**Comparison of the association of masked hypertension defined by the 2017 ACC/AHA BP guideline versus the JNC7 guideline with left ventricular hypertrophy.**

Bharat POUDELa, Anthony J. VIERAb, Daichi SHIMBOc, Joseph E. SCHWARTZ c, d, James M. SHIKANYa, Swati SAKHUJAa, Donald M. LLOYD-JONESe,Paul MUNTNERa, Yuichiro YANOb, f.

a University of Alabama at Birmingham, Birmingham, AL; b Duke University, Durham, NC; c Columbia University, New York, NY; d Stony Brook University, Stony Brook, NY; e Northwestern University, Chicago, IL; f Yokohama City University, Kanagawa, Japan.

**Supplemental materials**:

|  |
| --- |
| Supplemental Table 1. Methods used to collect data in each study. |
|  | JHS | CARDIA | MHT Study | IDH Study | NCMH Study |
| Age  | Self-reported  |
| Sex |
| Less than high school education  |
| Current smoking |
| Alcohol intake | Self-reported and categorized as no drinker: 0 drinks/week; Moderate drinker: 1-14 drinks/week for males, 1-7 drink/week for females; Heavy drinker: >14 drinks/week for males, and >7 drinks/week for females. |
| Body mass index | Calculated using weight in kilograms divided by height in meters squared |
| Total and HDL cholesterol | Oxidase method | Enzymatic method |
| Diabetes | Fasting glucose ≥ 126 mg/dL, hemoglobin A1c ≥ 6.5%, or glucose-lowering medication use | Fasting glucose ≥ 126 mg/dL or glucose-lowering medication use | Fasting glucose ≥ 126 mg/dL, hemoglobin A1c ≥ 6.5%, or glucose-lowering medication use |
| Family history of hypertension | Self-reported | Not assessed |
| Glucose lowering medication use | Self-reported | Not assessed |
| Lipid lowering medication use | Self-reported | Not assessed |
| History of CVD | Self-reported | Adjudicated cardiovascular events between baseline and the Y30 study visit | NoneHistory of CVD was an exclusion criteria |
| Estimated glomerular filtration rate (eGFR) | Serum creatinine was measured by the Jaffé method, and reduced eGFR was calculated using the creatinine-based Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation [1]and defined as less than 60 mL/min/1.73m2. | Not assessed |
| Albumin-to-creatinine-ratio (ACR) | The nephelometric immunoassay method | Immunoturbidimetric assay | The nephelometric immunoassay method  |
| Heart rate | Measured during office visit in beats per minute |
| JHS=Jackson Heart Study; CARDIA=Coronary Artery Risk Development in Young Adults; MHT=Masked Hypertension; IDH=Improving the Detection of Hypertension; NCMH=North Carolina Masked Hypertension; HDL=high-density lipoprotein; CVD: cardiovascular disease. |

|  |
| --- |
| Supplemental Table 2. Methods used to measure office and ambulatory blood pressure in each study cohort. |
|  | JHS | CARDIA | MHT Study | IDH Study | NCMH Study |
| Office BP  | Hawksley random-zero sphygmomanometer (Hawksley & Sons Ltd., UK)\* | Oscillometric device (Omron HEM-907XL) | Mercury column sphygmomanometer (Baum, Copiague, NY) | Mercury column sphygmomanometer (Baum, Copiague, NY) | Oscillometric device (Welch Allyn Vital Signs, Skaneateles Falls, NY) |
| Number and interval of Office BP readings | Two times at 1-minute intervals on a single occasion | Three times at 1-minute intervals on a single occasion | Three times at 1- to 2-minute intervals on 3 separate occasions | Three times at 1 to 2-minute intervals on 3 separate occasions | Three times at ≥ 1-minute intervals on 5 separate occasions |
| Office BP was defined as the average of all readings from the first examination |
| Cuff size | An appropriately sized BP cuff based on measured arm circumference was used |
| ABPM: Validated devices | SpaceLabs model 90207(SpaceLabs Healthcare, Snoqualmie, WA) | SpaceLabs model 90227 (SpaceLabs Healthcare, Snoqualmie, WA) | SpaceLabs model 90207 (SpaceLabs Healthcare, Snoqualmie, WA) | SpaceLabs model 90207 (SpaceLabs Healthcare, Snoqualmie, WA) | Oscar 2 monitor (Suntech Medical, Morrisville, NC) |
| Interval of ambulatory BP readings | Every 20 minutes over a 24-hour period | Every 30 minutes over a 24-hour period | Every 28 minutes over a 24-hour period | Every 30 minutes over a 24-hour period | Every 30 minutes between 6 AM to 10 PM and hourly between 10 PM and 6 AM |
| Assessments of in-bed and out-of-bed times  | Self-report | Wrist actigraphy, supplemented with self-report  | Wrist actigraphy, supplemented with self-report | Wrist actigraphy, supplemented with self-report | Self-report |
| Cuff size | An appropriately sized blood pressure cuff based on measured arm circumference was used |
| \* The random-zero blood pressure measurements were calibrated to an oscillometric device using robust regression as previously described (Seals SR, et al. Blood Press Monit. 2019;24:130-136.) [2]. JHS=Jackson Heart Study; CARDIA=Coronary Artery Risk Development in Young Adults; MHT=Masked Hypertension; IDH=Improving the Detection of Hypertension; NCMH=North Carolina Masked Hypertension; BP=blood pressure; ABPM=ambulatory blood pressure monitoring.  |

|  |
| --- |
| Supplemental Table 3. Blood pressure levels used for defining masked hypertension by office blood pressure and awake blood pressure only and office blood pressure and awake, asleep, or 24-hour blood pressure according to the thresholds in the JNC7 blood pressure guideline and the 2017 ACC/AHA blood pressure guideline. |
| Office SBP/DBP, mmHg | Awake SBP/DBP, mmHg | Asleep SBP/DBP, mmHg | 24-hour SBP/DBP, mmHg | JNC7 guideline | 2017 ACC/AHA guideline |
| Phenotypes defined using office and awake BP |  |  |  |  |
| <130/80 | <130/80 | Not applicable | Not applicable | Sustained normotension | Sustained normotension |
| 130-139/80-89 | <130/80 | Not applicable | Not applicable | Sustained normotension | White coat hypertension |
| <130/80 | 130-134/80-84 | Not applicable | Not applicable | Sustained normotension | Masked hypertension |
| 130-139/80-89 | 130-134/80-84 | Not applicable | Not applicable | Sustained normotension | Sustained hypertension |
| <130/80 | ≥ 135/85 | Not applicable | Not applicable | Masked hypertension | Masked hypertension |
| 130-139/80-89 | ≥ 135/85 | Not applicable | Not applicable | Masked hypertension | Sustained hypertension |
| Phenotypes defined using office and awake, asleep, or 24-hour BP |  |  |
| <130/80 | <130/80 | <110/65 | <125/75 | Sustained normotension | Sustained normotension |
| 130-139/80-89 | <130/80 | <110/65 | <125/75 | Sustained normotension | White coat hypertension |
| <130/80 | 130-134/80-84 | 110-119/65-70 | 125-129/75-79 | Sustained normotension | Masked hypertension |
| 130-139/80-89 | 130-134/80-84 | 110-119/65-70 | 125-129/75-79 | Sustained normotension | Sustained hypertension |
| <130/80 | ≥ 135/85 | ≥ 120/70 | ≥ 130/80 | Masked hypertension | Masked hypertension |
| 130-139/80-89 | ≥ 135/85 | ≥ 120/70 | ≥ 130/80 | Masked hypertension | Sustained hypertension |
| ACC/AHA: American College of Cardiology/American Heart Association Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults; JNC7: The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; BP: blood pressure; SBP: systolic blood pressure; DBP: diastolic blood pressure.No shading indicates that all the criteria (office, awake, asleep, and 24-hour blood pressure) had to be met. Grey shading indicates that at least one of the criteria had to be met. If the criteria were not met, blood pressure had to be lower than the range given. |

|  |
| --- |
| Supplemental Table 4. Prevalence of blood pressure phenotypes defined using the combination of the JNC7 blood pressure guideline and the 2017 ACC/AHA blood pressure guideline among participants not taking and taking antihypertensive medication and restricted to participants with systolic blood pressure <140 mm Hg and diastolic blood pressure <90 mm Hg. |
|  | Using awake BP | Using awake, asleep, or 24-hour BP |
| Participants not taking antihypertensive medication (n=1,811) |  |  |
| JNC7 guideline | 2017 ACC/AHA guideline | Percentage (95% confidence interval) |
| Sustained normotension | Sustained normotension | 45.3 (43.0, 47.6) | 32.7 (30.6, 34.9) |
| Sustained normotension | White coat hypertension | 9.1 (7.8, 10.4) | 4.4 (3.4, 5.3) |
| Sustained normotension | Masked hypertension | 12.2 (10.7, 13.7) | 17.6 (15.8, 19.3) |
| Sustained normotension | Sustained hypertension | 8.4 (7.1, 9.7) | 8.3 (7.1, 9.6) |
| Masked hypertension | Masked hypertension | 10.6 (9.1, 12.0) | 17.8 (16.0, 19.5) |
| Masked hypertension | Sustained hypertension | 14.4 (12.8, 16.0) | 19.2 (17.4, 21.0) |
| Participants taking antihypertensive medication (n=640) |  |  |
| JNC7 guideline | 2017 ACC/AHA guideline | Percentage (95% confidence interval) |
| Sustained normotension | Sustained normotension | 36.8 (33.1, 40.6) | 16.1 (13.3, 18.9) |
| Sustained normotension | White coat hypertension | 10.3 (8.0, 12.7) | 2.7 (1.4, 3.9) |
| Sustained normotension | Masked hypertension | 10.3 (8.0, 12.7) | 17.7 (14.7, 20.6) |
| Sustained normotension | Sustained hypertension | 7.2 (5.2, 9.2) | 8.0 (5.9, 10.1) |
| Masked hypertension | Masked hypertension | 17.8 (14.9, 20.8) | 31.2 (27.7, 34.8) |
| Masked hypertension | Sustained hypertension | 17.5 (14.6, 20.4) | 24.4 (21.1, 27.7) |
| ACC/AHA: American College of Cardiology/American Heart Association Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults; JNC7: The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. The blood pressure levels for different phenotypes were provided in Supplemental Table 3. |
| Supplemental Table 5. Mean and mean difference in left ventricular mass (g/m2.7) associated with blood pressure phenotypes as defined using the JNC7 guideline and the 2017 ACC/AHA blood pressure guideline stratified by antihypertensive medication use, restricting to participants with systolic blood pressure <140 mm Hg and diastolic blood pressure <90 mm Hg. |
|  | Not taking antihypertensive medication | Taking antihypertensive medication |
| Phenotypes defined using office and awake BP |
| JNC7 guideline | 2017 ACC/AHA guideline | N | Mean (SD) | Mean difference (95% confidence interval) | N  | Mean (SD) | Mean difference (95% confidence interval) |
|  |  |  |  | Model 1 | Model 2 |  |  | Model 1 | Model 2 |
| Sustained normotension | Sustained normotension | 821 | 30.9 (8.1) | 0 (ref) | 0 (ref) | 236 | 39.8 (12.6) | 0 (ref) | 0 (ref) |
| Sustained normotension | White coat hypertension | 165 | 34.3 (7.5) | 1.16(0.13, 2.45) | 0.51(-0.98, 2.01) | 66 | 40.2 (12.5) | 2.02(-1.65, 5.69) | 0.99(-3.40, 5.39) |
| Sustained normotension | Sustained hypertension | 152 | 32.8 (8.3) | 0.17(-1.17, 1.50) | -0.47(-2.03, 1.09) | 46 | 41.9 (13.0) | 2.64(-1.56, 6.85) | 1.87(-2.89, 6.64) |
| Sustained normotension | Masked hypertension | 221 | 33.3 (9.9) | 1.96(0.83, 3.09) | 1.69(0.54, 2.85) | 66 | 37.9 (9.7) | -0.19(-3.91, 3.53) | -0.39(-4.09, 3.30) |
| Masked hypertension | Masked hypertension | 191 | 35.0 (9.3) | 1.88(0.57, 3.18) | 1.45(0.10, 2.79) | 114 | 41.4 (13.2) | 3.28(0.23, 6.33) | 2.75(-0.34, 5.84) |
| Masked hypertension | Sustained hypertension | 261 | 36.2 (8.3) | 3.92(2.71, 5.13) | 3.05(1.53, 4.56) | 112 | 43.0 (13.1) | 4.51(1.39, 7.62) | 3.21(-0.95, 7.36) |
| Phenotypes defined using office and awake, asleep, or 24-hour BP |
| JNC7 guideline | 2017 ACC/AHA guideline | N | Mean (SD) | Model 1 | Model 2 | N | Mean (SD) | Model 1 | Model 2 |
| Sustained normotension | Sustained normotension | 593 | 30.5 (8.1) | 0 (ref) | 0 (ref) | 103 | 39.5 (11.2) | 0 (ref) | 0 (ref) |
| Sustained normotension | White coat hypertension | 79 | 33.2 (7.0) | 1.05(-0.71, 2.81) | 0.16(-1.79, 2.11) | 17 | 37.7 (9.4) | 0.74(-6.07, 7.55) | -1.43(-8.72, 5.87) |
| Sustained normotension | Sustained hypertension | 151 | 32.8 (8.0) | 0.06(-1.30, 1.42) | -0.76(-2.37, 0.84) | 51 | 39.7 (10.6) | 3.03(-1.39, 7.46) | 2.38(-2.66, 7.42) |
| Sustained normotension | Masked hypertension | 318 | 31.9 (8.1) | 0.16(-0.87, 1.18) | -0.12(-1.16, 0.93) | 113 | 38.6 (10.6) | 0.96(-2.58, 4.51) | 0.71(-2.82, 4.24) |
| Masked hypertension | Masked hypertension | 322 | 34.7 (10.0) | 1.82(0.70, 2.94) | 1.32(0.14, 2.49) | 200 | 40.9 (13.8) | 3.24(-0.01, 6.49) | 2.89(-0.40, 6.19) |
| Masked hypertension | Sustained hypertension | 348 | 36.0 (8.3) | 3.11(1.96, 4.26) | 1.97(0.48, 3.46) | 156 | 43.1 (13.8) | 5.07(1.70, 8.44) | 3.98(-0.49, 8.45) |
| ACC/AHA: American College of Cardiology/American Heart Association Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults; JNC7: The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; BP: blood pressure; SD: standard deviation. Model 1: Adjusted for age, sex, less than high school, study, smoking status, alcohol consumption, family history of hypertension, total and high-density lipoprotein cholesterol, body mass index, prevalent diabetes, statin use, antihyperglycemic medication use, and estimated glomerular filtration rate < 60 mL/min/1.73 m2. Model 2: Adjusted for variables in Model 1 and office systolic BP and diastolic BP. |

|  |
| --- |
| Supplemental Table 6. Prevalence and prevalence ratio for left ventricular hypertrophy associated with blood pressure phenotypes as defined using the JNC7 guideline and the 2017 ACC/AHA blood pressure guideline stratified by antihypertensive medication use, restricting to participants with systolic blood pressure <140 mm Hg and diastolic blood pressure <90 mm Hg. |
|  | Not taking antihypertensive medication (N=1,811) | Taking antihypertensive medication (N=640) |
| Phenotypes defined using office and awake BP |
| JNC7 guideline | 2017 ACC/AHA guideline | Prevalence, n (%) | Prevalence ratio (95% CI) | Prevalence, n (%) | Prevalence ratio (95% CI) |
|  | Model 1 | Model 2 |  | Model 1 | Model 2 |
| Sustained normotension | Sustained normotension | 34 (4.1%) | 1 (ref) | 1 (ref) | 58 (24.6%) | 1 (ref) | 1 (ref) |
| Sustained normotension | White coat hypertension | 9 (5.5%) | 0.77(0.32, 1.85) | 0.46(0.18, 1.19) | 15 (22.7%) | 1.00(0.61, 1.65) | 0.83(0.45, 1.54) |
| Sustained normotension | Sustained hypertension | 7 (4.6%) | 0.60(0.21, 1.73) | 0.36(0.11, 1.14) | 14 (30.4%) | 1.33(0.74, 2.39 | 1.17(0.58, 2.34) |
| Sustained normotension | Masked hypertension | 19 (8.6%) | 2.12(1.22, 3.68) | 1.82(1.06, 3.12) | 8 (12.1%) | 0.65(0.33, 1.27) | 0.61(0.32, 1.18) |
| Masked hypertension | Masked hypertension | 19 (10.0%) | 2.00(1.08, 3.72) | 1.60(0.85, 3.02) | 32 (28.1%) | 1.36(0.92, 2.01) | 1.22(0.81, 1.84) |
| Masked hypertension | Sustained hypertension | 22 (8.4%) | 2.19(1.31, 3.63) | 1.21(0.62, 2.36) | 34 (30.4%) | 1.50(0.99, 2.27) | 1.21(0.70, 2.12) |
| Phenotypes defined using office and awake, asleep, or 24-hour BP  |
| JNC7 guideline | 2017 ACC/AHA guideline | Prevalence, n (%) | Prevalence ratio (95% CI) | Prevalence, n (%) | Prevalence ratio (95% CI) |
|  | Model 1 | Model 2 |  | Model 1 | Model 2 |
| Sustained normotension | Sustained normotension | 20 (3.4%) | 1 (ref) | 1 (ref) | 29 (28.2%) | 1 (ref) | 1 (ref) |
| Sustained normotension | White coat hypertension | 2 (2.5%) | 0.35(0.05, 2.39) | 0.18(0.02, 1.51) | 1 (5.9%) | 0.29(0.05, 1.62) | 0.19(0.04, 0.85) |
| Sustained normotension | Sustained hypertension | 6 (4.0%) | 1.01(0.50, 2.06) | 0.84(0.41, 1.73) | 15 (29.4%) | 1.41(0.78, 2.56) | 1.14(0.56, 2.31) |
| Sustained normotension | Masked hypertension | 14 (4.4%) | 0.78(0.30, 2.06) | 0.43(0.14, 1.35) | 22 (19.5%) | 0.91(0.53, 1.55) | 0.88(0.51, 1.51) |
| Masked hypertension | Masked hypertension | 38 (11.8%) | 2.23(1.23, 4.06) | 1.76(0.93, 3.33) | 47 (23.5%) | 1.05(0.67, 1.63) | 0.98(0.62, 1.54) |
| Masked hypertension | Sustained hypertension | 30 (8.6%) | 1.87(1.01, 3.45) | 0.97(0.42, 2.26) | 47 (30.1%) | 1.30(0.83, 2.03) | 1.02(0.56, 1.87) |
| ACC/AHA: American College of Cardiology/American Heart Association Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults; JNC7: The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; BP: blood pressure; CI: confidence interval.Model 1: Adjusted for age, sex, less than high school, study, smoking status, alcohol consumption, family history of hypertension, total and high-density lipoprotein cholesterol, body mass index, prevalent diabetes, statin use, antihyperglycemic medication use, and estimated glomerular filtration rate < 60 mL/min/1.73 m2. Model 2: Adjusted for variables in Model 1 and office systolic BP and diastolic BP.  |

**References**:

1. Levey AS, Stevens LA, Schmid CH, Zhang YL, Castro AF, 3rd, Feldman HI, Kusek JW, Eggers P, Van Lente F, Greene T *et al*: **A new equation to estimate glomerular filtration rate**. *Annals of internal medicine* 2009, **150**(9):604-612.

2. Seals SR, Colantonio LD, Tingle JV, Shimbo D, Correa A, Griswold ME, Muntner P: **Calibration of blood pressure measurements in the Jackson Heart Study**. *Blood pressure monitoring* 2019, **24**(3):130-136.