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Factors Associated With Hypertension Control in US Adults Using 2017 ACC/AHA Guidelines: National Health and Nutrition Examination Survey 1999–2016

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Abstract

BACKGROUND—Factors and trends associated with hypertension control (BP < 130/80 mm Hg) and mean blood pressure (BP) among hypertensive adults (BP ≥ 130/80 mm Hg or medicated for hypertension).

METHOD—Data on 22,911 hypertensive US adults from the 1999–2016 National Health and Nutrition Examination Survey.

RESULTS—For men, hypertension control prevalence increased from 8.6% in 1999–2000 to 16.2% in 2003–2004 ($P < 0.001$), and continued the increasing trend afterwards to 23.2% in 2011–2012 ($P < 0.001$) and then plateaued. For women, hypertension control prevalence increased from 1999–2000 to 2009–2010 (10.8–26.3%, $P < 0.001$) and then plateaued. For men with hypertension, systolic BP decreased from 1999–2000 to 2011–2012 (135.7–132.8 mm Hg, $P < 0.001$) and then increased to 135.3 mm Hg in 2015–2016 ($P < 0.001$). For women with hypertension, systolic BP decreased from 1999–2000 to 2009–2010 (139.7–131.9 mm Hg; $P < 0.001$) and then increased to 134.4 mm Hg in 2015–2016 ($P = 0.003$). Diastolic BP decreased from 1999–2000 to 2015–2016 (men: 79.1–75.5 mm Hg and women: 76.4–73.7 mm Hg, $P < 0.001$ for both). In 2011–2016, hypertension control was 22.0% for men and 25.2% for women. The adjusted prevalence ratio (PR) of hypertension control were lower for non-Hispanic black men and women (PR = 0.72, 95% confidence interval (CI) = 0.61–0.86; PR = 0.83, 95% CI = 0.70–0.99, respectively; non-Hispanic white (NHW) as reference), Hispanic and non-Hispanic Asian men (PR = 0.70, 95% CI = 0.54–0.92; PR = 0.59, 95% CI = 0.39–0.86; respectively; NHW as reference).

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SUPPLEMENTARY MATERIAL

Supplementary data are available at *American Journal of Hypertension* online.

DISCLOSURE

The authors declared no conflict of interest.

CONCLUSION—Hypertension control significantly increased from 1999–2000 to 2011–2012 (men) and 2009–2010 (women) and then plateaued. About a quarter of US adults with hypertension were controlled in 2011–2016.

Keywords

blood pressure; blood pressure control; hypertension; NHANES; systolic and diastolic BP
ACC/AHA 2017 guidelines

Recently, the Global Burden of Disease report identified elevated systolic blood pressure (BP), as one of the 10 largest contributors to disability-adjusted life years lost during 2015.¹ Effective BP management, resulting in a reduction in BP values, has been shown to decrease the incidence of mortality, stroke, heart attack, and heart failure.^{2–8}

Using the most recent NHANES data, and the new 2017 American College of Cardiology/American Heart Association (ACC/AHA) hypertension guidelines, our analysis focused on hypertension control with three objectives.⁹ The first objective was to assess trends in hypertension control from 1999 to 2016 by gender. The second objective was to assess trends in mean systolic and diastolic BP among those with hypertension and those with controlled hypertension from 1999 to 2016. The third objective was to describe the association between hypertension control during 2011–2016 and demographic, health care utilization, risk factors, and comorbidities. Survey years 2011–2016 were used because they include non-Hispanic Asian American and three survey cycles of data provide sufficient sample size to generalize to US adult population.

METHODS

Survey description

The National Health and Nutrition Examination Survey (NHANES) of the National Center for Health Statistics is a cross-sectional, nationally representative health examination surveys of the US civilian noninstitutionalized population. The survey uses a complex, stratified, multistage probability cluster-sampling design.¹⁰ Participants are interviewed in their homes to obtain information on health history, health behaviors, and risk factors. Subsequently, they undergo a physical examination at a mobile examination center (MEC). The procedures to select the sample and conduct the interview and examination have been previously specified.^{10,11} Informed consent is obtained from all participants, and the Research Ethics Review Board of the National Center for Health Statistics approved the NHANES protocol.

Sample

The unweighted sample size for each 2-year NHANES cycle appears in Supplementary Table 1-e. Overall, the response rate for the MEC exam varied from 71% (4,976/7,038) in 1999–2000 to 59% (5,735/9,800) in 2015–2016. Of those examined during survey years 1999–2016, 3,778 persons were excluded from this analysis for the following reasons: 1,533 were pregnant, and 2,245 had missing systolic and diastolic BP data. These exclusions

resulted in a final sample of 47,056 participants aged 18 years and older out of which 22,911 individuals were classified as having hypertension.

For the analysis using 2011–2016 NHANES, 17,274 (62%) were examined in the MEC. Of those examined, 809 persons were excluded for the following reasons: 192 were pregnant, and 456 had missing systolic and diastolic BP data. These exclusions resulted in a final sample of 16,465 (59%) participants aged 18 years and older out of which 7,972 individuals were classified as adults with hypertension.

Outcome variables

All BP readings were obtained during a single examination visit. Trained physicians followed a standard protocol measuring BP at the MEC using a Bauman true gravity mercury wall model and standard Bauman cuffs. Appropriate BP cuff sizes were based on the measurement of the participant's mid-arm circumference. After a 5 min rest, participants had their systolic and diastolic BPs (onset of K1 and fading of K5) measured; systolic and diastolic BP measurements were taken 30 s apart.^{11,12}

The average of up to three brachial systolic and diastolic BP readings was used as the participants' systolic and diastolic BP values. For participants with only one reading, that single reading was used as the average. Using the new 2017 ACC/AHA guidelines, an individual was defined as having stage I hypertension if at least one of the following conditions was satisfied: systolic BP of 130 mm Hg or greater, diastolic BP of 80 mm Hg or greater, or the participant reported currently taking medication to lower high BP.⁹ Hypertension control was defined as systolic BP less than 130 mm Hg and diastolic BP less than 80 mm Hg among those with hypertension.⁹ Mean systolic and diastolic trends were assessed among adults having hypertension and among adults who controlled their hypertension.

Covariates

Demographics.—Age was categorized as 18–39, 40–59, 60–79, and 80 years and older. Data on race/Hispanic origin were categorized as non-Hispanic white, non-Hispanic black, non-Hispanic Asian, Hispanic, and other in 2011–2016.

Income and health care utilization.—Family income to poverty ratio (FIPR) is the ratio of a family's income to its appropriate poverty guidelines as established by the US Department of Health and Human Services.¹³ Four categories of approximately equal number of individuals in each category were used for these analyses: <1.00, 1.00–1.99, 2.00–2.99, and 3.00. Larger FIPRs indicate higher income. Frequency of visits to a health care provider was self-reported based on the answer to the home interview question, "During the past 12 months, how many times have you seen a doctor or other health care professional about your health at a doctor's office, a clinic, hospital emergency room, at home, or some other place?".¹²

Risk factors.—A number of risk factors are associated with hypertension and hypertension control and were included in this analysis as covariates, among them are body mass index, physical activity, diabetes, and chronic kidney disease.^{3,8,14–18}

Fasting and nonfasting weights were obtained in kilograms using a digital scale while wearing a standardized two piece examination outfit. Height in cm was obtained using a stadiometer with a fixed vertical backboard and an adjustable head *piece*.¹² Body mass index (BMI) was calculated as measured weight over measured height in meters squared (kg/m^2), and was categorized using criteria established by the National Institutes of Health as underweight ($<18.5 \text{ kg}/\text{m}^2$), normal weight ($18.5\text{--}24.9 \text{ kg}/\text{m}^2$), overweight ($25.0\text{--}29.9 \text{ kg}/\text{m}^2$), and obese ($\geq 30.0 \text{ kg}/\text{m}^2$).¹⁹ Due to the relatively small number of participants in the underweight category, the underweight category was combined with the normal weight category after a sensitivity analysis showed little difference in the results when excluding the underweight category or when including it in the normal weight category.

Leisure time physical activity (LTPA) was calculated from the NHANES physical activity questionnaire.²⁰ Respondents reported the usual amount of time, per week, spent in moderate and vigorous recreational activities. Minutes of vigorous LTPA was doubled and added to moderate LTPA to get total LTPA. Based on physical activity guidelines, total LTPA was categorized into: none; some, but less than 150 min/week; and 150 or more min/week.¹⁸

Diabetes was defined as “diagnosed diabetic” if a participant reported being told by a doctor or health care provider that he/she has diabetes.¹²

The Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation was used to estimate glomerular filtration rate (GFR) or, the presence of albuminuria (creatinine to albumin ratio). CKD was defined as a GFR less than $60 \text{ ml}/\text{min}$ per 1.73 m^2 or albumin-to-creatinine ratio greater than $30 \text{ mg}/\text{g}$.¹⁷

Statistical methods

All statistical analyses were performed using survey procedures in SAS 9.4 for Windows (SAS Institute, Inc., Cary, NC) and SUDAAN 10.0 software (Research Triangle Institute, Research Triangle Park, NC). All estimates were weighted using the MEC sample weights and incorporated sampling design information; the sample weights accounted for the unequal probabilities of selection resulting from the complex sample design, survey nonresponse, and the planned oversampling of selected population subgroups.

The trend analysis was applied to 1999–2016 survey years and followed the recent analytic method used by Ogden *et al.*²¹ Trends in hypertension and hypertension control and trends in mean systolic and diastolic BP were examined using regression models with the survey period treated as a continuous variable. Linear trend and quadratic trends were tested separately; the latter included both linear and quadratic terms in the models. If a quadratic trend was found, Joinpoint software was used to find the inflection point(s) (Joinpoint version 3.0.1, National Cancer Institute). After an inflection point (or points) was found, the differences in slopes between the adjacent segments were tested using piecewise linear

regression (surveylogistic and surveyreg procedures, SAS v9.4). The hypertension control trends for males and females were statistically significantly different (significant survey cycle and gender interaction), so we conducted analyses stratified by gender.

For the NHANES 2011–2016 hypertension control prevalence analysis, the weighted prevalence and 95% confidence intervals (CIs) of hypertension control were calculated by gender and selected covariates among adults classified as having hypertension. Because hypertension is more prevalent among older individuals, we followed the Crim et al. recommendations and calculated age-adjusted prevalence of hypertension control using the direct method and the distribution of the subpopulation of individuals who had defined hypertension in NHANES 2007–2016 with age groups 18–39, 40–59, 60–79, and 80 years and older.²² Ten years of NHANES data were used to derive reliable age distribution of the most recent hypertensive population. Multivariate logistic regression models were used to examine the independent association of the covariates with the response variable hypertension control among those with hypertension. Prevalence ratios (PRs) with a 95% CI not including 1.0 were considered statistically significant. We derived PR in this article to avoid overestimating the strength of the association of the prevalence odds ratio (OR).^{23,24}

Means systolic and diastolic BP estimates among adults with hypertension and adults with controlled hypertension were age-adjusted by the direct method to the subpopulation of individuals who had defined hypertension in NHANES 2007–2016 with age groups 18–39, 40–59, 60–79, and 80 years and older.²² Hypertension prevalence estimates were age-adjusted by the direct method to the 2000 US census population using age groups 18–39, 40–59, 60–79, and 80 and older.²³

RESULTS

Trends in hypertension control and mean systolic and diastolic values, 1999–2016

Figure 1 and Supplementary Table 2-e show the gender-specific age-adjusted trends in hypertension and hypertension control from 1999 to 2016 for adults aged 18 years and older. Since 1999, there was a statistically significant linear decreasing trend in the prevalence of hypertension among men (51.8% in 1999–2000, 47.3% in 2015–2016, slope = -0.02 , $P = 0.004$), however, there was no significant change in the prevalence of hypertension among women (42.0% in 1999–2000, 39.8% in 2015–2016, slope = -0.01 , $P = 0.09$) (Figure 1). Overall, hypertension control prevalence increased from 9.7% in 1999–2000 to 23.8% in 2009–2010 and then plateaued to 21.7% in 2015–2016. Joinpoint analysis and piecewise regression analysis showed two break points for men at 2003–2004 and 2011–2012 and one break point for women at 2009–2010 (for men, slope before 2003–2004 was 0.33, $P = 0.001$, slope between 2003–2004 and 2011–2012 was 0.13, $P = 0.001$, and slope after 2011–2012 was -0.08 , $P = 0.28$; and for women, slope before 2009–2010 was 0.22, $P = 0.001$ and slope after 2009–2010 was -0.04 , $P = 0.42$). For men, these changes in slopes were due to hypertension control increasing from 8.6% in 1999–2000 to 16.2% in 2003–2004, and continuing the increasing trend afterwards, but at a slower speed, to 23.2% in 2011–2012, and then being stable with no further increase between 2013 and 2016. For women, hypertension control was increasing from 10.8% in 1999–2000 to 26.3% in 2009–2010, and then being stable afterwards with no further increase between 2011 and 2016.

Figure 2 shows the trends in mean systolic and diastolic BP across the nine survey-periods for adults with hypertension. For men, mean SBP decreased ($P = 0.001$) from 135.7 mm Hg in 1999–2000 to 132.8 mm Hg in 2011–2012, and then increased ($P = 0.001$) to 135.3 mm Hg in 2015–2016. For women, SBP decreased ($P = 0.001$) from 139.7 mm Hg in 1999–2000 to 131.9 mm Hg in 2009–2010, and then increased ($P = 0.003$) to 134.4 mm Hg in 2015–2016. No changes in directions were found in DBP trends for both men and women. Among men mean DBP decreased from 79.1 mm Hg in 1999–2000 to 75.5 mm Hg in 2015–2016 ($P = 0.001$); whereas, for women mean DBP decreased from 76.4 mm Hg in 1999–2000 to 73.7 mm Hg in 2015–2016 ($P = 0.001$).

Figure 3 shows the trends in mean systolic and diastolic BP across the nine survey periods for adults with controlled hypertension. There were no significant linear trends in SBP and DBP among those with controlled hypertension for both men and women. Mean SBP was 115.2 mm Hg in 1999–2000 and 117.7 mm Hg in 2015–2016 for men, and 117.7 mm Hg in 1999–2000 and 116.6 mm Hg in 2015–2016 for women. Mean DBP was 69.4 mm Hg in 1999–2000 and 68.2 mm Hg in 2015–2016 for men, and 66.2 mm Hg in 1999–2000 and 64.5 mm Hg in 2015–2016 for women.

Characteristics of adults with controlled hypertension, 2011–2016

The percent of adults with controlled hypertension by various characteristics stratified by gender is presented in Table 1. Among adults aged 18 years and older with hypertension, the age-adjusted prevalence of hypertension control in 2011–2016 was 22.0% among men and 25.2% among women. Controlled hypertension for men was 4.0% for those aged 18–39 years; 21.3% for 40–59 years; 30.5% for 60–79 years; and 26.7% for 80 years and older. Controlled hypertension for women was 17.0% for those 18–39 years; 26.1% for 40–59 years; 29.5% for 60–79 years; and 19.8% for 80 years and older. Age-adjusted controlled hypertension among men was 24.1% for NHW; 18.1% for NHB; 15.7% for Hispanic; and 13.0% for NHA. Controlled hypertension among women was 26.5% for NHW; 24.0% for NHB; 23.4% for Hispanic; and 15.9% for NHA. Controlled hypertension prevalence estimates by survey cycles, gender, income, health care utilization, BMI categories, diagnosed, and defined CKD appear in Table 1.

The adjusted prevalence ratios (aPR) by gender and selected covariates derived from the logistic regression models appear in Table 2. The PRs of hypertension control were significantly higher among men aged 40–59 years (aPR = 4.45, 95% CI = 2.65–7.48), 60–79 years (aPR = 5.14, 95% CI = 3.12–8.48), and 80 years and older (aPR = 4.52, 95% CI = 2.57–7.94) compared with reference men aged 18–39 years. As for women, the PRs of hypertension control were significantly higher among aged 40–59 years (aPR = 1.53, 95% CI = 1.14–2.04), 60–79 years (aPR = 1.59, 95% CI = 1.21–2.09) compared with reference women aged 18–39 years. The PRs of hypertension control were significantly lower among NHB for both men and women (aPR = 0.72, 95% CI = 0.61–0.86 and aPR = 0.83, 95% CI = 0.70–0.99), among Hispanic and NHA men (aOR = 0.70, 95% CI = 0.54–0.92 and aPR = 0.59, 95% CI = 0.39–0.89, respectively) compared with their NHW counterparts. Health care visits were significantly associated with increased PR of hypertension control for both men and women compared with the reference of no health care visits ((1–3 visits:

men, aPR = 3.64, 95% CI = 1.77–7.46; women, aPR = 3.36, 95% CI = 1.53–7.36) and (≥ 4 visits, men, aPR = 5.79, 95% CI = 2.69–12.47; women, aPR = 4.84, 95% CI = 2.23–10.48)). The PR of hypertension control was significantly associated with men who were classified as overweight (aPR = 1.42, 95% CI = 1.04–1.93) and men and women classified as obese (aPR = 1.40, 95% CI = 1.07–1.82, and aPR = 1.48, 95% CI = 1.17–1.88, respectively) compared with women and men of normal weight. Lastly, the PR of hypertension control were significantly higher among women who were diagnosed as having diabetes (aPR = 1.43, 95% CI = 1.18–1.72) compared with women not diagnosed with diabetes.

DISCUSSION

Using 2017 ACC/AHA new definition for stage I hypertension, between 1999–2000 and 2015–2016, there was an overall increase in hypertension control among adults with hypertension.⁹ For adult men, hypertension control increased from 8.6% in 1999–2000 to 23.2% in 2011–2012, and then stabilized. As for women, hypertension control increased from 10.8% in 1999–2000 to 26.3% 2009–2010 and then stabilized.

Among men with hypertension, systolic BP decreased from 1999–2000 to 2011–2012 and then increased from 2011–2012 to 2015–2016 was small (135.7 mm Hg vs. 135.3 mm Hg); whereas among women there was a 5 mm Hg difference in systolic BP between 1999–2000 and 2015–2016 (139.7 mm Hg vs. 134.4 mm Hg). For both genders with hypertension, diastolic BP decreased between 1999–2000 and 2015–2016, specifically for men by 4 mm Hg and for women by 3 mmHg. There were no significant changes in systolic BP and diastolic BP among those with controlled hypertension for both men and women between 1999–2000 and 2015–2016.

The increase in hypertension control could be associated with the increased use of antihypertensive medication among US adults with hypertension. Using NHANES 2001–2010, Gu *et al.* showed the prevalence of antihypertensive medication use increased from 63.5% in 2001–2002 to 77.3% in 2009–2010. In addition, during this time period, there was a significant increase in the use of multiple antihypertensive medications from 36.8% to 47.7%.²⁵ Similarly, using NHANES 1988–1994 and 1999–2010 data, Egan *et al.* showed a significant increase in antihypertension medication use among younger adults (< 60 years) from 34.6% to 54.7% and older adults (≥ 60 years) from 55.6% to 77.5%.²⁶

On 13 November 2017, new guidelines establishing systolic and diastolic BP thresholds for classification of hypertension were published by ACC/AHA. These new guidelines updated the JNC 7 guideline by defining stage I hypertension as BP $\geq 130/80$ mm Hg and stage II hypertension as BP $\geq 140/90$ mm Hg (the latter is the JNC 7 old definition of hypertension).⁹ Younger people had lower stage I hypertension control compared to other age groups for both males and females in 2011–2016 (Table 1). A number of studies suggested that lower hypertension control among younger adults is driven mostly by young men being less aware and less treated than young women.^{15,27,28} However, the prevalence of stage II hypertension control for this age group was higher compared to those of the other age groups ((males: 74% for 18–39 years old; 67% for 40–59 years old; 62% for 60–79 years old; and 53% for 80 years and older) and (females: 80% for 18–39 years old; 75% for 40–59 years old; 61%

for 60–79 years old; and 41% for 80 years and older)). Trends and factors associated with stage II hypertension control are out of scope of this article but deserve further study.

Healthy People 2020 Leading Health Indicators established BP control goals among adults with hypertension to be 61.2% by 2020.²⁹ Our analyses showed this goal has yet to be met for stage I hypertension control.

The findings in this report are subject to some limitations. First, there is only a one-time assessment of BP by NHANES; therefore, the results may overestimate or under-estimate the prevalence of hypertension because of white-coat hypertension or masked hypertension. Together, both phenomena may represent 30% of all erroneous BP readings in a clinical setting.³⁰ Second, misclassification of individuals could occur if they provide inaccurate information; for example, individuals reporting to be physically active when they were not, having being told by a physician that they have diabetes when they do not, individuals who were taking antihypertensive medications but did not acknowledge taking medications to lower their BP and were normotensive at the time of examination and were classified as normotensive. Also, hypertension control was defined based on use of medications. Other modalities such as low sodium diet and smoking cessation may independently contribute to BP reduction and hence increase hypertension control.^{31–33}

Although overall from 1999 to 2010, hypertension control prevalence increased among adult men and women with stage I hypertension, these increases plateaued thereafter. Using the (ACC/AHA 2017) guidelines during 2011–2016, approximately 22% and 25% of men and women with hypertension were controlled, but this falls short of current national goals. In 2011–2016, non-Hispanic blacks of both genders, non-Hispanic Asian and Hispanic men, and women aged 80 years and older, all had lower PRs of controlling their hypertension. For both genders, increased health care visits were associated with increased PRs of hypertension control. Lastly, this is the first report using NHANES 1999–2016 data and the ACC/AHA 2017 guidelines.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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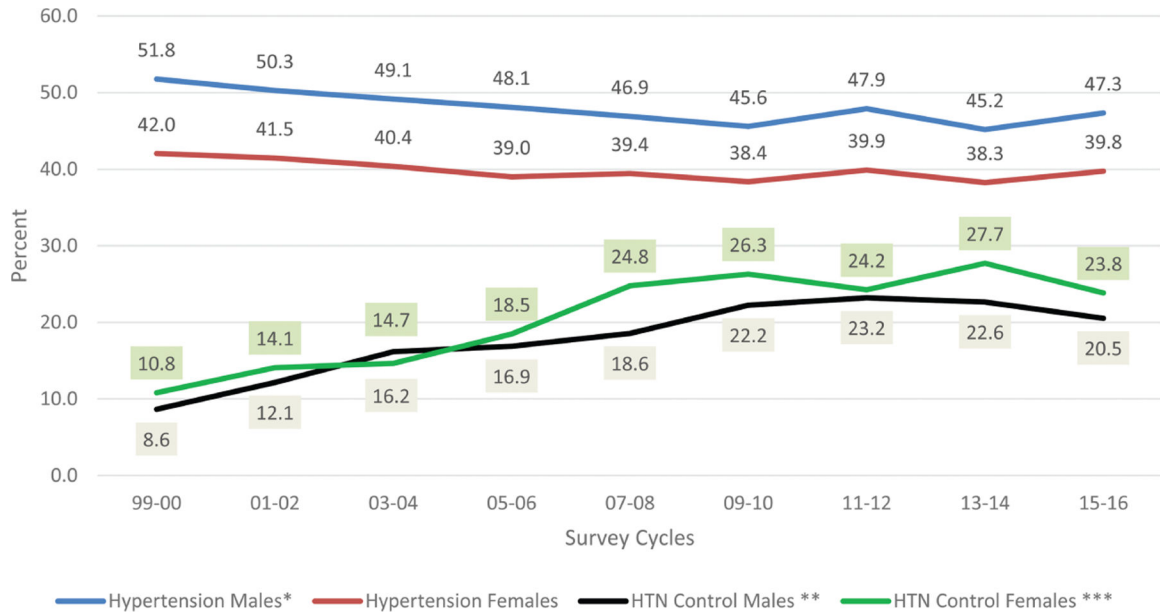


Figure 1. Gender-specific and age-adjusted^a trends in hypertension among adults aged 18 years and older and age-adjusted^b hypertension control^c among adults aged 18 and older: United States, 1999–2016. *Significant linear decreasing trend from 99–00 to 15–16. **Significant linear increasing trend from 99–00 to 03–04, and from 03–04 to 11–12. ***Significant linear increasing trend from 99–00 to 09–10. ^aHypertension estimates are age-adjusted by the direct method to the 2000 US Census population using age groups 18–39, 40–59, 60–79, and 80 and older. ^bEstimates of controlled hypertension are age-adjusted by the direct method using computed weights based on the subpopulation of persons with hypertension in the 2007–2016 National Health and Nutrition Examination Survey, 18–39, 40–59, 60–79, and 80 and older with weights 0.1661, 0.4061, 0.3446, and 0.0832. ^cHypertension control (BP < 130/80 mm Hg) among those with hypertension. *Note:* Numbers in green box refer to hypertension control of females; numbers in gray box refer to hypertension control of males.

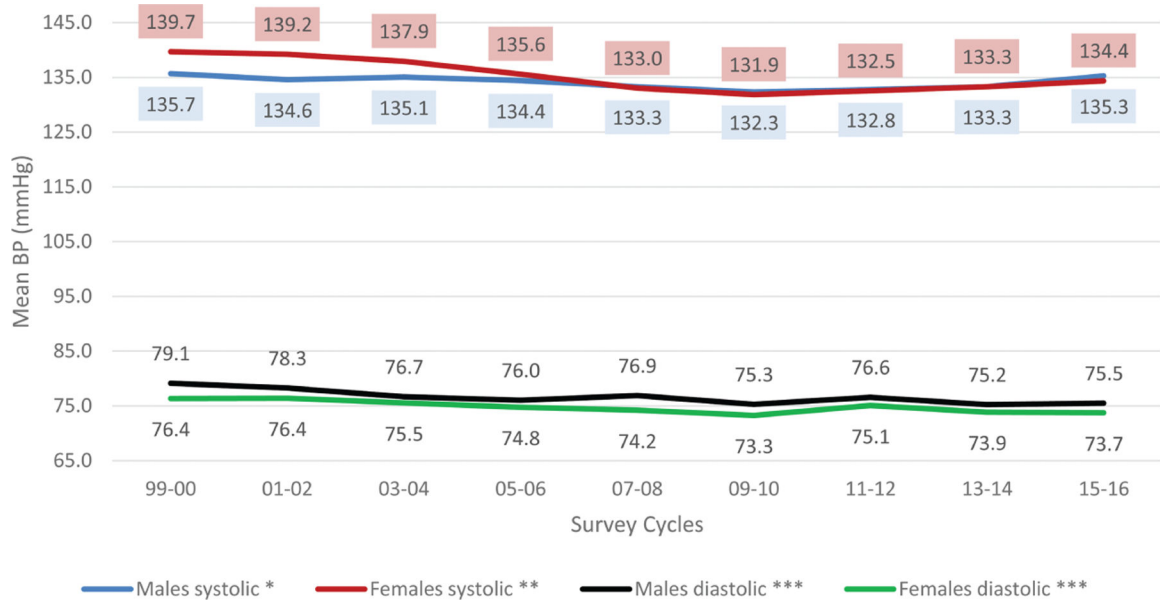


Figure 2. Gender-specific and age-adjusted^a mean systolic and diastolic blood pressure among adults aged 18 and older with hypertension: United States, 1999–2016. *Significant linear decreasing trend from 99–00 to 11–12, significant linear increasing trend from 11–12 to 15–16. **Significant linear decreasing trend from 99–00 to 09–10, significant linear increasing trend from 09–10 to 15–16. ***Significant linear decreasing trend from 99–00 to 15–16. ^aEstimates of controlled hypertension are age-adjusted by the direct method using computed weights based on the subpopulation of persons with hypertension in the 2007–2016 National Health and Nutrition Examination Survey, 18–39, 40–59, 60–79, and 80 and older with weights 0.1661, 0.4061, 0.3446, and 0.0832. Note: numbers in red box refer to female systolic; numbers in blue box refer to male systolic.

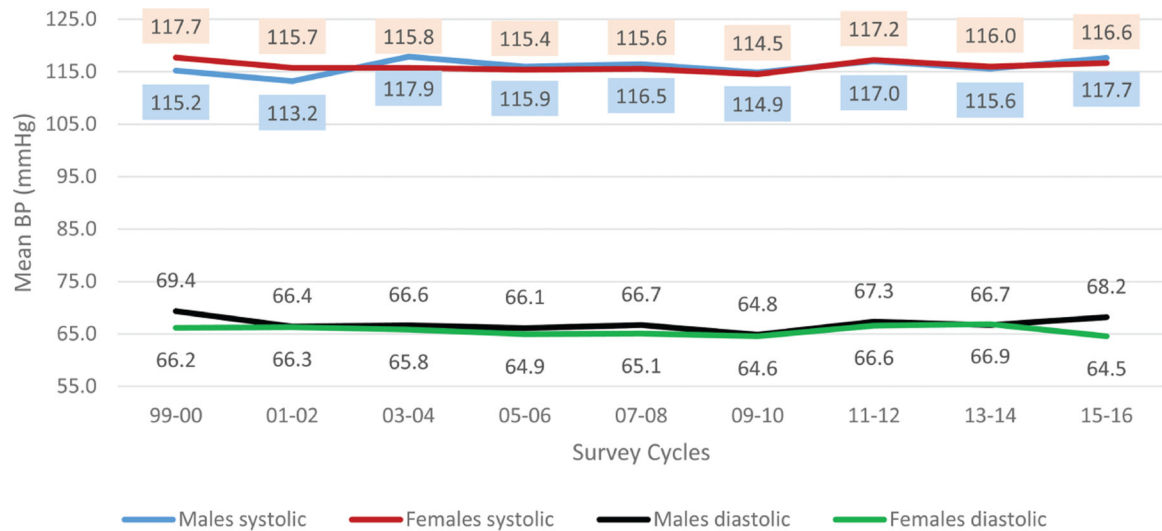


Figure 3.

Gender-specific and age-adjusted^a mean systolic and diastolic blood pressure among adults aged 18 and older with controlled hypertension,^b 1999–2016. ^aEstimates of controlled hypertension are age-adjusted by the direct method using computed weights based on the subpopulation of persons with hypertension in the 2007–2016 National Health and Nutrition Examination Survey, 18–39, 40–59, 60–79, and 80 and older with weights 0.1661, 0.4061, 0.3446, and 0.0832. ^bHypertension control (BP < 130/80 mm Hg) among those with hypertension. *Note:* numbers in red box refer to female systolic; numbers in blue box refer to male systolic.

Hypertension control among adults aged 18 years and older with hypertension by demographic, health care utilization, risk factors, and comorbidity: NHANES 2011–2016

Table 1.

	N	Total	Age-adjusted ^d	
			Males (n = 4,147)	Females (n = 3,825)
			% Controlled (95% CI)	
Overall	7,972	23.1 (21.3–25.0)	22.0 (20.1–24.1)	25.2 (22.7–28.0)
Survey period				
2011–2012	2,587	23.1 (20.0–26.4)	23.2 (20.7–26.0)	24.2 (19.2–30.1)
2013–2014	2,630	24.8 (21.9–27.8)	22.6 (19.6–26.0)	27.7 (24.1–31.6)
2015–2016	2,755	21.7 (18.5–25.3)	20.5 (16.8–24.8)	23.8 (19.7–28.5)
Age group				
18–39 years	1,198	8.2 (6.2–10.9)	4.0 (2.7–6.1)	17.0 (12.8–22.1)
40–59 years	2,774	23.5 (20.7–26.7)	21.3 (18.0–25.0)	26.1 (22.3–30.4)
60–79 years	3,194	29.9 (27.1–33.0)	30.5 (27.1–34.1)	29.5 (25.8–33.4)
80 years and older	806	22.3 (18.4–26.7)	26.7 (21.6–32.4)	19.8 (15.3–25.3)
Race and Hispanic status				
Hispanic	1,770	19.0 (17.0–21.2)	15.7 (12.9–19.0)	23.4 (20.4–26.7)
Non-Hispanic white	3,013	24.6 (22.2–27.3)	24.1 (21.4–26.9)	26.5 (23.0–30.3)
Non-Hispanic black	2,191	21.0 (18.9–23.4)	18.1 (15.5–20.9)	24.0 (21.1–27.2)
Non-Hispanic Asian	774	14.5 (11.9–17.5)	13.0 (9.2–18.2)	15.9 (12.2–20.4)
Family income-to-poverty ratio				
Less than 1	1,659	22.7 (19.8–26.0)	19.6 (15.1–25.1)	26.6 (22.6–31.1)
1 to less than 2	2,024	23.6 (21.2–26.2)	20.6 (17.4–24.2)	27.4 (23.1–32.2)
2 to less than 4	1,852	23.6 (20.6–26.9)	24.2 (20.4–28.5)	23.9 (20.7–27.5)
4 or more	1,703	23.7 (20.6–27.0)	23.7 (20.7–26.9)	24.8 (20.2–30.1)
Health care visits in past year				
None	986	4.7 (2.5–8.6)	4.7 (2.0–10.8)	5.3 (2.5–11.0)
1–3	3,313	19.5 (17.1–22.1)	19.0 (16.1–22.2)	20.6 (17.7–23.7)
4 or more	3,666	31.5 (28.9–34.1)	31.3 (28.1–34.6)	31.9 (28.0–36.0)
Body mass index category				

	N	Age-adjusted ^a		
		Total	Males (n = 4,147)	Females (n = 3,825)
		% Controlled (95% CI)		
Underweight/normal	1,708	15.7 (12.6–19.4)	14.4 (11.1–18.6)	17.2 (12.9–22.5)
Overweight	2,486	22.2 (19.4–25.3)	22.0 (19.2–25.2)	24.8 (20.2–30.1)
Obese	3,667	26.7 (24.8–28.7)	25.0 (22.4–27.8)	28.9 (26.1–31.9)
Leisure time physical activity				
None	4,547	24.5 (22.5–26.6)	23.4 (21.0–26.0)	26.4 (23.7–29.3)
Some, but <150	1,149	23.5 (20.8–26.5)	21.9 (17.6–26.8)	25.3 (21.0–30.2)
150 or more	2,259	21.2 (18.3–24.3)	20.7 (17.6–24.2)	23.0 (18.4–28.3)
Diagnosed diabetes				
Yes	1,662	34.3 (30.5–38.3)	31.6 (27.3–36.3)	37.4 (31.9–43.3)
No	6,308	21.2 (19.0–23.5)	20.4 (18.1–22.9)	23.1 (20.1–26.3)
Chronic kidney disease				
Yes	1,996	24.3 (21.7–27.2)	23.8 (20.4–27.6)	25.1 (21.0–29.7)
No	5,413	23.1 (20.9–25.6)	22.2 (19.8–24.8)	25.3 (22.3–28.5)

Hypertension control (BP < 130/80 mm Hg) among those with hypertension.

^a Age-adjusted using the age groups 18–39, 40–59, 60–79, 80 years and older with weights 0.1661, 0.4061, 0.3446, and 0.0832.

Source: NHANES 2007–2016.

Adjusted^a prevalence ratios for hypertension control among adults aged 18 years and older with hypertension: NHANES 2011–2016

Table 2.

	Prevalence ratio (95% CI)	
	Males (n = 4,147)	Females (n = 3,825)
Survey period		
2011–2012	Reference	Reference
2013–2014	0.93 (0.75–1.16)	1.15 (0.87–1.52)
2015–2016	0.91 (0.71–1.16)	1.02 (0.75–1.38)
Age group		
18–39 years	Reference	Reference
40–59 years	4.45 (2.65–7.48)	1.53 (1.14–2.04)
60–79 years	5.14 (3.12–8.48)	1.59 (1.21–2.09)
80 years and older	4.52 (2.57–7.94)	1.17 (0.77–1.80)
Race and Hispanic status		
Hispanic	0.70 (0.54–0.92)	0.85 (0.71–1.01)
Non-Hispanic white	Reference	Reference
Non-Hispanic black	0.72 (0.61–0.86)	0.83 (0.70–0.99)
Non-Hispanic Asian	0.59 (0.39–0.89)	0.78 (0.58–1.04)
Family income-to-poverty ratio		
Less than 1	Reference	Reference
1 to less than 2	1.10 (0.77–1.57)	0.97 (0.77–1.22)
2 to less than 4	1.28 (0.97–1.669)	0.91 (0.72–1.16)
4 or more	1.13 (0.86–1.48)	0.91 (0.72–1.16)
Health care visits in past year		
None	Reference	Reference
1–3	3.64 (1.77–7.46)	3.36 (1.53–7.36)
4 or more	5.79 (2.69–12.47)	4.84 (2.23–10.48)
Body mass index category		
Underweight/normal	Reference	Reference
Overweight	1.42 (1.04–1.93)	1.26 (0.95–1.67)
Obese	1.40 (1.07–1.82)	1.48 (1.17–1.88)

	Males (n = 4,147)	Females (n = 3,825)
	Prevalence ratio (95% CI)	
Leisure time physical activity		
None	Reference	Reference
Some, but less than 150 min	0.99 (0.78–1.27)	0.98 (0.81–1.18)
150 min or more	0.89 (0.72–1.09)	0.98 (0.78–1.23)
Diagnosed diabetes		
Yes	1.24 (0.98–1.55)	1.43 (1.18–1.72)
No	Reference	Reference
Chronic kidney disease		
Yes	0.94 (0.77–1.14)	0.91 (0.74–1.12)
No	Reference	Reference

^aEach variable is adjusted for all other variables in the table.