



Published in final edited form as:

JAMA Intern Med. 2014 August ; 174(8): 1397–1400. doi:10.1001/jamainternmed.2014.2492.

## Prevalence and Characteristics of Systolic Blood Pressure Thresholds in Individuals Aged 60 Years and Older

Daichi Shimbo, MD<sup>1</sup>, Rikki M. Tanner, MPH<sup>2</sup>, and Paul Muntner, PhD<sup>2</sup>

<sup>1</sup>Department of Medicine, Columbia University Medical Center, New York, NY

<sup>2</sup>Department of Epidemiology, University of Alabama at Birmingham, Birmingham, AL

### TO THE EDITOR

For over 20 years, US Joint National Committee (JNC) hypertension guidelines, including JNC7, have recommended systolic and diastolic blood pressure (SBP and DBP) thresholds of 140/90 mmHg for initiating antihypertensive medication and goal attainment while on treatment for individuals without diabetes or chronic kidney disease (CKD).<sup>1, 2</sup> The 2014 Evidence-Based Guideline for the Management of High Blood Pressure in Adults Report from the panel members appointed to JNC8 recently recommended a higher SBP threshold (150 mmHg) for treatment initiation and goal attainment in adults 60 years and older.<sup>3</sup> We estimated the percentage and characteristics of older US adults potentially affected by the new SBP threshold.

### Methods

We used data from the National Health and Nutrition Examination Surveys (NHANES) 2005–2010.<sup>4</sup> NHANES includes cross-sectional, multistage, stratified probability samples of the US civilian non-institutionalized population. Data were collected through interviews, a medical evaluation and a pill bottle review. We included 5,797 participants 60 years or older who completed a medical evaluation in the mobile examination center. The response rate for this age group was 65.0%.<sup>4</sup> BP was measured three times by trained physicians using sphygmomanometers and appropriately sized cuffs. Analyses were limited to 5,157 participants with data on BP and antihypertensive medication. NHANES' protocols were

---

**Corresponding author:** Daichi Shimbo, MD, 622 West 168<sup>th</sup> Street, PH 9-310, New York, NY 10032, Telephone: (212) 305-4490, Fax: (646) 304-7003, ds2231@cumc.columbia.edu.

There are no other potential conflicts of interest.

**Author Contributions:** Daichi Shimbo (Columbia University Medical Center) and Rikki Tanner (University of Alabama at Birmingham) had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Paul Muntner and Rikki Tanner (University of Alabama at Birmingham) conducted the data analysis.

*Study concept and design:* Shimbo, Muntner

*Acquisition, analysis or interpretation of data:* Shimbo, Tanner, Muntner

*Drafting of the manuscript:* Shimbo

*Critical revision of the manuscript for important intellectual content:* Tanner, Muntner

*Statistical analysis:* Tanner, Muntner

*Administrative, technical, or material support:* Shimbo, Tanner, Muntner

*Study supervision:* Shimbo, Muntner

approved by the Centers for Disease Control and Prevention Institutional Review Board. Participants provided written informed consent.

Analyses were conducted stratified by antihypertensive medication use. The distribution of SBP (<140, 140–149, 150 mmHg) was calculated for the entire sample, and in men and women, separately. Characteristics of the sample were calculated by SBP category. Differences in participant characteristics for those with SBP <140 and 150 mmHg versus 140–149 mmHg were evaluated using logistic and linear regression. P values <0.05 were considered statistically significant. Analyses were performed using SUDAAN 10.1 (Research Triangle Institute, Research Triangle Park, NC) taking into account the sampling design of NHANES.

## Results

Of untreated older adults, 29.4% (95% CI 26.8%–32.2%) had SBP at or above the JNC7 threshold of 140 mmHg. This percentage decreased to 16.3% (95% CI 14.5%–18.3%) with SBP that exceeded the JNC8 threshold of 150 mmHg (Table 1). Among treated older adults, 36.3% (95% CI 34.1%–38.7%) had SBP at or above the 140 mmHg threshold. This percentage decreased to 20.5% (95% CI 18.5%–22.6%) with SBP that exceeded the 150 mmHg threshold. Overall, 13.1% (95% CI 11.1%–15.5%) and 15.8% (95% CI 14.3%–17.5%) of untreated and treated participants had SBP of 140–149 mmHg, respectively. The percentages were similar in men and women and among participants without diabetes or CKD.

Untreated participants with SBP of 140–149 mmHg versus <140 mm Hg were more likely to be 80 years or older, have an estimated glomerular filtration rate <60 ml/min/1.73 m<sup>2</sup> and DBP ≥90 mmHg; and less likely to have history of myocardial infarction (Table 2). Treated participants with SBP of 140–149 mmHg versus <140 mm Hg were more likely to have albuminuria, a history of stroke, DBP ≥90 mmHg, and be taking only 1 class of antihypertensive medication.

## Discussion

Many older US adults are no longer eligible for antihypertensive medication initiation or intensification according to JNC8 guidelines.<sup>5</sup> However, achieving goal blood pressure remains a substantial challenge under the new guidelines. As highlighted in the current study, more older adults have SBP ≥150 mmHg than 140–149 mmHg. Study limitations include reliance on BP from a single visit; absence of ambulatory BP monitoring; small sample sizes in some BP categories; and lack of data on antihypertensive medication indication, adherence and dosing. Until data on the benefits of a lower SBP threshold become available, therapy in older adults should focus on patients with SBP ≥150 mmHg.

## Acknowledgments

NHANES exam data were gathered by the NCHS CDC with additional support for cardiovascular exam components from National Heart, Lung, and Blood Institute (NHLBI) at the National Institutes of Health (NIH) through an Interagency Agreement (Y1-HC-8039). Support was also partially provided through P01-HL047540 (Dr. Shimbo) from NHLBI. The funding sources had no role in the design and conduct of the study; collection,

management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication. Dr. Muntner received an institutional grant from Amgen Inc and has served on an advisory board for Amgen Inc.

## References

1. The fifth report of the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure (JNC V). *Arch Intern Med.* Jan 25; 1993 153(2):154–183. [PubMed: 8422206]
2. Chobanian AV, Bakris GL, Black HR, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. *JAMA.* May 21; 2003 289(19):2560–2572. [PubMed: 12748199]
3. James PA, Oparil S, Carter BL, et al. 2014 evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). *JAMA.* 201310.1001/jama.2013.284427
4. Centers for Disease Control and Prevention; National Center for Health Statistics. National Health and Nutrition Examination Survey Questionnaire. [http://www.cdc.gov/nchs/nhanes/nhanes\\_questionnaires.htm](http://www.cdc.gov/nchs/nhanes/nhanes_questionnaires.htm). Accessed March 31, 2014
5. Navar-Boggan AM, Pencina MJ, Williams MS, Sniderman AD, Peterson ED. Proportion of US Adults Potentially Affected by the 2014 Hypertension Guideline. *JAMA.* 201410.1001/jama.2014.2531

**Table 1**

Distribution of SBP for US adults  $\geq 60$  years of age not taking and taking antihypertensive medication in the overall sample, among men and women, and among participants without diabetes or chronic kidney disease, NHANES 2005–2010.

	Prevalence (95% CI) – Overall population		
	SBP, mmHg		
Not taking antihypertensive medication	<140	140 – 149	150
Overall	70.6 (67.8, 73.2)	13.1 (11.1, 15.5)	16.3 (14.5, 18.3)
Men	74.2 (70.3, 77.7)	12.3 (9.9, 15.3)	13.5 (11.3, 16.0)
Women	67.3 (63.6, 70.8)	13.9 (11.4, 16.8)	18.9 (16.6, 21.4)
Taking antihypertensive medication			
Overall	63.7 (61.3, 65.9)	15.8 (14.3, 17.5)	20.5 (18.5, 22.6)
Men	67.3 (64.2, 70.3)	16.2 (14.0, 18.7)	16.5 (13.9, 19.4)
Women	61.0 (58.1, 63.9)	15.6 (13.3, 18.2)	23.4 (21.1, 25.8)
	Number of US adults $\geq 60$ years of age in millions (95% CI) – Overall population		
	SBP, mmHg		
Not taking antihypertensive medication	<140	140 – 149	150
Overall	17.304 (15.377, 19.231)	3.223 (2.639, 3.807)	3.998 (3.387, 4.610)
Men	8.587 (7.415, 9.759)	1.428 (1.079, 1.777)	1.557 (1.283, 1.831)
Women	8.716 (7.720, 9.712)	1.795 (1.430, 2.160)	2.441 (2.008, 2.874)
Taking antihypertensive medication			
Overall	16.907 (14.775, 19.040)	4.208 (3.642, 4.774)	5.444 (4.664, 6.224)
Men	7.442 (6.350, 8.534)	1.788 (1.437, 2.139)	1.822 (1.463, 2.181)
Women	9.465 (8.248, 10.682)	2.419 (2.029, 2.809)	3.623 (3.070, 4.176)
	Prevalence (95% CI) – Population without diabetes or CKD		
	SBP, mmHg		
Not taking antihypertensive medication	<140	140 – 149	150
Overall	73.2 (69.4, 76.6)	12.0 (9.8, 14.7)	14.9 (12.4, 17.7)
Men	75.3 (70.8, 79.2)	11.9 (9.4, 14.9)	12.8 (10.2, 16.1)
Women	71.4 (66.2, 76.0)	12.1 (9.0, 16.0)	16.6 (13.3, 20.4)
Taking antihypertensive medication			
Overall	67.0 (63.3, 70.5)	16.1 (13.7, 18.8)	16.9 (14.1, 20.1)
Men	69.9 (64.6, 74.8)	17.4 (13.7, 21.9)	12.7 (9.2, 17.2)
Women	64.8 (59.8, 69.6)	15.1 (11.4, 19.7)	20.1 (16.0, 24.9)
	Number of US adults $\geq 60$ years of age in millions (95% CI) – Population without diabetes or CKD		
	SBP, mmHg		
Not taking antihypertensive medication	<140	140 – 149	150
Overall	11.568 (10.143, 12.993)	1.895 (1.489, 2.301)	2.348 (1.923, 2.773)
Men	5.508 (4.640, 6.376)	0.871 (0.646, 1.096)	0.940 (0.748, 1.132)

	Prevalence (95% CI) – Overall population		
	SBP, mmHg		
Women	6.060 (5.275, 6.845)	1.024 (0.712, 1.336)	1.408 (1.057, 1.759)
<b>Taking antihypertensive medication</b>			
Overall	7.381 (6.238, 8.524)	1.773 (1.448, 2.098)	1.859 (1.494, 2.224)
Men	3.318 (2.710, 3.926)	0.826 (0.587, 1.065)	0.601 (0.413, 0.789)
Women	4.063 (3.345, 4.781)	0.947 (0.621, 1.273)	1.258 (0.918, 1.599)

Data in table are number or percent (95% confidence interval). Data are weighted and accounted for the complex sampling design. Numbers were estimated by weighting the NHANES data to US census data. NHANES sampling weights were recalibrated to account for missing data. Some percentages do not add up to 100% due to rounding. CKD: chronic kidney disease.

**Table 2**  
 Characteristics of US adults 60 years of age not taking and taking antihypertensive medication by SBP, NHANES 2005–2010.

Characteristics	Not taking antihypertensive medication			P value <sup>a</sup>	P value <sup>b</sup>
	<140 (n=1,661)	SBP, mmHg 140 – 149 (n=327)	150 (n=445)		
Age group, %					
60 – 69 years	59.9 (57.1, 62.6)	54.0 (47.0, 61.0)	39.9 (33.9, 46.2)	ref	ref
70 – 79 years	27.1 (25.3, 29.1)	24.7 (20.5, 29.3)	32.1 (26.5, 38.3)	0.95	0.01
80 years	13.0 (10.9, 15.4)	21.3 (16.9, 26.5)	28.0 (23.6, 32.8)	0.002	0.01
Women, %	50.4 (47.4, 53.4)	55.7 (49.1, 62.1)	61.1 (56.5, 65.4)	0.18	0.11
Race/Ethnicity, %					
Non-hispanic white	83.8 (80.3, 86.8)	83.8 (78.0, 88.3)	77.0 (71.2, 82.0)	ref	ref
Non-hispanic black	5.3 (4.1, 6.9)	6.5 (4.3, 9.9)	8.6 (6.2, 11.7)	0.35	0.12
Hispanic	6.9 (5.4, 8.9)	7.6 (5.0, 11.3)	8.8 (6.0, 12.7)	0.63	0.29
Other	3.9 (2.7, 5.7)	2.1 (0.8, 5.9)	5.6 (3.6, 8.7)	0.28	0.08
Diabetes mellitus, %	11.0 (9.4, 12.9)	11.2 (7.7, 16.1)	10.7 (7.7, 14.6)	0.94	0.83
C-reactive protein > 3 mg/L, %	33.9 (31.6, 36.3)	36.0 (29.4, 43.1)	39.1 (32.6, 46.0)	0.56	0.52
eGFR < 60 ml/min/1.73m <sup>2</sup> , %	21.0 (18.9, 23.3)	28.3 (21.2, 36.7)	24.4 (20.0, 29.5)	0.046	0.38
Albuminuria, %	9.8 (8.3, 11.6)	12.3 (8.5, 17.6)	24.7 (18.9, 31.4)	0.28	<0.001
History of myocardial infarction, %	8.1 (6.9, 9.6)	3.4 (1.7, 7.0)	5.6 (3.5, 9.0)	0.02	0.35
History of stroke, %	4.0 (2.9, 5.5)	3.5 (1.9, 6.4)	6.3 (3.8, 10.1)	0.72	0.15
1 Impaired ADLs, %	17.1 (15.1, 19.3)	13.6 (11.3, 16.3)	17.2 (12.6, 22.9)	0.06	0.14
1 Impaired IADLs, %	17.4 (15.4, 19.6)	15.8 (11.6, 21.3)	18.2 (14.2, 23.1)	0.60	0.45
DBP 90 mmHg, %	0.8 (0.4, 1.5)	4.8 (2.4, 9.4)	13.4 (10.0, 17.6)	<0.001	0.01
	<b>Taking antihypertensive medication</b>				
	SBP, mmHg				
Characteristics	<140 (n=1,697)	140 – 149 (n=419)	150 (n=608)	P value <sup>a</sup>	P value <sup>b</sup>
Age group, %					
60 – 69 years	46.9 (43.8, 50.1)	47.6 (42.1, 53.2)	32.8 (28.4, 37.5)	ref	ref

	Not taking antihypertensive medication				P
	SBP, mmHg				
70 – 79 years	36.0 (33.1, 38.9)	32.1 (27.7, 36.8)	35.9 (30.8, 41.4)	0.26	0.02
80 years	17.1 (14.9, 19.6)	20.3 (16.7, 24.4)	31.3 (26.3, 36.7)	0.35	<0.001
Women, %	56.0 (53.3, 58.7)	57.5 (51.6, 63.2)	66.5 (62.1, 70.7)	0.65	0.02
Race/Ethnicity, %					
Non-hispanic white	80.0 (75.8, 83.5)	79.1 (74.2, 83.4)	73.4 (67.7, 78.5)	ref	ref
Non-hispanic black	10.5 (8.2, 13.3)	10.5 (8.0, 13.8)	14.5 (11.4, 18.3)	0.92	0.02
Hispanic	5.4 (3.7, 7.7)	5.7 (4.0, 8.0)	7.7 (4.9, 11.7)	0.65	0.03
Other	4.2 (2.7, 6.5)	4.6 (2.6, 8.3)	4.4 (2.7, 7.1)	0.74	0.96
Diabetes mellitus, %	24.6 (21.8, 27.6)	26.9 (21.8, 32.6)	28.7 (23.6, 34.5)	0.49	0.63
C-reactive protein > 3 mg/L, %	40.8 (37.7, 44.0)	39.2 (31.9, 47.1)	44.3 (39.3, 49.5)	0.73	0.14
eGFR < 60 ml/min/1.73m <sup>2</sup>	38.4 (35.7, 41.1)	39.5 (33.9, 45.3)	39.0 (33.9, 44.5)	0.73	0.91
Albuminuria, %	17.5 (15.1, 20.2)	24.8 (20.6, 29.6)	39.5 (34.6, 44.6)	<0.001	<0.001
History of myocardial infarction, %	11.4 (9.3, 13.9)	12.7 (9.2, 17.3)	10.9 (7.8, 15.0)	0.57	0.45
History of stroke, %	11.0 (9.0, 13.4)	15.7 (11.7, 20.7)	11.8 (8.4, 16.4)	0.02	0.21
Impaired ADLs, %	23.6 (21.0, 26.4)	25.3 (21.5, 29.6)	26.3 (22.1, 30.9)	0.44	0.77
Impaired IADLs, %	26.9 (24.3, 29.8)	30.3 (25.6, 35.5)	30.2 (26.5, 34.1)	0.24	0.96
DBP 90 mmHg, %	1.0 (0.6, 1.6)	5.7 (3.4, 9.4)	11.7 (9.1, 15.0)	<0.001	0.02
Number of antihypertensive medications, %					
0 classes	0.0	0.0	0.0	—	—
1 class	29.5 (26.8, 32.4)	38.9 (33.1, 45.1)	31.2 (26.5, 36.4)	ref	ref
2 classes	37.3 (34.7, 39.9)	31.0 (26.7, 35.6)	33.4 (29.1, 37.9)	0.004	0.09
3 classes	33.2 (29.7, 36.9)	30.1 (24.1, 36.9)	35.4 (30.4, 40.8)	0.05	0.06

Numbers in table are percent (95% confidence interval). Percentages are weighted and accounted for the complex sampling design.

ADLs: activities of daily living; BP: blood pressure; eGFR: Estimated glomerular filtration rate; IADLs: instrumental activities of daily living.

<sup>a</sup>Comparing SBP 140 – 149 mmHg to SBP < 140 mmHg.

<sup>b</sup>Comparing SBP 150 mmHg to SBP 140 – 149 mmHg.