SBP  $< 130$  mm Hg and DBP  $< 80$  mm Hg or [3] were missing data on antihypertensive medication use, BP, or other variables used to determine high CVD risk according to the ACC/AHA or ACP/AAFP guideline. Participants with SBP  $< 130$  mm Hg and DBP  $< 80$  mm Hg were excluded because no adults with BP in this range are recommended initiation or intensification of antihypertensive medication by either the ACC/AHA guideline or the ACP/AAFP guideline. After these exclusions, data were available from 11,682 participants (n=10,616 REGARDS participants and n=1,066 JHS participants) for the current analysis (Figure S1 and Figure S2, respectively). Conduct of the REGARDS study and JHS were approved by institutional review boards at the participating institutions and conduct of the current analysis was approved by the institutional review board at the University of Alabama at Birmingham. All participants provided written informed consent at baseline.

### Study Variables

Information on age, sex, race, education, cigarette smoking, and history of myocardial infarction or stroke was collected at baseline by self-administered questionnaire for JHS participants and by computer-assisted telephone interviews for REGARDS study participants. Height and weight were measured during each study's baseline visit and used to calculate body mass index (BMI). Blood and urine specimens collected at each study's baseline visit were used to measure total and high-density lipoprotein (HDL) cholesterol, serum creatinine, serum glucose, and urinary albumin-to-creatinine ratio (ACR).<sup>6-9</sup> Estimated glomerular filtration rate (eGFR) was calculated using the Chronic Kidney Disease Epidemiology Collaboration equation.<sup>10</sup> Albuminuria was defined as an ACR  $\geq 30$

mg/g. Diabetes was defined as a fasting serum glucose  $\geq 126$  mg/dL, non-fasting serum glucose  $\geq 200$  mg/dL, or self-report of a prior diagnosis with glucose-lowering medication use (insulin or oral hypoglycemic medication).<sup>11</sup> Glycosylated hemoglobin A1c (HbA1c) was measured in the JHS and participants with HbA1c  $\geq 48$  mmol/mol ( $\geq 6.5\%$ ) were considered to have diabetes. In both studies, participants completed an electrocardiogram during the baseline study visit. A history of CVD was defined as a history of stroke, heart failure, or myocardial infarction at baseline. REGARDS study participants with a history of coronary revascularization were also considered to have a history of CVD. Coronary revascularization was not assessed at baseline in the JHS. For participants without a history of CVD, 10-year predicted ASCVD risk was calculated using the Pooled Cohort risk equations.<sup>12</sup>

### **Blood Pressure Measurement**

In both the REGARDS study and the JHS, each participant had their SBP and DBP measured twice after a 5 minute seated rest. BP was measured using an aneroid sphygmomanometer (American Diagnostic Corporation, Hauppauge, NY) in the REGARDS study and using a Hawksley random-zero sphygmomanometer (Hawksley and Sons Ltd, Lancing, UK) in JHS. As previously described, the random-zero BP measurements in JHS were calibrated to an oscillometric device using robust regression.<sup>13</sup>

### **Hypertension Guideline Recommendations**

Recommendations for initiation or intensification of antihypertensive medication were defined according to the ACC/AHA and ACP/AAFP guidelines (Figure 1). Participants not taking antihypertensive medication at baseline were categorized into one of three mutually exclusive treatment initiation groups: those recommended initiation of antihypertensive medication by [1] neither guideline, [2] the ACC/AHA but not the ACP/AAFP guideline, or [3] both guidelines. Participants taking antihypertensive medication at baseline were categorized into one of three mutually exclusive treatment intensification groups: those who were recommended intensification of antihypertensive medication by [1] neither guideline, [2] the ACC/AHA but not the ACP/AAFP guideline, or [3] both guidelines. As only 66 participants with SBP  $\geq 130$  mm Hg or DBP  $\geq 80$  mm Hg taking antihypertensive medication were not recommended for intensification of antihypertensive medication by either guideline, this group was not analyzed.

### **ASCVD Events and All-Cause Mortality**

The primary outcome for the current study was ASCVD, defined by a stroke or coronary heart disease during follow-up. Descriptions of the adjudication process in the REGARDS study and JHS have been published.<sup>6,14,15</sup> Participants or their proxies were contacted to identify hospitalizations and possible ASCVD events at 6-month intervals in the REGARDS study and annually in the JHS. When potential events were identified, medical records were retrieved and events were adjudicated by trained physicians. All-cause mortality was evaluated as a secondary outcome. Deaths were detected by reports from next of kin, the National Death Index, or through online resources (e.g., Social Security Death Index). Follow-up for the current analysis was available through December 31, 2014 for REGARDS study participants and December 31, 2012 for JHS participants.

## Statistical Analysis

We calculated baseline characteristics for participants in the three treatment initiation groups. The cumulative incidence and incidence rates for ASCVD and all-cause mortality, separately, were computed for participants in these three groups, overall and after stratification by age (60 to < 75 years and ≥ 75 years), race (white and black), and sex (women and men). We computed hazard ratios for ASCVD and all-cause mortality with multivariable-adjustment using three nested models, with participants not recommended initiation of antihypertensive medication by either guideline serving as the referent group. In model 1, hazard ratios were adjusted for enrollment in the JHS or REGARDS study. Model 2 included adjustment for variables in model 1 and age, sex, and race. Model 3 included adjustment for variables in model 2 and education, smoking habits, diabetes, estimated glomerular filtration rate < 60 ml/min/1.73 m<sup>2</sup>, body mass index, albumin-to-creatinine ratio ≥ 30 mg/g, total cholesterol, high density lipoprotein, and history of ASCVD events (i.e., stroke or coronary heart disease). Hazard ratios were also calculated for participants who were recommended for initiation of antihypertensive medication by both guidelines versus those recommended initiation of antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline. For participants who were taking antihypertensive medication at baseline, the above analyses were repeated, comparing those who were recommended intensification of antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline to those who were recommended intensification by both guidelines. For the analysis of intensification of antihypertensive medication, model 3 included the variables listed above and the number of classes of antihypertensive medications being taken at baseline. The cumulative incidence and hazard ratio calculations for ASCVD events took into account the competing risk for mortality.<sup>16</sup> Participants contributed time at risk for ASCVD from baseline until their first adjudicated ASCVD event, death, or end of follow-up, whichever occurred earliest. For mortality, participants contributed time at risk from baseline through their death or end of follow-up, whichever occurred earliest. Analyses were conducted using R version 3.5.0 and SAS version 9.4.

## RESULTS

### Initiation of Antihypertensive Medication

Among 4,311 participants not taking antihypertensive medication at baseline with SBP ≥ 130 mm Hg or DBP ≥ 80 mm Hg, 11.4% were not recommended initiation of antihypertensive medication by either the ACC/AHA or the ACP/AAFP guideline, 61.2% were recommended initiation of antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline, and 27.4% were recommended initiation of antihypertensive medication by both guidelines. Characteristics of the participants in these three groups are presented in Table 1. The mean 10-year predicted ASCVD risk (and % of participants with risk ≥ 10%) was 6.4% (0%), 18.7% (87.7%), and 25.8% (91.8%) among participants who were not recommended initiation of antihypertensive medication by either guideline, recommended initiation of antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline, and recommended initiation of antihypertensive medication by both guidelines, respectively

Over 12.2 years of follow-up, there were 592 ASCVD events and 1,075 deaths among participants not taking antihypertensive medication at baseline. The cumulative incidence of ASCVD and all-cause mortality were higher among participants who were recommended initiation of antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline or by both guidelines compared with their counterparts who were not recommended initiation of antihypertensive medication by either guideline (Figure S3). After adjustment for study (i.e., JHS or REGARDS study), participants who were recommended initiation of antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline and by both guidelines were 5.00 (95% confidence interval [CI] 2.94, 8.52) and 6.95 (95% CI 4.05, 11.91) times more likely, respectively, to have an ASCVD event compared to their counterparts who were not recommended initiation of antihypertensive medication by either guideline (Table 2). Participants who were recommended for initiation of antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline and by both guidelines were 5.62 (95% CI 3.71, 8.52) and 8.58 (95% CI 5.64, 13.07) times more likely, respectively, to die compared to their counterparts who were not recommended initiation of antihypertensive medication by either guideline. These associations remained statistically significant after multivariable adjustment. Higher ASCVD and mortality rates were present among participants recommended initiation of antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline and both guidelines compared with their counterparts not recommended initiation of antihypertensive medication by either guideline in sub-groups defined by age, race, and sex (Table S1). The hazard ratio for ASCVD events and all-cause mortality adjusted for enrollment in the JHS or REGARDS study among participants who were recommended for initiation of antihypertensive medication by both guidelines compared with their counterparts who were recommended for initiation by the ACC/AHA but not the ACP/AAFP guideline was 1.39 (95% CI, 1.17-1.64) and 1.53 (95% CI, 1.35-1.73), respectively.

### **Intensification of Antihypertensive Medication**

Among 7,281 participants taking antihypertensive medication at baseline with SBP  $\geq$  130 mm Hg or DBP  $\geq$  80 mm Hg, 57.9% and 42.1% were recommended intensification of antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline and by both guidelines, respectively. The mean 10-year predicted ASCVD risk was 20.8% and 31.4% among participants who were recommended intensification of antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline and by both guidelines, respectively (Table 3).

Over 12.2 years of follow-up, there were 1,258 ASCVD events and 2,194 deaths among participants taking antihypertensive medication. The cumulative incidence of ASCVD events and all-cause mortality was higher among participants recommended for antihypertensive medication intensification by both the ACC/AHA and ACP/AAFP guidelines compared with their counterparts recommended for intensification by the ACC/AHA but not the ACP/AAFP guideline (Figure S4). These associations remained statistically significant after multivariable adjustment (Table 4). Results were consistent in sub-groups defined by age, race, and sex (Table S2).

## DISCUSSION

In the current analysis, 61.2% of adults  $\geq 60$  years of age with SBP  $\geq 130$  mm Hg or DBP  $\geq 80$  mm Hg not taking antihypertensive medication at baseline were recommended for initiation of antihypertensive medication by the ACC/AHA guideline but not by the ACP/AAFP guideline. The ASCVD and mortality event rates were approximately five times higher among this group compared to those not recommended for initiation of antihypertensive medication by either guideline. For participants taking antihypertensive medication at baseline, the ASCVD event rate was higher among those recommended for intensification of antihypertensive medication by both the ACC/AHA and ACP/AAFP guidelines versus their counterparts recommended for intensification of antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline. Based on these data, adults recommended initiation or intensification of antihypertensive medication by both guidelines are expected to experience greater absolute ASCVD and all-cause mortality risk reduction compared to adults recommended initiation or intensification of antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline. However, the ASCVD and all-cause mortality event rates were high in both of these groups.

There are three differences in the ACC/AHA and ACP/AAFP guidelines that may explain why a higher proportion of adults with  $\geq 60$  years of age are recommended for antihypertensive medication initiation and intensification by the ACC/AHA but not the ACP/AAFP guideline and why this group has high ASCVD and mortality event rates. First, the ACC/AHA guideline recommends a lower SBP threshold for treatment initiation and a lower BP treatment goal than the ACP/AAFP guideline. Using data from randomized controlled trials, an independent review committee assembled by the ACC/AHA guideline writing committee found that treatment to a SBP goal  $< 130$  mm Hg versus a higher goal was associated with a risk ratio for major CVD events of 0.83 (95% CI 0.74, 0.92), myocardial infarction of 0.85 (95% CI 0.73, 1.00), and stroke of 0.82 (95% CI 0.70, 0.96).<sup>17</sup> In a separate systematic review conducted for the ACP/AAFP guideline, randomization to an SBP goal of  $< 140$  mm Hg versus a higher goal was associated with risk ratio of 0.86 (95% CI 0.69, 1.06) for all-cause mortality, 0.82 (95% CI 0.64, 1.00) for cardiac events, and 0.79 (95% CI 0.59, 0.99) for stroke.<sup>1</sup> A meta-analysis of trials with a SBP goal  $< 130$  mm Hg versus higher goals was not reported in the ACP/AAFP guideline.

A second difference between the ACC/AHA and ACP/AAFP guidelines is the consideration of DBP to guide antihypertensive medication initiation and intensification. The ACC/AHA guideline recommendation to use DBP in guiding antihypertensive treatment is based on expert opinion.<sup>2</sup> The ACP/AAFP stated that there was insufficient evidence to determine the benefit of antihypertensive treatment for isolated diastolic hypertension.<sup>1</sup> Isolated diastolic hypertension (i.e., DBP but not SBP in the hypertensive range) is not a common phenotype among adults  $\geq 60$  years of age and using DBP to guide treatment recommendations for older adults is unlikely to affect many people.<sup>18</sup>

A third difference is the approach used to define high CVD risk. Both guidelines consider kidney disease, diabetes, and a history of CVD as conditions warranting more intensive antihypertensive treatment to achieve lower BP goals. The ACC/AHA guideline also

recommends more intensive BP reduction for individuals with 10-year predicted ASCVD risk  $\geq 10\%$ . Studies have shown that risk equations can predict future ASCVD events more accurately compared to clinical judgment or counting the number of risk factors that are present.<sup>19–21</sup> In addition to antihypertensive medication, 10-year predicted ASCVD risk has been used to guide recommendations for initiation of statins and aspirin therapy.<sup>22,23</sup>

The decision to initiate or intensify antihypertensive medication should balance the benefits of treatment versus the potential harms.<sup>24,25</sup> A meta-analysis of 11 randomized controlled trials demonstrated that antihypertensive medication provides larger absolute risk reductions at progressively higher levels of predicted ASCVD risk.<sup>26</sup> This suggests that adults with high predicted ASCVD risk may attain substantial absolute risk reduction by initiating or intensifying antihypertensive medication. There was no evidence of a difference in the rate of serious adverse events between participants randomized to the intensive versus standard SBP goal in the Systolic Blood Pressure Intervention Trial.<sup>27</sup> Also, ASCVD events can be fatal or non-fatal but severely disabling, whereas the overwhelming majority of serious adverse events are non-fatal, transient, and associated with complete recovery.<sup>28,29</sup> The ACC/AHA guideline states that for older adults with a high burden of comorbidity and limited life expectancy that clinical judgment, patient preference, and a team-based approach to assess risk/benefit should be used for antihypertensive medication treatment decision making.<sup>2</sup> Therefore, it may be appropriate for some older adults to not initiate or intensify antihypertensive medication despite meeting the BP criteria in the ACC/AHA guideline.

The current analysis has several strengths. There was substantial representation of men and women, blacks and whites and people  $\geq 75$  years of age. Participants were followed prospectively for up to 12.2 years and ASCVD events were adjudicated using published guidelines by trained personnel. The current analysis should be interpreted in the context of known and potential limitations. We did not have data indicating whether participants initiated or intensified antihypertensive medication during follow-up. BP levels were based on measurements obtained during a single visit. Both the ACC/AHA and ACP/AAFP guidelines recommend the diagnosis of hypertension be based on two or more BP measurements at two or more visits. The JHS and REGARDS study only included community-dwelling blacks and whites. Therefore, results may not be generalizable to people of other race groups or institutionalized adults including those in nursing homes.

## PERSPECTIVES

In the current study, the ASCVD event and mortality rates were approximately five times higher among participants  $\geq 60$  years of age not taking antihypertensive medication at baseline who were recommended for treatment initiation by the ACC/AHA guideline but not the ACC/AAFP guideline compared with their counterparts who were not recommended treatment initiation by either guideline. Among participants taking antihypertensive medication at baseline, the risk for ASCVD events and all-cause mortality was high among those who were recommended for treatment intensification by the ACC/AHA guideline but not the ACP/AAFP guideline. In conclusion, the ACC/AHA guideline directs antihypertensive medication towards a large segment of older adults who may attain



substantial ASCVD risk reduction through initiation or intensification of antihypertensive medication.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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## References

1. Qaseem A, Wilt TJ, Rich R, Humphrey LL, Frost J, Forcica MA. Pharmacologic treatment of hypertension in adults aged 60 years or older to higher versus lower blood pressure targets: a clinical practice guideline from the American College of Physicians and the American Academy of Family Physicians. *Ann Intern Med* 2017;166(6):430–437. [PubMed: 28135725]
2. Whelton PK, Carey RM, Aronow WS, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol* 2017;71(19):e127–e248. [PubMed: 29146535]
3. TJ W D K, A Q, Physicians for the CGC of the AC of. Hypertension limbo: Balancing benefits, harms, and patient preferences before we lower the bar on blood pressure. *Ann Intern Med* 2018;168(5):369–370. doi:10.7326/M17-3293 [PubMed: 29357397]
4. Howard VJ, Cushman M, Pulley L, et al. The reasons for geographic and racial differences in stroke study: objectives and design. *Neuroepidemiology* 2005;25(3):135–143. [PubMed: 15990444]
5. Taylor HA, Jr, Wilson JG, Jones DW, et al. Toward resolution of cardiovascular health disparities in African Americans: design and methods of the Jackson Heart Study. *Ethn Dis* 2005;15(4 Suppl 6):S6–4.
6. Safford MM, Brown TM, Muntner PM, et al. Association of race and sex with risk of incident acute coronary heart disease events. *JAMA* 2012;308(17):1768–1774. [PubMed: 23117777]

7. Muntner P, Colantonio LD, Cushman M, et al. Validation of the atherosclerotic cardiovascular disease Pooled Cohort risk equations. *JAMA* 2014;311(14):1406–1415. [PubMed: 24682252]
8. Taylor HA, Coady SA, Levy D, et al. Relationships of BMI to cardiovascular risk factors differ by ethnicity. *Obesity* 2010;18(8):1638–1645. [PubMed: 19927137]
9. Tanner RM, Shimbo D, Dreisbach AW, Carson AP, Fox ER, Muntner P. Association between 24-hour blood pressure variability and chronic kidney disease: a cross-sectional analysis of African Americans participating in the Jackson heart study. *BMC Nephrol* 2015;16(1):84. [PubMed: 26099630]
10. Levey AS, Stevens LA, Schmid CH, et al. A new equation to estimate glomerular filtration rate. *Ann Intern Med* 2009;150(9):604–612. [PubMed: 19414839]
11. Hickson DA, Burchfiel CM, Liu J, et al. Diabetes, impaired glucose tolerance, and metabolic biomarkers in individuals with normal glucose tolerance are inversely associated with lung function: the Jackson Heart Study. *Lung* 2011;189(4):311–321. [PubMed: 21567165]
12. Goff DC, Lloyd-Jones DM, Bennett G, et al. 2013 ACC/AHA guideline on the assessment of cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2014;63(25 Part B):2935–2959. [PubMed: 24239921]
13. Abdalla M, Booth JN, Seals SR, et al. Masked hypertension and incident clinic hypertension among blacks in the Jackson Heart Study. *Hypertension* 2016;(68):220–226. [PubMed: 27185746]
14. Keku E, Rosamond W, Taylor HA, Jr, et al. Cardiovascular disease event classification in the Jackson Heart Study: methods and procedures. *Ethn Dis* 2005;15(4 Suppl 6):S6–62.
15. Howard VJ, Kleindorfer DO, Judd SE, et al. Disparities in stroke incidence contributing to disparities in stroke mortality. *Ann Neurol* 2011;69(4):619–627. [PubMed: 21416498]
16. Fine JP, Gray RJ. A proportional hazards model for the subdistribution of a competing risk. *J Am Stat Assoc* 1999;94(446):496–509.
17. Reboussin DM, Allen NB, Griswold ME, et al. Systematic review for the 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol* 2018;71(19):2176–2198. [PubMed: 29146534]
18. Franklin SS, Jacobs MJ, Wong ND, Gilbert JL, Lapuerta P. Predominance of isolated systolic hypertension among middle-aged and elderly US hypertensives: analysis based on National Health and Nutrition Examination Survey (NHANES) III. *Hypertension* 2001;37(3):869–874. [PubMed: 11244010]
19. Pignone M, Phillips CJ, Elasy TA, Fernandez A. Physicians' ability to predict the risk of coronary heart disease. *BMC Health Serv Res* 2003;3(1):13. [PubMed: 12857356]
20. Grover SA, Lowensteyn I, Esrey KL, Steinert Y, Joseph L, Abrahamowicz M. Do doctors accurately assess coronary risk in their patients? Preliminary results of the coronary health assessment study. *Bmj* 1995;310(6985):975–978. [PubMed: 7728035]
21. Friedmann PD, Brett AS, Mayo-Smith MF. Differences in generalists' and cardiologists' perceptions of cardiovascular risk and the outcomes of preventive therapy in cardiovascular disease. *Ann Intern Med* 1996;124(4):414–421. [PubMed: 8554250]
22. Deckers J, Blumenthal RS. Statins for primary prevention of cardiovascular disease. *BMJ* 2011;342.
23. Bibbins-Domingo K. Aspirin use for the primary prevention of cardiovascular disease and colorectal cancer: US Preventive Services Task Force Recommendation Statement. *Ann Intern Med* 2016;164(12):836–845. [PubMed: 27064677]
24. Basu S, Sussman JB, Rigdon J, Steimle L, Denton BT, Hayward RA. Benefit and harm of intensive blood pressure treatment: Derivation and validation of risk models using data from the SPRINT and ACCORD trials. *PLoS Med* 2017;14(10):e1002410. [PubMed: 29040268]
25. Williamson JD, Supiano MA, Applegate WB, et al. Intensive vs standard blood pressure control and cardiovascular disease outcomes in adults aged 75 years: a randomized clinical trial. *Jama* 2016;315(24):2673–2682. [PubMed: 27195814]

26. Blood Pressure Lowering Treatment Trialists' Collaboration. Blood pressure-lowering treatment based on cardiovascular risk: a meta-analysis of individual patient data. *The Lancet* 2014;384(9943):591–598.
27. SPRINT Research Group. A randomized trial of intensive versus standard blood-pressure control. *N Engl J Med* 2015;373(22):2103–2116. [PubMed: 26551272]
28. Rocco MV, Sink KM, Lovato LC, et al. Effects of Intensive Blood Pressure Treatment on Acute Kidney Injury Events in the Systolic Blood Pressure Intervention Trial (SPRINT). *Am J Kidney Dis* 2018;71(3):352–361. [PubMed: 29162340]
29. Sink KM, Evans GW, Shorr RI, et al. Syncope, hypotension, and falls in the treatment of hypertension: results from the randomized clinical systolic blood pressure intervention trial. *J Am Geriatr Soc* 2018;66(4):679–686. [PubMed: 29601076]

## NOVELTY AND SIGNIFICANCE

### What Is New?

- For many adults, initiation or intensification of antihypertensive medication is recommended by the 2017 ACC/AHA guideline but not the 2017 ACP/AAFP guideline.

### What Is Relevant?

- Among 4,175 JHS/REGARDS participants aged ≥ 60 years not taking antihypertensive medication, 59.1% were recommended for initiation of antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline.
- For these participants, ASCVD event rates were five-fold higher compared to those who were not recommended for initiation of antihypertensive medication by the ACC/AHA guideline.

### Summary.

- The ACC/AHA guideline directs antihypertensive medication towards a large segment of adults aged ≥ 60 years with high ASCVD risk.

Systolic Blood Pressure	Initiation of antihypertensive medication recommended by:		
	Neither guideline: (n = 492)	The ACC/AHA guideline only: (n = 2,637)	Both guidelines: (n = 1,182)
< 130 mm Hg	DBP < 80 mm Hg <b>OR</b> DBP 80-89 mm Hg and <i>none</i> of the following conditions are present: 1. Diabetes or 2. eGFR < 60 ml/min/1.73 m <sup>2</sup> or 3. ACR ≥ 30 mg/g or 4. 10-year risk of ASCVD ≥ 10% or 5. History of CVD.	DBP ≥ 90 mm Hg <b>OR</b> DBP 80-89 mm Hg and <i>any</i> of the following conditions are present: 1. Diabetes or 2. eGFR < 60 ml/min/1.73 m <sup>2</sup> or 3. ACR ≥ 30 mg/g or 4. 10-year risk of ASCVD ≥ 10% or 5. History of CVD.	---
130 – 139 mm Hg	DBP < 90 mm Hg and <i>none</i> of the following conditions are present: 1. Diabetes or 2. eGFR < 60 ml/min/1.73 m <sup>2</sup> or 3. ACR ≥ 30 mg/g or 4. 10-year risk of ASCVD ≥ 10% or 5. History of CVD or 6. Age ≥ 65 years.	DBP ≥ 90 mm Hg <b>OR</b> DBP < 90 mm Hg and <i>any</i> of the following conditions are present: 1. Diabetes or 2. eGFR < 60 ml/min/1.73 m <sup>2</sup> or 3. ACR ≥ 30 mg/g or 4. 10-year risk of ASCVD ≥ 10% or 5. History of CVD or 6. Age ≥ 65 years.	---
140 – 149 mm Hg	-	<i>Any DBP and none</i> of the following conditions are present: 1. Diabetes or 2. eGFR < 45 ml/min/1.73 m <sup>2</sup> or 3. History of stroke or TIA or 4. Known vascular disease* or 5. Metabolic syndrome.	<i>Any</i> DBP and any of the following conditions are present: 1. Diabetes or 2. eGFR < 45 ml/min/1.73 m <sup>2</sup> or 3. History of stroke or TIA or 4. Known vascular disease* or 4. Metabolic syndrome.
≥ 150 mm Hg	-	--	<i>All adults (any DBP)</i>
Systolic Blood Pressure	Intensification of antihypertensive medication recommended by:		
	Neither guideline: (n = 66)	The ACC/AHA guideline only: (n = 4,214)	Both guidelines: (n = 3,067)
< 130 mm Hg	DBP < 80 mmHg <b>OR</b> DBP ≥ 80 mm Hg and <i>none</i> of the following conditions are present: 1. Diabetes or 2. eGFR < 60 ml/min/1.73 m <sup>2</sup> or 3. ACR ≥ 30 mg/g or 4. 10-year risk of ASCVD ≥ 10% or 5. History of CVD or 6. Age < 65 years.	DBP ≥ 80 mm Hg and <i>any</i> of the following conditions are present: 1. Diabetes or 2. eGFR < 60 ml/min/1.73 m <sup>2</sup> or 3. ACR ≥ 30 mg/g or 4. 10-year risk of ASCVD ≥ 10% or 5. History of CVD or 6. Age < 65 years.	---
130 – 139 mm Hg	-	<i>All adults (Any DBP)</i>	---
140 – 149 mm Hg	-	<i>Any DBP and none</i> of the following conditions are present: 1. Diabetes or 2. eGFR < 45 ml/min/1.73 m <sup>2</sup> or 3. History of stroke or TIA or 4. Known vascular disease* or 5. Metabolic syndrome.	<i>Any</i> DBP and any of the following conditions are present: 1. Diabetes or 2. eGFR < 45 ml/min/1.73 m <sup>2</sup> or 3. History of stroke or TIA or 4. Known vascular disease* or 5. Metabolic syndrome.
≥ 150 mm Hg	-	--	<i>All adults (Any DBP)</i>

**Figure 1:** Recommendations for initiation and intensification of antihypertensive medication by the 2017 ACC/AHA blood pressure guideline and the 2017 ACP/AAFP blood pressure guideline.

\* All adults recommended antihypertensive medication initiation or intensification by the ACP/AAFP guideline are also recommended treatment initiation or intensification by the ACC/AHA guideline. However, based on differences in the ACC/AHA and ACP/AAFP guidelines, many adults 60 years of age may be recommended to initiate or intensify antihypertensive medication by the ACC/AHA but not the ACP/AAFP guideline

† -At this level of systolic blood pressure, no one is recommended for antihypertensive medication initiation or intensification by neither guideline.

‡ --At this level of systolic blood pressure, no one is recommended for antihypertensive medication initiation or intensification by the ACC/AHA but not the ACP/AAFP guideline.

§ ---At this level of systolic blood pressure, no one is recommended for antihypertensive medication initiation or intensification by both guidelines.

|| 10-year risk of atherosclerotic cardiovascular disease represents the risk for a coronary heart disease or stroke event within 10-years and was calculated using the Pooled Cohort risk equations.

¶ For the current study, known vascular disease included history of myocardial infarction, stroke, or coronary revascularization.

AAFP = American Academy of Family Physicians; ACC = American College of Cardiology; ACP = American College of Physicians; ACR = albumin-to-creatinine ratio; AHA = American Heart Association; ASCVD = atherosclerotic cardiovascular disease; DBP = diastolic blood pressure; eGFR = estimated glomerular filtration rate; SBP = systolic blood pressure; TIA = transient ischemic attack

**Table 1:**

Characteristics\* of participants according to recommendations for initiation† of antihypertensive medication by the 2017 ACC/AHA and ACP/AAFP blood pressure guidelines.

Participant Characteristic	Initiation of Antihypertensive Treatment		
	Recommended by the ACP/AAFP BP Guideline		
	No	Yes	
	Recommended by the ACC/AHA BP Guideline		
	No (n = 492)	Yes (n = 2,637)	Yes (n = 1,182)
Age, years	63.1 (2.9)	70.2 (6.9)	70.7 (7.3)
Male, %	30.3	59.0	53.0
Black, %	35.8	35.9	43.3
REGARDS study, %	97.2	94.3	90.4
Less than high school education, %	8.3	14.2	20.7
Current Smoker, %	4.7	13.2	15.9
Body Mass Index, kg/m <sup>2</sup>	28.5 (5.4)	28.0 (5.2)	29.2 (6.1)
Total cholesterol, mg/dL	201.8 (37.0)	197.2 (39.3)	201.4 (45.1)
HDL cholesterol, mg/dL	59.1 (15.4)	52.4 (16.2)	50.1 (16.8)
‡Albuminuria, %	0.0	13.9	25.4
eGFR < 60 ml/min/1.73 m <sup>2</sup>	0.0	8.7	11.7
Diabetes, %	0.0	13.9	24.3
History of CVD, %	0.0	18.3	28.3
§10-year predicted ASCVD risk 10%, %	0.0	87.7	91.8
Mean 10-year predicted ASCVD risk †	6.4 (2.2)	18.7 (10.4)	25.8 (14.7)
Systolic BP, mm Hg	124.8 (8.3)	132.3 (8.1)	153.8 (14.0)
Diastolic BP, mm Hg	80.6 (4.5)	79.3 (7.2)	84.0 (10.1)

\* Values in table are mean (standard deviation) or percent.

† Table restricted to participants not taking antihypertensive medication at baseline.

‡ Albuminuria was defined as an albumin-to-creatinine ratio ≥ 30 mg/g.

§ 10-year predicted atherosclerotic cardiovascular disease risk was calculated for participants without a history of cardiovascular disease using the Pooled Cohort risk equations.<sup>12</sup>

AAFP = American Academy of Family Physicians; ACC = American College of Cardiology; ACP = American College of Physicians; AHA = American Heart Association; ASCVD = atherosclerotic cardiovascular disease; BP = blood pressure; CVD = cardiovascular disease; eGFR = estimated glomerular filtration rate; HDL = high density lipoprotein; REGARDS = REasons for Geographic And Racial Differences in Stroke;

**Table 2:**

Incidence rates and hazard ratios for atherosclerotic cardiovascular disease and all-cause mortality according to recommendations for initiation<sup>\*</sup> of antihypertensive medication by the 2017 ACC/AHA and ACP/AAFP blood pressure guidelines.

Event Characteristics	Initiation of Antihypertensive Treatment		
	Recommended by the ACP/AAFP BP Guideline		
	No	Yes	
	Recommended by the ACC/AHA BP Guideline		
	No (n = 492)	Yes (n = 2,637)	Yes (n = 1,182)
	Atherosclerotic Cardiovascular Disease		
Number of Events	14	364	214
Person Years	4,125	20,266	8,473
Rate (95% CI) per 1,000 person-years	3.39 (1.62, 5.17)	18.0 (16.1, 19.8)	25.3 (21.9, 28.6)
<sup>†</sup> Hazard Ratio (95% CI)			
Model 1	1 (ref)	5.00 (2.94, 8.52)	6.95 (4.05, 11.91)
Model 2	1 (ref)	3.18 (1.85, 5.47)	4.40 (2.54, 7.64)
Model 3	1 (ref)	2.48 (1.43, 4.31)	2.97 (1.68, 5.26)
	All-Cause Mortality		
Number of Events	23	649	403
Person Years	4,152	21,282	9,042
Rate (95% CI) per 1,000 person-years	5.54 (3.28, 7.80)	30.5 (28.1, 32.8)	44.6 (40.2, 48.9)
<sup>†</sup> Hazard Ratio (95% CI)			
Model 1	1 (ref)	5.62 (3.71, 8.52)	8.58 (5.64, 13.07)
Model 2	1 (ref)	2.50 (1.64, 3.84)	3.65 (2.37, 5.63)
Model 3	1 (ref)	1.70 (1.10, 2.63)	2.04 (1.31, 3.19)

\* Table restricted to participants not taking antihypertensive medication at baseline.

<sup>†</sup> Model 1 includes adjustment for enrollment in the Jackson Heart Study or REasons for Geographic and Racial Differences in Stroke study

Model 2 includes adjustment for variables in Model 1 plus age, sex, and race.

Model 3 includes adjustment for variables in Model 2 plus education, smoking habits, diabetes, estimated glomerular filtration rate < 60 ml/min/1.73 m<sup>2</sup>, body mass index, albumin-to-creatinine ratio > 30 mg/g, total cholesterol, high density lipoproteins, and history of atherosclerotic cardiovascular disease events (i.e., stroke or coronary heart disease).

AAFP = American Academy of Family Physicians; ACC = American College of Cardiology; ACP = American College of Physicians; AHA = American Heart Association; BP = blood pressure; CI = confidence interval.



**Table 3:**

Characteristics\* of participants according to recommendations for intensification† of antihypertensive medication by the 2017 ACC/AHA and ACP/AAFP blood pressure guidelines.

Participant Characteristics	Intensification of Antihypertensive Treatment	
	Recommended only by the ACC/AHA BP Guideline (n=4,214)	Recommended by both the ACC/AHA and ACP/AAFP BP Guidelines (n=3,067)
Age, years	69.3 (6.8)	70.4 (7.0)
Male, %	44.8	45.0
Black, %	53.5	59.7
REGARDS study, %	89.4	88.8
Less than high school education, %	17.2	24.6
Current Smoker, %	9.8	12.0
Body Mass Index, kg/m <sup>2</sup>	30.4 (6.2)	31.0 (6.5)
Total cholesterol, mg/dL	189.0 (38.9)	190.5 (42.1)
HDL cholesterol, mg/dL	52.4 (16.4)	49.8 (15.5)
‡Albuminuria, %	17.6	32.9
eGFR < 60 ml/min/1.73 m <sup>2</sup> , %	17.4	24.1
Diabetes, %	24.4	42.5
History of CVD, %	29.5	47.9
§10-year predicted ASCVD risk 10% †, %	84.5	97.1
Mean 10-year predicted ASCVD risk †	20.8 (11.6)	31.4 (15.5)
Systolic BP, mm Hg	132.8 (7.4)	154.2 (13.1)
Diastolic BP, mm Hg	79.1 (7.5)	82.5 (10.5)
Number of classes of antihypertensive medication taken	2.0 (0.9)	2.2 (1.0)

\* Values in table are mean (standard deviation) or percent.

† Table restricted to participants taking antihypertensive medication at baseline.

‡ Albuminuria was defined as an albumin-to-creatinine ratio ≥ 30 mg/g.

§ 10-year predicted atherosclerotic cardiovascular disease risk was calculated for participants without a history of cardiovascular disease using the Pooled Cohort risk equations.<sup>12</sup>

AAFP = American Academy of Family Physicians; ACC = American College of Cardiology; ACP = American College of Physicians; AHA = American Heart Association; ASCVD = atherosclerotic cardiovascular disease; BP = blood pressure; CVD = cardiovascular disease; eGFR = estimated glomerular filtration rate; HDL = high density lipoprotein; REGARDS = REasons for Geographic And Racial Differences in Stroke.

**Table 4:**

Incidence rates and hazard ratios for atherosclerotic cardiovascular disease events and all-cause mortality according to recommendations for intensification\* of antihypertensive medication by the 2017 ACC/AHA and ACP/AAFP blood pressure guidelines.

Event Characteristics	Intensification of Antihypertensive Treatment	
	Recommended only by the ACC/AHA Guideline (n=4,214)	Recommended by both the ACC/AHA and ACP/AAFP Guidelines (n=3,067)
	<b>Atherosclerotic Cardiovascular Disease</b>	
<b>Number of Events</b>	578	680
<b>Person Years</b>	31,786	20,630
<b>Rate (95% CI) per 1,000 person-years</b>	18.2 (16.7, 19.7)	33.0 (30.5, 35.4)
<b>Hazard Ratio (95% CI)</b>		
<b>Model 1</b>	1 (ref)	1.72 (1.54, 1.92)
<b>Model 2</b>	1 (ref)	1.67 (1.49, 1.86)
<b>Model 3</b>	1 (ref)	1.33 (1.17, 1.51)
	<b>All-Cause Mortality</b>	
<b>Number of Events</b>	1,000	1,194
<b>Person Years</b>	33,365	22,510
<b>Rate (95% CI) per 1,000 person-years</b>	30.0 (28.1, 31.8)	53.0 (50.0, 56.1)
<b>Hazard Ratio (95% CI)</b>		
<b>Model 1</b>	1 (ref)	1.81 (1.67, 1.97)
<b>Model 2</b>	1 (ref)	1.67 (1.53, 1.81)
<b>Model 3</b>	1 (ref)	1.21 (1.10, 1.33)

\* Table restricted to participants taking antihypertensive medication at baseline.

† Model 1 includes adjustment for enrollment in the Jackson Heart Study or REasons for Geographic and Racial Differences in Stroke study

Model 2 includes adjustment for variables in Model 1 plus age, sex, and race.

Model 3 includes adjustment for variables in Model 2 plus education, smoking habits, diabetes, estimated glomerular filtration rate < 60 ml/min/1.73 m<sup>2</sup>, body mass index, albumin-to-creatinine ratio ≥ 30 mg/g, total cholesterol, high density lipoproteins, history of atherosclerotic cardiovascular disease events (i.e., stroke or coronary heart disease), and number of classes of antihypertensive medication taken at baseline.

AAFP = American Academy of Family Physicians; ACC = American College of Cardiology; ACP = American College of Physicians; AHA = American Heart Association; BP = blood pressure; CI = confidence interval.