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Mean Systolic and Diastolic Blood Pressure in Adults Aged 18 and Over in the United States, 2001–2008

by Jacqueline D. Wright, Dr.P.H.; Jeffery P. Hughes, M.P.H.; Yechiam Ostchega, Ph.D., R.N.;
Sung Sug Yoon, Ph.D.; and Tatiana Nwankwo, M.S., Division of Health and Nutrition Examination Surveys,
National Center for Health Statistics

Abstract

Objective—This report presents estimates for the period 2001–2008 of means and selected percentiles of systolic and diastolic blood pressure by sex, race or ethnicity, age, and hypertension status in adults aged 18 and over.

Methods—Demographic characteristics were collected during a personal interview, and blood pressures were measured during a physician examination. All estimates were calculated using the mean of up to three measurements. The final analytic sample consisted of 19,921 adults aged 18 and over with complete data. Examined sample weights and sample design variables were used to calculate nationally representative estimates and standard error estimates that account for the complex design, using SAS and SUDAAN statistical software.

Results—Mean systolic blood pressure was 122 mm Hg for all adults aged 18 and over; it was 116 mm Hg for normotensive adults, 130 mm Hg for treated hypertensive adults, and 146 mm Hg for untreated hypertensive adults. Mean diastolic blood pressure was 71 mm Hg for all adults 18 and over; it was 69 mm Hg for normotensive adults, 75 mm Hg for treated hypertensive adults, and 85 mm Hg for untreated hypertensive adults. There was a trend of increasing systolic blood pressure with increasing age. A more curvilinear trend was seen in diastolic blood pressure, with increasing then decreasing means with age in both men and women. Men had higher mean systolic and diastolic pressures than women. There were some differences in mean blood pressure by race or ethnicity, with non-Hispanic black adults having higher mean systolic and diastolic blood pressures than non-Hispanic white and Mexican-American adults, but these differences were not consistent after stratification by hypertension status and sex.

Conclusions—These estimates of the distribution of blood pressure may be useful for policy makers who are considering ways to achieve a downward shift in the population distribution of blood pressure with the goal of reducing morbidity and mortality related to hypertension.

Keywords: cross-sectional studies • ethnic groups • hypertension • National Health and Nutrition Examination Survey (NHANES)

Introduction

Although mortality due to heart disease has declined over the past 15 years, it remains the leading cause of death in the United States (1). The most recent report on hypertension (2), which used data from the National Health and Nutrition Examination Survey (NHANES), estimated that 30% of adults aged 18 and over had hypertension. No significant change was observed between 1999–2000 and 2007–2008. The *Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure* (JNC 7) (3) reaffirmed that the relationship between blood pressure and cardiovascular disease is continuous, with increased blood pressure associated with higher risk of heart attack, heart failure, stroke, and kidney disease. In recognition of the continuous risk associated with higher blood pressure, the objective of this report was to estimate the mean and distribution of systolic and diastolic blood pressure for adults 18 and over using data from NHANES 2001–2008. Estimated means and selected percentiles of systolic and diastolic blood pressure are presented by sex, race or ethnicity, age, and hypertension status.



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Center for Health Statistics



Methods

Data source

NHANES is conducted on a continuous basis to monitor the health and nutritional status of the U.S. population. The survey sampled the civilian noninstitutionalized U.S. population residing in the 50 states and the District of Columbia. During 2001–2006, the NHANES sample design included an oversampling of the following groups: low-income persons, adolescents aged 12–19, persons aged 60 and over, and African-American and Mexican-American persons. In 2007–2008, the subdomains that were oversampled were changed to include low-income persons, African-American and all Hispanic (not just Mexican-American) persons, and persons aged 60 and over. The survey consisted of a personal interview in the household, followed by an examination in a mobile examination center (MEC). The MEC allows greater standardization of examination procedures and measurements and has been a key design element of the survey for 50 years. A description of the survey design and data collection procedures has been published for each of the 2-year survey cycles examined here: 2001–2002, 2003–2004, 2005–2006, and 2007–2008 (4–7).

Interview and examination methods

Information on demographic characteristics was collected during the personal interview, and blood pressures were measured during the physician examination. Detailed descriptions of the blood pressure measurement procedures and an evaluation study of the effect of training procedures for blood pressure measurement for 1999–2000 have been published elsewhere (8–12). Blood pressure was measured in accordance with the current recommendations of the American Heart Association (13). For the present report, all estimates were calculated using the mean of up to three measurements. Three hypertension status categories were used: *normal or*

normotensive was defined as reporting no use of antihypertensive medication, with a mean systolic blood pressure of less than 140 mm Hg and mean diastolic blood pressure less than 90 mm Hg; *treated hypertensive* was defined as reporting use of antihypertensive medication regardless of the level of measured blood pressure (i.e., including both controlled and uncontrolled hypertension); and *untreated hypertensive* was defined as reporting no use of antihypertensive medication with a mean systolic blood pressure of 140 mm Hg or higher or mean diastolic blood pressure of 90 mm Hg or higher.

Statistical methods

The eligible sample for all four survey periods consisted of 51,722 persons of all ages, and the examined sample consisted of 39,832, giving an examined response rate of 77%. Of 22,224 examined adults aged 18 and over, the final analytic sample with complete data was 19,921 after exclusion of 916 persons with missing data for all measured systolic or diastolic blood pressure, 397 persons who had all diastolic blood pressure measurements recorded as zero, and 990 women who were pregnant at the time of the exam. Sample sizes for all analyses are provided in the Table in “Technical Notes.”

Analyses were conducted using SAS (version 9.2; SAS Institute, Cary, NC) and SUDAAN (version 10.0; Research Triangle Institute, Research Triangle Park, NC) with examined sample weights and sample design variables to produce nationally representative estimates and standard error estimates that account for the clustered design (14). All means presented were adjusted for age except for age-specific means. Age adjustment was performed by the direct method using the 2000 U.S. population with the following three age groups: 18–39 years, 40–59 years, and 60 years and over (15). To graphically display distributions of mean blood pressure, two smoothing algorithms were used. For Figures 1 and 2 showing mean blood pressure by age, the LOESS method was used with the

SAS procedure SGPLOT (16). For Figures 5–8, in order to display the distributions of blood pressure by sex, age, and hypertension status, systolic and diastolic blood pressures were smoothed using a nonparametric kernel density estimate with the SAS procedure SGPPANEL (16). Differences in the distribution of hypertension status and demographic factors were tested using chi-square statistics with an alpha level of 0.05. Differences between group means were tested using *t* tests with an alpha level of 0.05 and adjustment for multiple comparisons using the Bonferroni method (17). Trends in age were tested using Satterthwaite-adjusted *F* statistics from linear regressions and orthogonal quadratic contrasts with an alpha level of 0.05. All differences reported here were statistically significant at the 0.05 alpha level.

Results

Demographic characteristics

The distribution of hypertension status among adults aged 18 and over for the study period from 2001 through 2008 is shown in Table 1 by sex, race or ethnicity, and age. Among men, 71.6% were classified as normotensive, 17.5% as treated hypertensive, and 10.9% as untreated hypertensive. Among women the percentages were 69.7%, 21.5%, and 8.9%, respectively. The distribution of hypertension status was statistically different across sex, race or ethnicity, and age groups. For example, adults aged 18–39 were more likely to be classified as normotensive than those in the two older age groups. Mexican-American adults were more likely to be classified as normotensive than non-Hispanic white or non-Hispanic black adults. Men were more likely to be classified as normotensive than women. With controlled hypertension being defined in this study as reporting use of antihypertensive medication and having measured systolic blood pressure below 140 mm Hg and measured diastolic blood pressure below 90 mm Hg, 11.7% of men and 13.0% of women had controlled hypertension. The low percentage of treated hypertensive adults

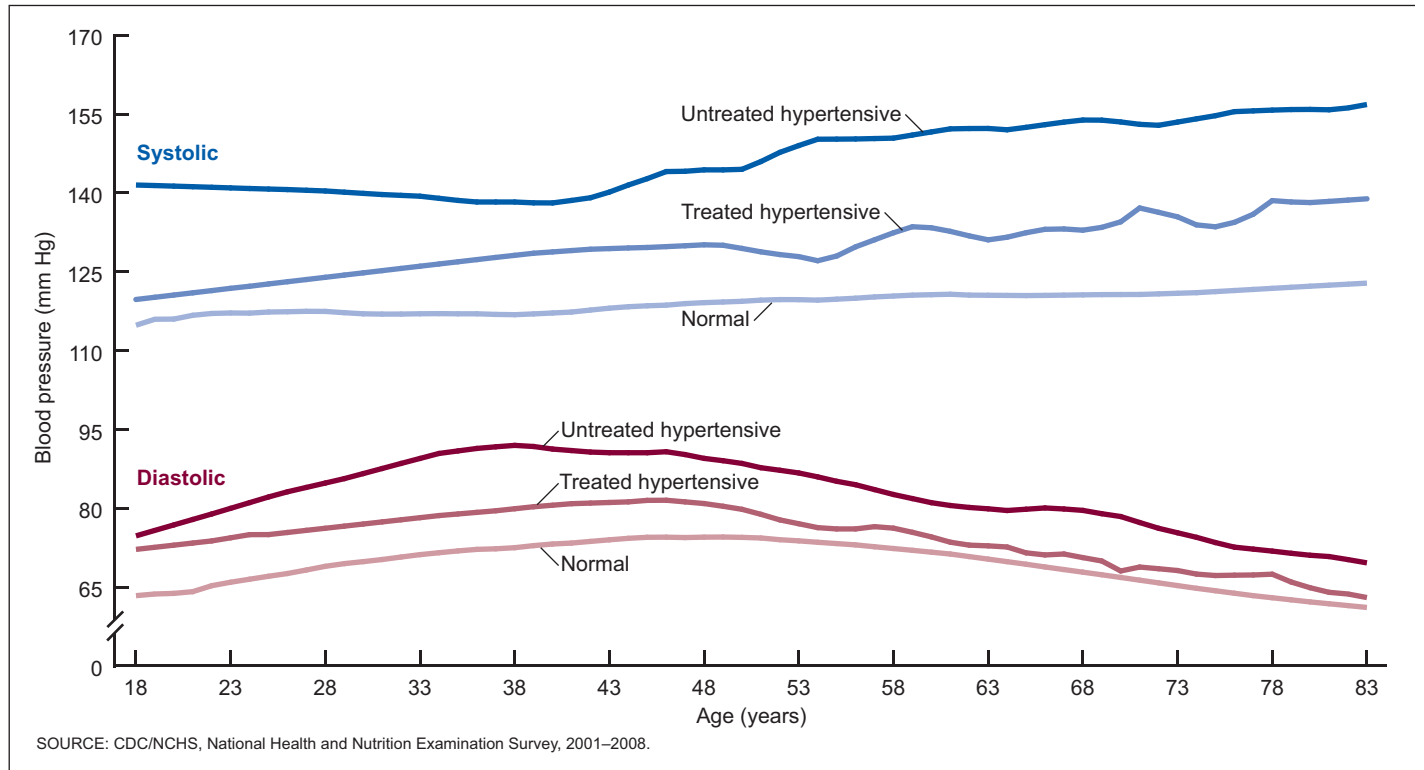


Figure 1. Mean systolic and diastolic blood pressure for men aged 18 years and over, by age and hypertension status

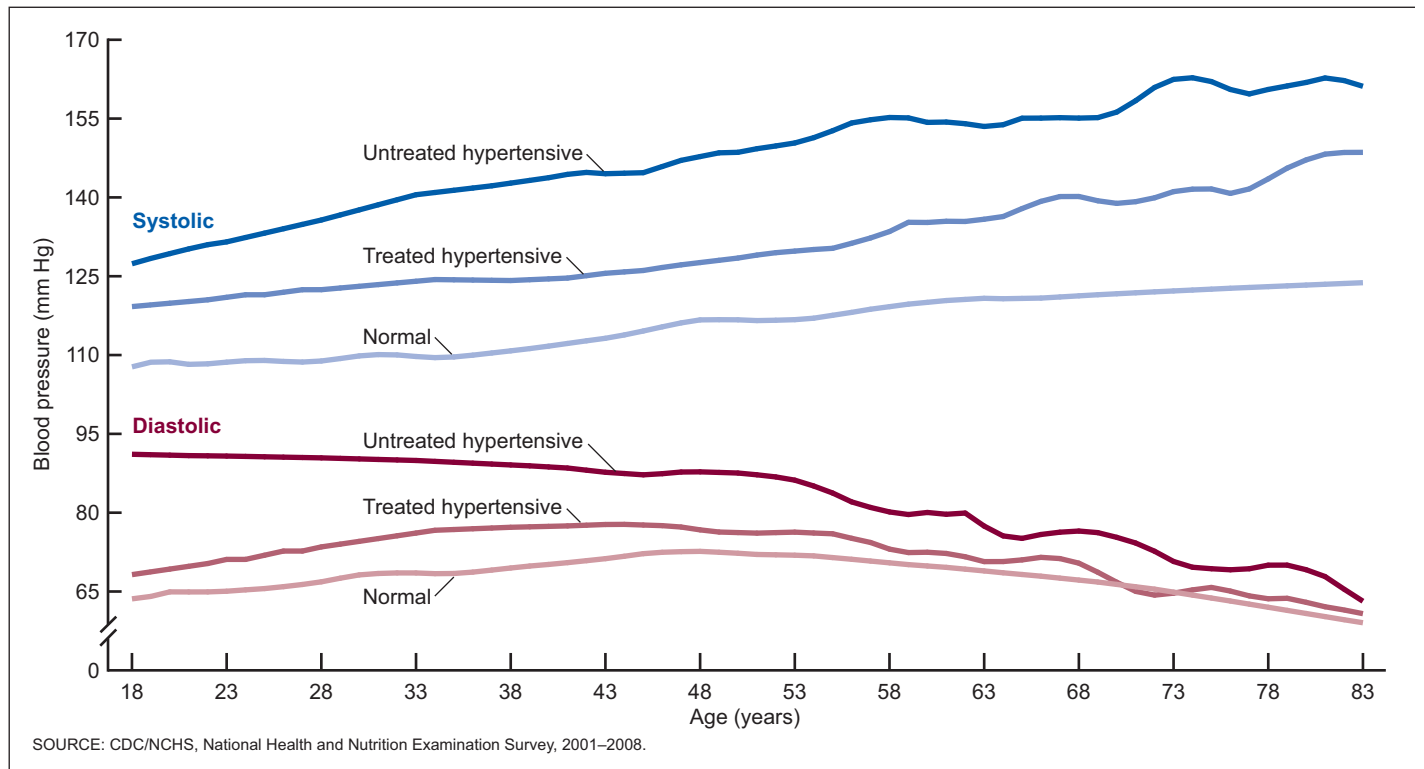


Figure 2. Mean systolic and diastolic blood pressure for women aged 18 years and over, by age and hypertension status

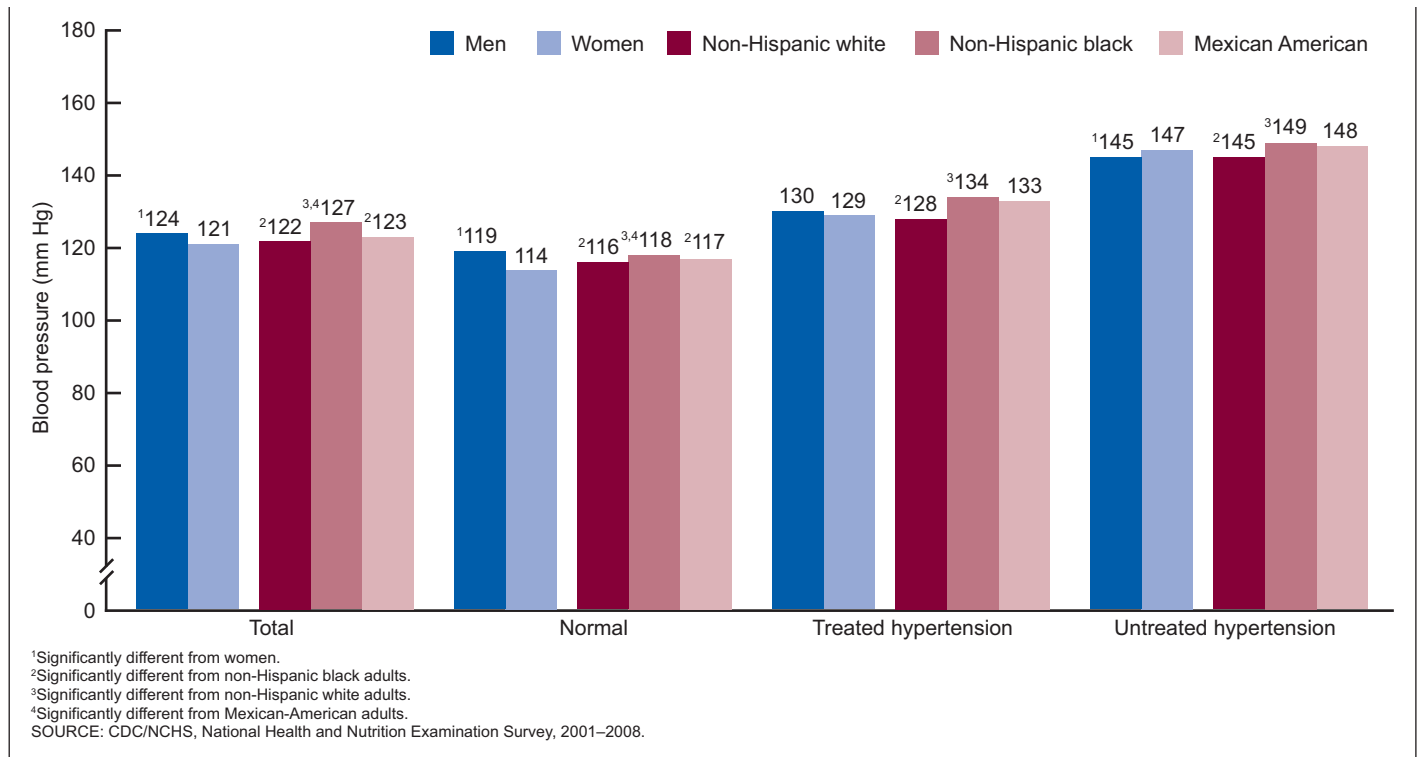


Figure 3. Age-adjusted mean systolic blood pressure (mm Hg) in adults aged 18 years and over, by hypertension status, sex, and race or ethnicity: United States, 2001–2008

in certain demographic groups, namely among those aged 18–39 (2.7%) and among Mexican-American persons (8.8%), precluded analyses stratified by whether hypertension was controlled.

Mean systolic blood pressure

Mean systolic blood pressure was 122 mm Hg for all adults 18 and over; it was 116 mm Hg for normotensive adults, 130 mm Hg for treated hypertensive adults, and 146 mm Hg for untreated hypertensive adults (Table 2). The trends with age can be seen for men and women for the three hypertension status categories (Figures 1 and 2). There was a significant linear trend of increasing mean systolic blood pressure with increasing age in men and women in all three hypertension status categories (Tables 3 and 4). Among all adults, a significant linear trend of increasing mean systolic blood pressure with increasing age was seen among all categories of hypertension status and race or ethnicity except among treated hypertensive Mexican-American adults

(Table 2). There was a significant linear trend in all categories of hypertension status among men of all races or ethnicities and among non-Hispanic white men (Table 3). The trend was significant in non-Hispanic black men only in the total and untreated hypertensive categories and in Mexican-American men in the total, normotensive, and untreated hypertensive categories. Among women, a significant linear trend was observed in all categories of hypertension status and race or ethnicity (Table 4).

Men had higher mean systolic blood pressure than women in the total population and in all hypertension status categories except in treated hypertensive adults (Figure 3). In the total population and in the normotensive population, comparing adults aged 18 and over revealed significant differences in the age-adjusted mean systolic blood pressure between non-Hispanic white and non-Hispanic black adults and between Mexican-American and non-Hispanic black adults (Figure 3 and Table 2). Non-Hispanic black adults had significantly higher mean systolic blood

pressure than non-Hispanic white adults or Mexican-American adults. These racial or ethnic differences persisted when mean blood pressures for men and women were examined separately in the total population, and the differences were significant only in women in the normotensive population (Tables 3 and 4). In the treated and untreated hypertensive populations, non-Hispanic black adults had significantly higher mean systolic blood pressure than non-Hispanic white adults (Figure 3 and Table 2). These racial or ethnic differences were also significant in men and in treated hypertensive women (Tables 3 and 4).

Mean diastolic blood pressure

Mean diastolic blood pressure was 71 mm Hg for all adults aged 18 and over; it was 69 mm Hg for normotensive adults, 75 mm Hg for treated hypertensive adults, and 84 mm Hg for untreated hypertensive adults (Table 5). There was a significant quadratic trend of increasing then

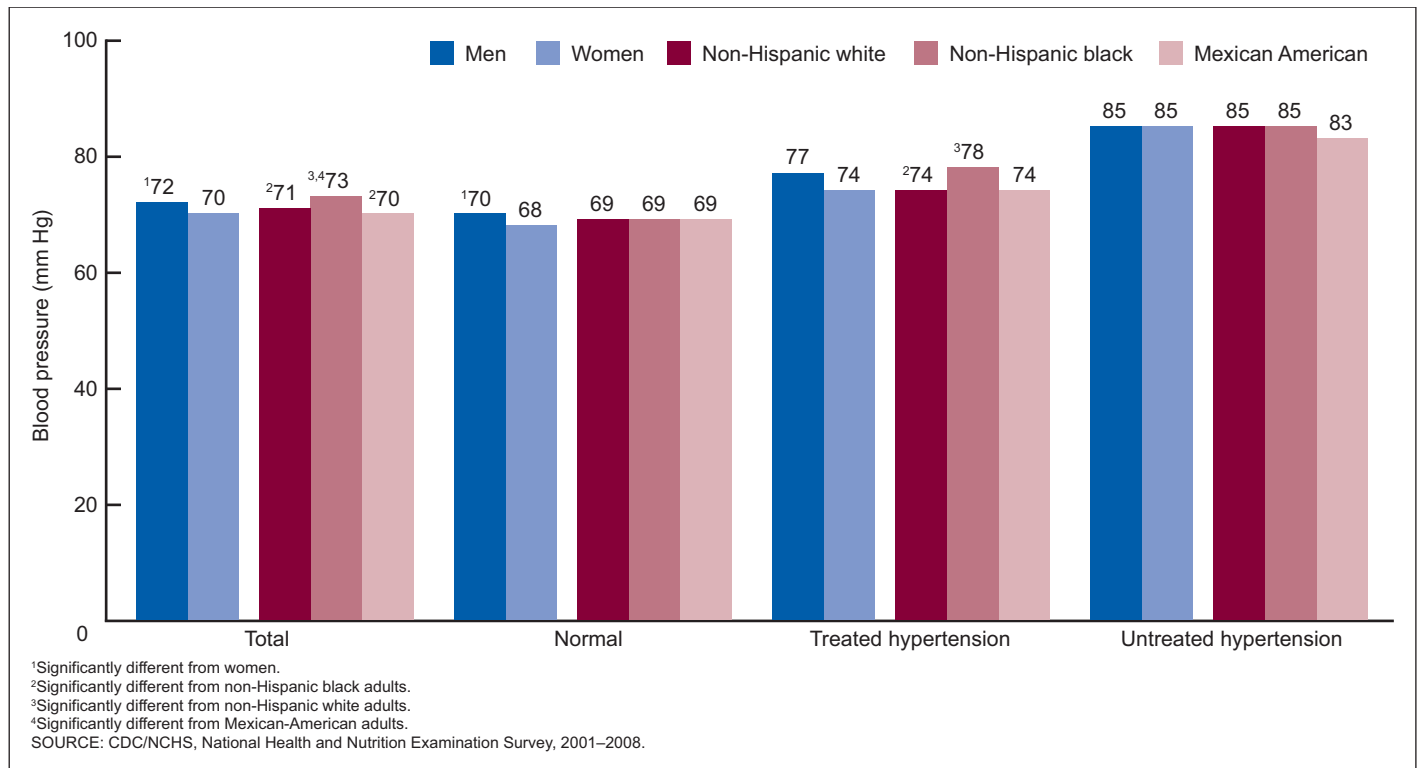


Figure 4. Age-adjusted mean diastolic blood pressure (mm Hg) in adults aged 18 years and over, by hypertension status, sex, and race or ethnicity: United States, 2001–2008

decreasing mean diastolic blood pressure with increasing age among men and women in all three hypertension status categories (Figures 1 and 2 and Tables 6 and 7). After stratification by race or ethnicity, the significant quadratic trend persisted in all racial or ethnic groups in the three hypertension status categories except in treated hypertensive non-Hispanic black and Mexican-American men (Table 6). In some instances, the curvilinear trend was flat in the two younger age groups and decreased in the older age group, as seen in treated hypertensive non-Hispanic white men. Among women, the significant quadratic trend of increasing then decreasing mean diastolic blood pressure with increasing age persisted after stratification by race or ethnicity in the total population and in normotensive women but was significant only in non-Hispanic white women in the treated and untreated hypertensive populations (Table 7).

In the total and normotensive populations, men had significantly higher mean diastolic blood pressure than women (Figure 4). Examination of

the total population without regard to hypertension status showed significant racial or ethnic differences in mean diastolic blood pressure (Table 5). Non-Hispanic white and Mexican-American adults had significantly lower mean diastolic blood pressure than non-Hispanic black adults (Figure 4 and Table 5). This was also true when mean diastolic blood pressure was examined for men and women separately (Tables 6 and 7). After stratification by hypertension status, significant racial or ethnic differences were seen only in the treated hypertensive population. Non-Hispanic black adults had higher mean diastolic blood pressure than non-Hispanic white adults (Figure 4 and Table 5). The difference was significant in women but not in men (Tables 6 and 7).

Distribution of systolic and diastolic blood pressure

Tables 8–13 present estimated percentiles of systolic and diastolic blood pressure for sex, race or ethnicity, age, and hypertension status categories.

For treated hypertensive persons, the 75th percentile estimates were above the hypertension cutpoint of 140 mm Hg systolic blood pressure for non-Hispanic white adults aged 60 and over and for non-Hispanic black and Mexican-American adults aged 40–59 and aged 60 and over. Similar patterns were seen in the systolic blood pressure distributions after stratification by sex. In the untreated hypertensive adults, the 25th or 50th percentile estimates were above the systolic blood pressure cutpoint of 140 mm Hg.

As expected based on the definitions used in this report, the distribution of systolic blood pressure was below the hypertension cutpoint of 140 mm Hg for the normotensive population (Figures 5 and 6). The distribution of systolic blood pressure for treated hypertensive adults extends on both sides of the cutpoint. The distribution of systolic blood pressure in the untreated hypertensive population appears somewhat skewed to the right in two age groups, 40–59 years and 60 years and over. The distribution of diastolic blood pressure for treated and

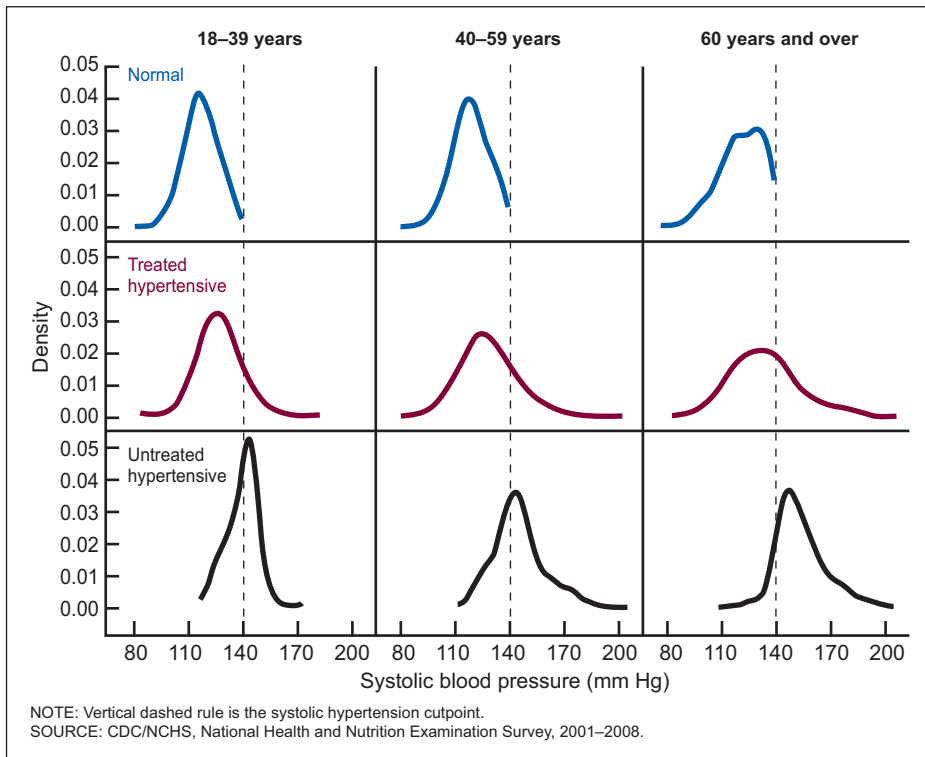


Figure 5. Mean systolic blood pressure for men aged 18 years and over, by age and hypertension status

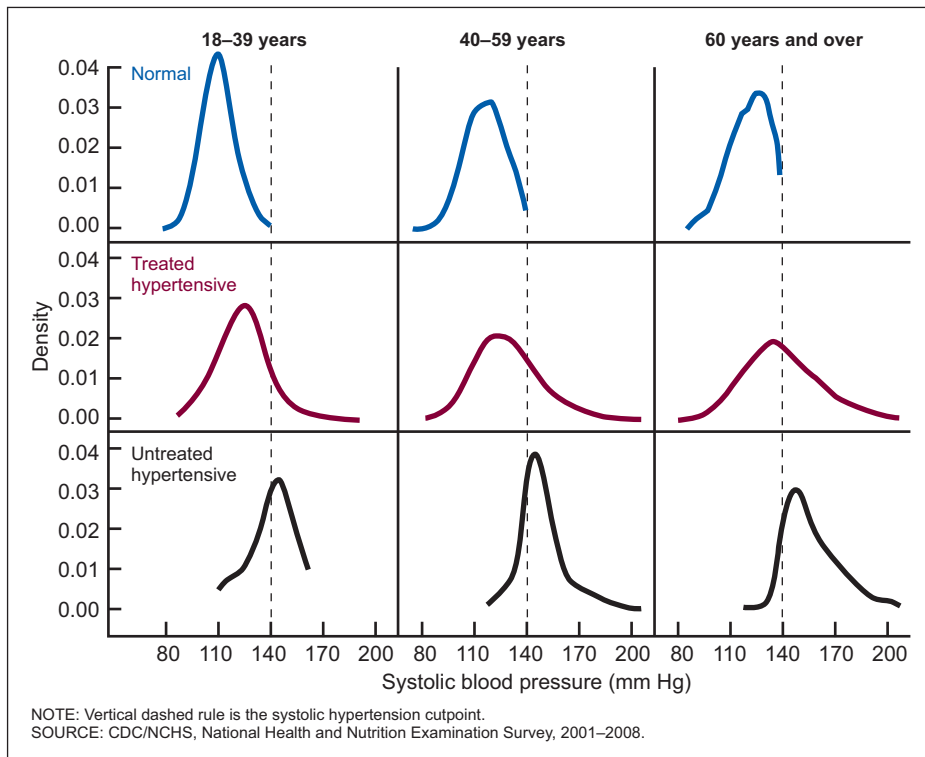


Figure 6. Mean systolic blood pressure for women aged 18 years and over, by age and hypertension status

untreated hypertensive men and women indicates that the distributions are centered below the hypertension cutpoint of 90 mm Hg (Figures 7 and 8). This is supported by the estimated medians for these groups: 74 mm Hg for treated men and 87 mm Hg for untreated men; 71 mm Hg for treated women and 80 mm Hg for untreated women.

Conclusions

In the U.S. population in 2001–2008, differences were seen in the mean blood pressures of adults in the demographic subgroups examined. The patterns of these differences varied by hypertension status. As might be expected, mean blood pressures were lowest for normotensive adults, followed by treated hypertensive adults, with untreated hypertensive adults having the highest mean blood pressures. There was a trend of increasing systolic blood pressure with increasing age, whereas mean diastolic blood pressure increased then decreased with age in men and women. The results showed a higher mean blood pressure in non-Hispanic black than non-Hispanic white adults; this was true for systolic blood pressure in all three hypertension status categories but for diastolic blood pressure only in treated hypertensive adults.

Some of the differences observed in blood pressure are similar to results published using earlier NHANES data. The trends in blood pressure with age can vary between populations (18). The rise in systolic blood pressure with age in the U.S. population was documented using NHANES III, 1988–1994 data (19). The authors also documented a rise in mean diastolic blood pressure from early adulthood until about age 60, with a decline in mean diastolic blood pressure from about age 60 and over.

JNC 7 noted the importance of achieving a downward shift in the population distribution of blood pressure, to reduce morbidity and

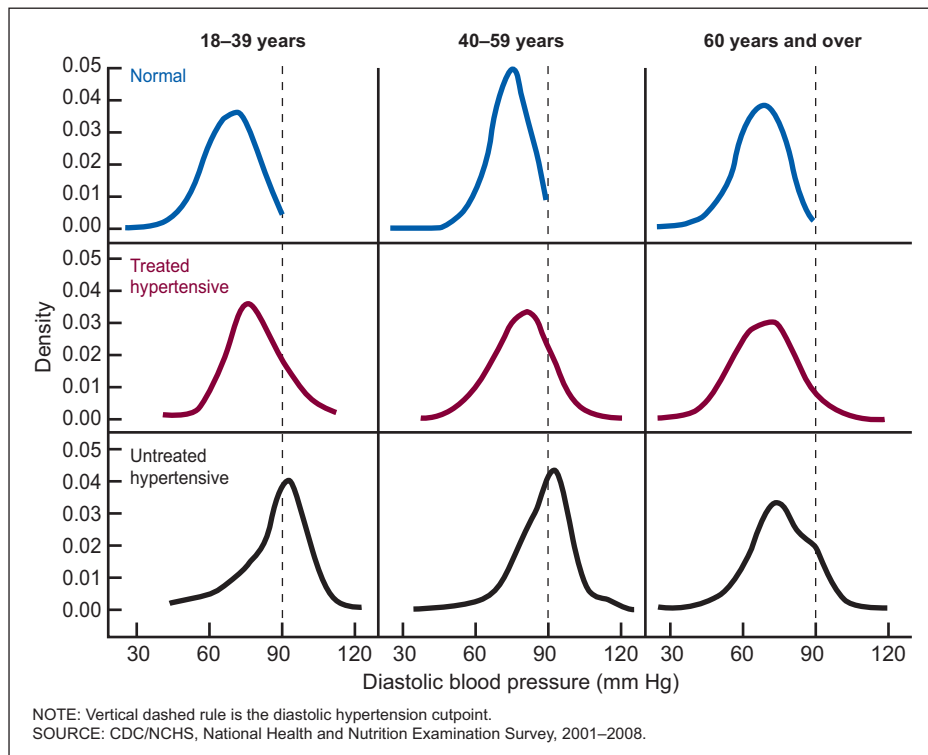


Figure 7. Mean diastolic blood pressure for men aged 18 years and over, by age and hypertension status

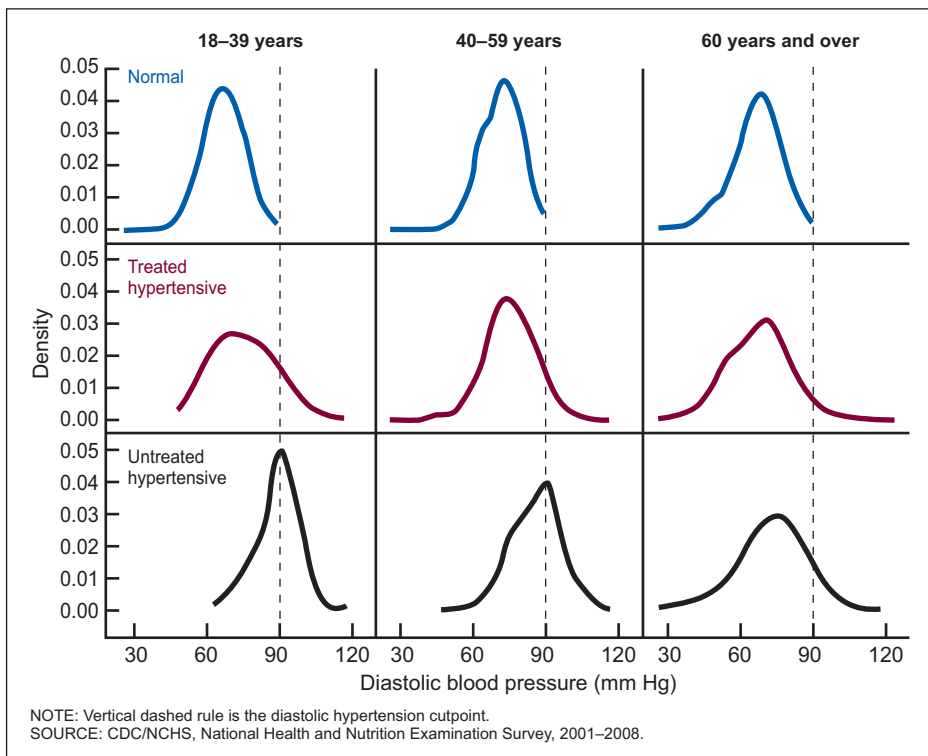


Figure 8. Mean diastolic blood pressure for women aged 18 years and over, by age and hypertension status

mortality related to hypertension (3). The present results provide detailed reference data from a nationally representative survey, which can be used for comparison with other studies. These estimates of the distribution of blood pressure for population subgroups may be useful for policy makers considering ways to achieve this goal.

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Table 1. Hypertension status among adults aged 18 and over, by sex, race or ethnicity, and age: United States, National Health and Nutrition Examination Survey, 2001–2008

Characteristic	Hypertension status									
	Normal				Treated			Untreated		
	Total sample size	Sample size	Percent	Standard error	Sample size	Percent	Standard error	Sample size	Percent	Standard error
Total	19,921	13,093	70.6	0.58	4,603	19.5	0.50	2,225	9.9	0.32
Sex										
Male	10,142	6,780	71.6	0.68	2,132	17.5	0.58	1,230	10.9	¹ 0.44
Female	9,779	6,313	69.7	0.65	2,471	21.5	0.61	995	8.9	0.34
Race or ethnicity										
Non-Hispanic white	9,755	6,151	69.6	0.70	2,467	20.4	0.59	1,137	10.0	¹ 0.39
Non-Hispanic black	4,291	2,569	62.8	1.07	1,219	25.5	0.87	503	11.7	0.62
Mexican American	4,002	3,022	83.6	1.15	579	8.8	0.85	401	7.6	0.55
Age										
18–39 years	7,676	7,172	92.9	0.41	198	2.7	0.26	306	4.3	¹ 0.32
40–59 years	5,826	3,877	68.6	0.91	1,239	20.0	0.68	710	11.4	0.63
60 years and over	6,419	2,044	33.3	0.87	3,166	49.3	0.80	1,209	17.4	0.67

¹ $p < 0.05$ for a chi square test of the distribution of hypertension categories across the demographic trait.

Table 2. Mean systolic blood pressure (mm Hg) and standard error of the mean among adults aged 18 and over, by hypertension status, race or ethnicity, and age: United States, National Health and Nutrition Examination Survey, 2001–2008

Characteristic	Hypertension status							
	Total		Normal		Treated		Untreated	
	Mean	Standard error	Mean	Standard error	Mean	Standard error	Mean	Standard error
All races or ethnicities								
18 years and over, age-adjusted	122	0.2	116	0.2	130	0.5	146	0.3
18–39 years	115	¹ 0.2	113	¹ 0.2	125	¹ 0.9	140	¹ 0.6
40–59 years	123	0.3	117	0.2	129	0.6	147	0.6
60 years and over	136	0.5	121	0.4	139	0.5	157	0.5
Non-Hispanic white								
18 years and over, age-adjusted	122	² 0.3	116	² 0.2	128	² 0.7	145	² 0.5
18–39 years	114	¹ 0.3	113	¹ 0.2	123	¹ 1.5	139	¹ 0.9
40–59 years	122	0.4	117	0.3	127	0.7	145	0.7
60 years and over	135	0.5	121	0.5	138	0.6	156	0.6
Non-Hispanic black								
18 years and over, age-adjusted	127	^{3,4} 0.4	118	^{3,4} 0.3	134	³ 0.9	149	³ 0.8
18–39 years	118	¹ 0.3	115	¹ 0.3	130	¹ 2.0	140	¹ 1.2
40–59 years	129	0.7	118	0.4	134	0.9	151	1.2
60 years and over	141	0.9	122	0.9	142	1.0	160	1.6
Mexican American								
18 years and over, age-adjusted	123	² 0.5	117	² 0.4	133	2.5	148	0.9
18–39 years	115	¹ 0.4	113	¹ 0.3	128	5.2	141	¹ 1.2
40–59 years	123	0.5	117	0.4	132	1.6	151	1.4
60 years and over	138	1.1	122	0.8	142	1.4	157	1.2

¹ $p < 0.05$ for a test of linear trend across age groups.

² $p < 0.05$ for a test of difference from non-Hispanic black adults (adjusted for multiple comparisons).

³ $p < 0.05$ for a test of difference from non-Hispanic white adults (adjusted for multiple comparisons).

⁴ $p < 0.05$ for a test of difference from Mexican-American adults (adjusted for multiple comparisons).

Table 3. Mean systolic blood pressure (mm Hg) and standard error of the mean among men aged 18 and over, by hypertension status, race or ethnicity, and age: United States, National Health and Nutrition Examination Survey, 2001–2008

Characteristic	Hypertension status							
	Total		Normal		Treated		Untreated	
	Mean	Standard error	Mean	Standard error	Mean	Standard error	Mean	Standard error
All races or ethnicities								
18 years and over, age-adjusted	124	0.3	119	0.2	130	0.6	145	0.4
18–39 years	119	¹ 0.3	117	¹ 0.3	127	¹ 1.2	140	¹ 0.7
40–59 years	124	0.4	119	0.3	129	0.7	145	0.9
60 years and over	133	0.5	121	0.4	135	0.7	154	0.7
Non-Hispanic white								
18 years and over, age-adjusted	123	² 0.3	118	0.3	128	² 0.9	144	² 0.5
18–39 years	118	¹ 0.4	117	¹ 0.4	126	¹ 1.7	139	¹ 0.9
40–59 years	124	0.5	119	0.3	128	0.9	144	1.1
60 years and over	132	0.6	121	0.5	134	0.7	153	0.7
Non-Hispanic black								
18 years and over, age-adjusted	128	^{3,4} 0.4	120	0.4	134	³ 1.1	147	³ 0.8
18–39 years	121	¹ 0.4	119	0.3	130	2.7	140	¹ 1.2
40–59 years	129	0.8	120	0.7	135	1.6	148	1.5
60 years and over	137	0.9	121	1.0	138	1.2	157	1.7
Mexican American								
18 years and over, age-adjusted	124	² 0.6	119	0.5	133	3.1	146	1.1
18–39 years	118	¹ 0.5	117	¹ 0.4	133	6.9	141	¹ 1.4
40–59 years	123	0.7	119	0.5	130	2.0	147	2.0
60 years and over	135	1.3	122	1.0	138	2.1	155	2.1

¹ $p < 0.05$ for a test of linear trend across age groups.² $p < 0.05$ for a test of difference from non-Hispanic black adults (adjusted for multiple comparisons).³ $p < 0.05$ for a test of difference from non-Hispanic white adults (adjusted for multiple comparisons).⁴ $p < 0.05$ for a test of difference from Mexican-American adults (adjusted for multiple comparisons).

Table 4. Mean systolic blood pressure (mm Hg) and standard error of the mean among women aged 18 and over, by hypertension status, race or ethnicity, and age: United States, National Health and Nutrition Examination Survey, 2001–2008

Characteristic	Hypertension status							
	Total		Normal		Treated		Untreated	
	Mean	Standard error	Mean	Standard error	Mean	Standard error	Mean	Standard error
All races or ethnicities								
18 years and over, age-adjusted	121	0.2	114	0.2	129	0.7	147	0.9
18–39 years	110	¹ 0.2	109	¹ 0.2	123	¹ 1.5	140	¹ 1.8
40–59 years	122	0.4	115	0.4	129	0.9	149	0.8
60 years and over	139	0.5	122	0.6	141	0.6	159	0.8
Non-Hispanic white								
18 years and over, age-adjusted	120	² 0.3	114	² 0.3	127	² 1.1	145	1.4
18–39 years	109	¹ 0.3	109	¹ 0.3	119	¹ 2.4	137	¹ 3.2
40–59 years	120	0.5	115	0.5	127	1.1	147	1.0
60 years and over	138	0.6	122	0.7	141	0.8	158	0.9
Non-Hispanic black								
18 years and over, age-adjusted	126	^{3,4} 0.5	117	^{3,4} 0.5	134	³ 1.3	151	1.2
18–39 years	114	¹ 0.5	112	¹ 0.4	129	¹ 2.9	140	¹ 1.7
40–59 years	128	0.9	117	0.7	133	1.3	154	1.8
60 years and over	144	1.2	124	1.2	144	1.3	164	2.1
Mexican American								
18 years and over, age-adjusted	121	² 0.6	114	² 0.5	131	1.6	150	1.5
18–39 years	110	¹ 0.5	109	¹ 0.5	122	¹ 4.2	140	¹ 2.5
40–59 years	122	0.8	116	0.6	134	2.3	156	2.1
60 years and over	141	1.4	121	1.0	145	1.8	159	1.3

¹ $p < 0.05$ for a test of linear trend across age groups.² $p < 0.05$ for a test of difference from non-Hispanic black adults (adjusted for multiple comparisons).³ $p < 0.05$ for a test of difference from non-Hispanic white adults (adjusted for multiple comparisons).⁴ $p < 0.05$ for a test of difference from Mexican-American adults (adjusted for multiple comparisons).

Table 5. Mean diastolic blood pressure (mm Hg) and standard error of the mean among adults aged 18 and over, by hypertension status, race or ethnicity, and age: United States, National Health and Nutrition Examination Survey, 2001–2008

Characteristic	Hypertension status							
	Total		Normal		Treated		Untreated	
	Mean	Standard error	Mean	Standard error	Mean	Standard error	Mean	Standard error
All races or ethnicities								
18 years and over, age-adjusted	71	0.2	69	0.2	75	0.4	84	0.5
18–39 years	69	0.2	68	¹ 0.2	77	¹ 0.9	87	¹ 1.0
40–59 years	75	0.2	73	0.2	77	0.4	87	0.6
60 years and over	68	0.3	67	0.3	68	0.3	74	0.5
Non-Hispanic white								
18 years and over, age-adjusted	71	² 0.2	69	0.2	74	² 0.6	85	0.7
18–39 years	69	0.2	68	¹ 0.2	76	¹ 1.3	88	¹ 1.4
40–59 years	75	0.3	73	0.3	76	0.5	87	0.8
60 years and over	68	0.3	67	0.3	67	0.4	74	0.6
Non-Hispanic black								
18 years and over, age-adjusted	73	^{3,4} 0.3	69	0.3	78	³ 0.7	85	0.6
18–39 years	70	0.3	68	0.3	82	¹ 1.5	86	¹ 1.3
40–59 years	77	0.4	72	0.4	79	0.6	88	0.8
60 years and over	70	0.6	66	0.7	70	0.6	77	1.3
Mexican American								
18 years and over, age-adjusted	70	² 0.3	69	0.3	74	1.6	83	1.0
18–39 years	67	0.4	67	0.3	74	3.9	85	¹ 1.8
40–59 years	74	0.4	72	0.4	76	1.0	87	1.1
60 years and over	68	0.5	67	0.7	68	0.8	71	0.8

¹ $p < 0.05$ for a test of linear trend across age groups.² $p < 0.05$ for a test of difference from non-Hispanic black adults (adjusted for multiple comparisons).³ $p < 0.05$ for a test of difference from non-Hispanic white adults (adjusted for multiple comparisons).⁴ $p < 0.05$ for a test of difference from Mexican-American adults (adjusted for multiple comparisons).

Table 6. Mean diastolic blood pressure (mm Hg) and standard error of the mean among men aged 18 and over, by hypertension status, race or ethnicity, and age: United States, National Health and Nutrition Examination Survey, 2001–2008

Characteristic	Hypertension status							
	Total		Normal		Treated		Untreated	
	Mean	Standard error	Mean	Standard error	Mean	Standard error	Mean	Standard error
All races or ethnicities								
18 years and over, age-adjusted	72	0.2	70	0.2	77	0.6	85	0.6
18–39 years	70	0.2	68	¹ 0.2	79	¹ 1.2	87	¹ 1.2
40–59 years	77	0.3	74	0.2	79	0.6	88	0.8
60 years and over	69	0.3	67	0.3	69	0.5	76	0.6
Non-Hispanic white								
18 years and over, age-adjusted	72	^{2,4} 0.2	70	0.2	76	0.8	85	0.8
18–39 years	70	0.3	69	¹ 0.3	78	¹ 1.7	88	¹ 1.6
40–59 years	76	0.3	74	0.3	78	0.7	88	0.9
60 years and over	69	0.4	67	0.4	69	0.5	76	0.7
Non-Hispanic black								
18 years and over, age-adjusted	74	^{3,4} 0.4	70	0.4	79	1.0	86	0.8
18–39 years	71	0.4	68	0.4	82	¹ 2.2	86	1.4
40–59 years	79	0.6	74	0.6	82	0.9	91	1.1
60 years and over	71	0.9	67	0.9	71	1.1	77	1.9
Mexican American								
18 years and over, age-adjusted	71	^{2,3} 0.3	69	0.4	76	2.0	83	1.0
18–39 years	68	0.5	67	0.4	79	4.8	85	¹ 2.1
40–59 years	75	0.4	73	0.4	76	1.5	89	1.3
60 years and over	69	0.6	68	1.0	69	1.3	73	1.1

¹ $p < 0.05$ for a test of linear trend across age groups.² $p < 0.05$ for a test of difference from non-Hispanic black adults (adjusted for multiple comparisons).³ $p < 0.05$ for a test of difference from non-Hispanic white adults (adjusted for multiple comparisons).⁴ $p < 0.05$ for a test of difference from Mexican-American adults (adjusted for multiple comparisons).

Table 7. Mean diastolic blood pressure (mm Hg) and standard error of the mean among women aged 18 and over, by hypertension status, race or ethnicity, and age: United States, National Health and Nutrition Examination Survey, 2001–2008

Characteristic	Hypertension status							
	Total		Normal		Treated		Untreated	
	Mean	Standard error	Mean	Standard error	Mean	Standard error	Mean	Standard error
All races or ethnicities								
18 years and over, age-adjusted	70	0.2	68	0.2	74	0.7	85	0.6
18–39 years	68	0.3	67	0.3	76	¹ 1.6	90	¹ 1.3
40–59 years	74	0.3	72	0.3	76	0.5	86	0.9
60 years and over	68	0.3	66	0.4	67	0.4	72	0.8
Non-Hispanic white								
18 years and over, age-adjusted	70	² 0.3	69	0.2	72	² 0.9	86	0.7
18–39 years	68	0.3	67	0.3	72	1.8	92	¹ 1.6
40–59 years	74	0.4	72	0.4	75	0.7	87	1.2
60 years and over	67	0.4	66	0.4	66	0.5	72	0.9
Non-Hispanic black								
18 years and over, age-adjusted	71	^{3,4} 0.3	68	0.4	78	³ 0.9	84	1.2
18–39 years	69	0.4	67	0.4	83	² 2.1	88	² 2.4
40–59 years	75	0.6	71	0.5	77	0.8	85	1.3
60 years and over	70	0.5	66	1.1	69	0.6	77	1.6
Mexican American								
18 years and over, age-adjusted	69	² 0.4	68	0.4	71	2.0	83	1.4
18–39 years	66	0.5	66	0.4	69	4.6	87	¹ 2.2
40–59 years	73	0.5	71	0.5	76	1.3	86	1.8
60 years and over	67	0.8	65	1.0	68	0.9	70	1.2

¹ $p < 0.05$ for a test of linear trend across age groups.² $p < 0.05$ for a test of difference from non-Hispanic black adults (adjusted for multiple comparisons).³ $p < 0.05$ for a test of difference from non-Hispanic white adults (adjusted for multiple comparisons).⁴ $p < 0.05$ for a test of difference from Mexican-American adults (adjusted for multiple comparisons).

Table 8. Selected percentiles of systolic blood pressure (mm Hg) for adults aged 18 and over, by hypertension status, race or ethnicity, and age: United States, National Health and Nutrition Examination Survey, 2001–2008

Characteristic	Hypertension status																			
	Total percentile					Normal percentile					Treated percentile					Untreated percentile				
	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th
All races or ethnicities																				
18 years and over, age-adjusted.	98	110	119	131	157	97	107	115	123	134	105	119	131	145	173	127	141	146	156	179
18–39 years	96	106	113	121	135	96	106	113	120	130	101	117	125	132	148	123	134	141	145	154
40–59 years	100	112	121	131	152	98	109	117	124	134	102	116	127	139	163	125	140	144	152	174
60 years and over	105	120	133	148	177	100	113	122	130	137	107	123	136	150	180	140	145	152	164	189
Non-Hispanic white																				
18 years and over, age-adjusted.	98	110	119	131	156	97	108	115	123	134	105	119	131	144	171	127	141	146	156	178
18–39 years	96	106	113	121	134	96	106	112	119	130	99	116	124	130	141	123	133	141	144	151
40–59 years	99	111	120	130	149	98	109	117	124	134	102	116	125	137	158	124	139	143	151	170
60 years and over	105	120	133	147	175	100	113	122	130	137	107	122	135	149	178	140	145	151	163	186
Non-Hispanic black																				
18 years and over, age-adjusted.	100	112	122	135	164	99	109	116	124	135	104	121	133	150	179	126	140	147	157	184
18–39 years	99	109	116	125	140	98	108	115	122	133	101	118	128	139	158	118	135	141	147	155
40–59 years	101	115	125	139	166	100	110	118	126	136	102	119	131	146	174	127	141	148	158	181
60 years and over	107	124	137	154	187	102	115	124	131	137	109	125	138	155	187	140	146	154	170	200
Mexican American																				
18 years and over, age-adjusted.	98	108	116	127	149	98	107	114	122	132	104	121	133	148	179	127	141	145	154	182
18–39 years	97	107	114	121	134	97	106	113	119	130	97	115	122	134	*	122	136	142	144	151
40–59 years	100	111	120	131	153	99	110	117	125	135	102	119	131	144	165	126	141	148	161	181
60 years and over	107	121	135	151	182	103	113	122	130	137	111	125	137	156	188	140	145	152	164	191

* Statistic was deemed unreliable based on sample size criteria.

Table 9. Selected percentiles of systolic blood pressure (mm Hg) for men aged 18 and over, by hypertension status, race or ethnicity, and age: United States, National Health and Nutrition Examination Survey, 2001–2008

Characteristic	Hypertension status																			
	Total percentile					Normal percentile					Treated percentile					Untreated percentile				
	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th
All races or ethnicities																				
18 years and over, age-adjusted.	102	113	121	131	152	101	111	118	125	134	105	119	130	141	168	125	139	144	152	172
18–39 years	101	111	117	125	138	101	110	116	123	132	107	119	125	133	148	124	134	141	144	152
40–59 years	103	114	122	132	151	102	112	118	125	135	104	118	127	139	161	124	137	143	151	171
60 years and over	103	119	131	144	169	99	113	122	130	137	105	120	133	146	172	140	145	151	160	181
Non-Hispanic white																				
18 years and over, age-adjusted.	102	113	121	131	151	101	111	118	125	134	105	119	129	140	166	125	139	144	152	171
18–39 years	101	111	117	125	137	100	110	116	123	133	109	119	125	133	143	124	134	141	144	150
40–59 years	103	114	121	131	148	102	112	118	125	134	104	117	126	136	155	124	137	142	150	169
60 years and over	102	118	130	143	167	98	113	122	130	137	105	120	132	145	170	140	145	150	159	177
Non-Hispanic black																				
18 years and over, age-adjusted.	104	115	123	135	159	103	112	119	126	135	106	121	132	148	175	125	140	145	154	176
18–39 years	104	113	120	128	142	103	112	119	125	134	100	119	128	135	155	120	135	141	146	155
40–59 years	103	117	126	139	165	101	113	119	127	136	103	120	132	149	174	125	140	145	157	178
60 years and over	106	121	134	148	178	100	111	122	132	137	110	122	135	148	179	138	144	152	164	191
Mexican American																				
18 years and over, age-adjusted.	102	112	118	128	145	102	111	117	124	133	101	121	131	145	169	125	139	143	150	175
18–39 years	102	111	117	125	137	102	111	116	123	132	*	114	124	134	*	123	135	141	145	151
40–59 years	102	112	121	131	150	102	111	118	126	136	96	119	130	138	161	124	138	145	151	180
60 years and over	106	120	132	145	173	105	114	122	130	137	106	124	136	148	178	*	144	150	160	187

* Statistic was deemed unreliable based on sample size criteria.

Table 10. Selected percentiles of systolic blood pressure (mm Hg) for women aged 18 and over, by hypertension status, race or ethnicity, and age: United States, National Health and Nutrition Examination Survey, 2001–2008

Characteristic	Hypertension status																			
	Total percentile					Normal percentile					Treated percentile					Untreated percentile				
	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th
All races or ethnicities																				
18 years and over, age-adjusted.	96	107	117	131	160	95	104	112	120	132	104	120	133	148	177	130	142	149	160	185
18–39 years	94	103	109	116	128	94	102	109	115	126	99	114	123	130	148	114	131	142	146	157
40–59 years	97	109	119	131	153	96	107	115	124	134	101	115	127	140	164	127	141	146	154	176
60 years and over	107	122	135	151	181	102	114	122	130	137	109	125	138	155	183	140	145	153	167	194
Non-Hispanic white																				
18 years and over, age-adjusted.	96	108	117	131	160	95	105	112	121	132	105	119	133	147	175	130	142	148	160	184
18–39 years	94	102	109	115	127	94	102	108	115	125	93	112	120	127	132	*	128	140	145	*
40–59 years	97	109	119	130	150	95	107	115	123	133	100	115	125	137	160	125	140	144	152	172
60 years and over	107	122	135	150	180	102	114	122	130	137	108	125	137	154	182	140	145	153	166	192
Non-Hispanic black																				
18 years and over, age-adjusted.	98	110	120	135	167	97	106	114	121	134	103	120	133	150	183	128	143	150	159	188
18–39 years	97	105	113	120	138	97	104	112	118	131	100	117	128	139	157	116	130	141	151	*
40–59 years	101	113	124	139	167	98	108	117	126	136	102	117	130	145	174	134	144	150	159	184
60 years and over	108	126	139	158	193	104	118	125	130	137	107	126	141	159	192	140	149	156	175	207
Mexican American																				
18 years and over, age-adjusted.	96	105	113	124	155	95	104	110	117	131	106	121	136	154	180	138	143	150	164	184
18–39 years	94	103	108	115	127	94	103	108	114	124	*	113	119	130	*	*	138	142	144	*
40–59 years	99	110	118	130	159	98	109	115	124	133	103	119	132	146	172	131	144	150	165	181
60 years and over	107	123	138	154	184	101	112	122	131	137	112	127	140	160	194	141	146	152	165	192

* Statistic was deemed unreliable based on sample size criteria.

Table 11. Selected percentiles of diastolic blood pressure (mm Hg) for adults aged 18 and over, by hypertension status, race or ethnicity, and age: United States, National Health and Nutrition Examination Survey, 2001–2008

Characteristic	Hypertension status																			
	Total percentile					Normal percentile					Treated percentile					Untreated percentile				
	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th
All races or ethnicities																				
18 years and over, age-adjusted.	52	64	71	78	90	53	63	70	76	84	50	63	72	81	93	57	74	84	92	101
18–39 years	52	61	68	75	86	51	61	68	74	83	59	69	76	85	99	62	81	90	95	102
40–59 years	59	69	75	81	92	58	67	73	78	85	58	70	77	84	95	69	80	89	93	103
60 years and over	47	60	69	76	89	48	61	67	73	82	46	59	68	76	89	49	66	74	83	93
Non-Hispanic white																				
18 years and over, age-adjusted.	52	64	71	78	89	53	63	70	76	84	49	63	71	80	91	56	73	83	91	100
18–39 years	52	62	68	75	86	52	61	68	74	83	56	68	75	84	94	63	83	91	95	102
40–59 years	59	69	75	81	91	59	67	73	78	86	58	69	76	84	94	69	80	89	93	102
60 years and over	47	60	69	76	88	48	61	67	73	82	46	59	68	76	88	49	66	74	82	93
Non-Hispanic black																				
18 years and over, age-adjusted.	52	64	72	80	94	52	62	70	76	84	52	66	76	84	99	59	77	87	93	106
18–39 years	51	62	69	76	90	51	61	68	75	83	60	73	82	91	102	58	78	90	93	102
40–59 years	58	69	76	84	98	56	67	73	78	87	59	71	78	86	102	68	81	89	95	109
60 years and over	47	61	71	79	93	46	60	68	74	80	47	60	70	79	93	50	68	77	88	99
Mexican American																				
18 years and over, age-adjusted.	52	62	69	76	88	51	61	68	74	84	51	64	71	80	94	55	74	83	91	102
18–39 years	50	60	67	74	85	50	60	67	73	82	50	62	69	80	*	51	76	88	93	102
40–59 years	58	68	73	80	90	57	67	72	77	86	58	69	75	82	95	72	80	88	93	105
60 years and over	49	60	68	76	87	48	60	67	73	82	48	59	69	76	89	51	63	71	79	90

* Statistic was deemed unreliable based on sample size criteria.

Table 12. Selected percentiles of diastolic blood pressure (mm Hg) for men aged 18 and over, by hypertension status, race or ethnicity, and age: United States, National Health and Nutrition Examination Survey, 2001–2008

Characteristic	Hypertension status																			
	Total percentile					Normal percentile					Treated percentile					Untreated percentile				
	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th
All races or ethnicities																				
18 years and over, age-adjusted.	53	65	72	80	91	53	64	71	77	85	52	65	74	83	95	61	76	87	93	101
18–39 years	51	62	70	77	88	51	61	69	76	84	62	72	76	85	101	59	80	90	95	103
40–59 years	60	70	76	83	94	60	69	74	80	86	58	70	79	86	97	69	82	90	94	102
60 years and over	49	61	69	77	89	49	61	67	74	82	48	60	69	77	90	54	68	75	84	94
Non-Hispanic white																				
18 years and over, age-adjusted.	53	65	73	80	91	53	64	71	77	85	51	63	73	82	93	61	75	86	92	100
18–39 years	51	62	70	77	89	51	62	69	76	85	62	72	76	86	98	62	80	91	95	102
40–59 years	60	70	76	82	93	60	69	74	80	86	57	70	79	85	95	67	81	89	94	101
60 years and over	49	61	69	76	89	49	61	67	74	82	48	60	69	77	90	54	68	75	84	93
Non-Hispanic black																				
18 years and over, age-adjusted.	53	65	74	82	96	52	63	71	77	85	53	68	77	86	102	58	79	90	95	109
18–39 years	51	63	71	78	90	50	61	69	75	83	58	73	83	90	106	57	79	90	94	102
40–59 years	59	70	78	87	100	58	68	74	80	87	61	73	80	91	105	69	83	91	96	111
60 years and over	47	61	72	80	95	48	60	68	74	81	45	61	71	81	96	47	69	78	88	101
Mexican American																				
18 years and over, age-adjusted.	50	62	70	77	88	50	62	69	76	85	52	65	73	80	95	58	74	87	92	102
18–39 years	48	60	68	75	87	48	60	67	74	84	*	64	71	81	*	48	75	88	93	102
40–59 years	58	69	74	81	90	58	68	73	78	87	57	69	75	81	95	72	82	89	93	105
60 years and over	50	61	69	77	88	50	61	68	76	84	48	60	70	78	89	51	66	74	79	90

* Statistic was deemed unreliable based on sample size criteria.

Table 13. Selected percentiles of diastolic blood pressure (mm Hg) for women aged 18 and over, by hypertension status, race or ethnicity, and age: United States, National Health and Nutrition Examination Survey, 2001–2008

Characteristic	Hypertension status																			
	Total percentile					Normal percentile					Treated percentile					Untreated percentile				
	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th
All races or ethnicities																				
18 years and over, age-adjusted.	52	63	70	77	88	53	62	69	75	83	48	62	71	79	91	54	71	80	90	100
18–39 years	52	61	67	73	83	52	61	67	73	81	57	65	75	85	97	72	84	90	93	101
40–59 years	58	67	73	80	91	57	66	72	77	84	59	69	75	83	93	69	79	87	92	103
60 years and over	45	59	68	76	88	46	60	67	73	82	44	58	67	75	88	46	64	73	82	93
Non-Hispanic white																				
18 years and over, age-adjusted.	52	63	70	77	88	53	63	69	75	83	47	62	70	78	89	51	70	80	90	100
18–39 years	52	61	67	73	82	52	61	67	73	81	53	62	70	81	*	78	88	91	95	101
40–59 years	59	67	73	80	91	58	66	72	77	84	59	69	75	81	91	69	79	88	92	104
60 years and over	45	59	68	76	87	46	60	67	72	82	43	57	67	75	87	46	64	73	82	93
Non-Hispanic black																				
18 years and over, age-adjusted.	52	63	71	79	92	52	62	69	75	83	52	66	75	83	97	60	75	83	91	101
18–39 years	52	62	68	76	89	51	61	67	74	83	61	72	80	92	101	67	77	90	92	*
40–59 years	56	68	75	82	95	55	65	72	77	85	58	70	77	84	98	64	77	84	92	100
60 years and over	47	60	70	78	92	44	60	68	73	79	48	59	70	78	92	52	66	76	86	99
Mexican American																				
18 years and over, age-adjusted.	52	62	68	74	85	53	61	68	73	81	49	62	70	79	93	55	71	79	89	99
18–39 years	52	60	66	72	79	52	60	66	71	78	*	59	65	72	*	*	77	88	92	*
40–59 years	57	67	73	79	90	56	66	71	76	84	58	68	74	82	94	72	77	83	93	105
60 years and over	48	59	67	75	86	48	58	65	71	79	48	59	68	75	88	51	61	70	79	89

* Statistic was deemed unreliable based on sample size criteria.

Technical Notes

Table. Sample sizes for adults aged 18 and over, by hypertension status, race or ethnicity, and age: United States, National Health and Nutrition Examination Survey, 2001–2008

Characteristic	Hypertension status			
	Total	Normal	Treated	Untreated
Total				
All races or ethnicities:				
18 years and over, age-adjusted	19,921	13,093	4,603	2,225
18–39 years.	7,676	7,172	198	306
40–59 years.	5,826	3,877	1,239	710
60 years and over	6,419	2,044	3,166	1,209
Non-Hispanic white:				
18 years and over, age-adjusted	9,755	6,151	2,467	1,137
18–39 years.	3,061	2,864	84	113
40–59 years.	2,900	2,009	575	316
60 years and over	3,794	1,278	1,808	708
Non-Hispanic black:				
18 years and over, age-adjusted	4,291	2,569	1,219	503
18–39 years.	1,859	1,672	82	105
40–59 years.	1,283	661	410	212
60 years and over	1,149	236	727	186
Mexican American:				
18 years and over, age-adjusted	4,002	3,022	579	401
18–39 years.	1,926	1,853	16	57
40–59 years.	1,052	803	142	107
60 years and over	1,024	366	421	237
Men				
All races or ethnicities:				
18 years and over, age-adjusted	10,142	6,780	2,132	1,230
18–39 years.	4,021	3,676	102	243
40–59 years.	2,924	1,940	577	407
60 years and over	3,197	1,164	1,453	580
Non-Hispanic white:				
18 years and over, age-adjusted	5,004	3,183	1,215	606
18–39 years.	1,597	1,451	53	93
40–59 years.	1,476	1,006	288	182
60 years and over	1,931	726	874	331
Non-Hispanic black:				
18 years and over, age-adjusted	2,169	1,342	527	300
18–39 years.	976	864	36	76
40–59 years.	623	337	168	118
60 years and over	570	141	323	106
Mexican American:				
18 years and over, age-adjusted	2,062	1,592	255	215
18–39 years.	1,029	976	7	46
40–59 years.	545	411	72	62
60 years and over	488	205	176	107
Women				
All races or ethnicities:				
18 years and over, age-adjusted	9,779	6,313	2,471	995
18–39 years.	3,655	3,496	96	63
40–59 years.	2,902	1,937	662	303
60 years and over	3,222	880	1,713	629
Non-Hispanic white:				
18 years and over, age-adjusted	4,751	2,968	1,252	531
18–39 years.	1,464	1,413	31	20
40–59 years.	1,424	1,003	287	134
60 years and over	1,863	552	934	377
Non-Hispanic black:				
18 years and over, age-adjusted	2,122	1,227	692	203
18–39 years.	883	808	46	29
40–59 years.	660	324	242	94
60 years and over	579	95	404	80

Table. Sample sizes for adults aged 18 and over, by hypertension status, race or ethnicity, and age: United States, National Health and Nutrition Examination Survey, 2001–2008—Con.

Characteristic	Hypertension status			Untreated
	Total	Normal	Treated	
Mexican American:				
18 years and over, age-adjusted	1,940	1,430	324	186
18–39 years.	897	877	9	11
40–59 years.	507	392	70	45
60 years and over	536	161	245	130

Affiliation Note

Dr. Wright is currently affiliated with the Epidemiology Branch, Division of Cardiovascular Sciences, National Heart, Lung, and Blood Institute, National Institutes of Health, Bethesda, Maryland.

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Centers for Disease Control and Prevention
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