Hypertension

ORIGINAL ARTICLE

Blood Pressure Control Among US Adults, 2009 to 2012 Through 2017 to 2020

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BACKGROUND: The National Health and Nutrition Examination Survey data indicate that the proportion of US adults with hypertension that had controlled blood pressure (BP) declined from 2013 to 2014 through 2017 to 2018. We analyzed data from National Health and Nutrition Examination Survey 2009 to 2012, 2013 to 2016, and 2017 to 2020 to confirm this finding.

METHODS: Hypertension was defined as systolic BP ≥140 mm Hg or diastolic BP ≥90 mm Hg or antihypertensive medication use. BP control among those with hypertension was defined as systolic BP <140 mm Hg and diastolic BP <90 mm Hg.

RESULTS: The age-adjusted prevalence of hypertension was 31.5% (95% CI, 30.3%–32.8%), 32.0% (95% CI, 30.6%–33.3%), and 32.9% (95% CI, 31.0%–34.7%) in 2009 to 2012, 2013 to 2016, and 2017 to 2020, respectively (*P* trend=0.218). The age-adjusted prevalence of hypertension increased among non-Hispanic Asian adults from 27.0% in 2011 to 2012 to 33.5% in 2017 to 2020 (*P* trend=0.003). Among Hispanic adults, the age-adjusted prevalence of hypertension increased from 29.4% in 2009 to 2012 to 33.2% in 2017 to 2020 (*P* trend=0.029). In 2009 to 2012, 2013 to 2016, and 2017 to 2020, 52.8% (95% CI, 50.0%–55.7%), 51.3% (95% CI, 47.9%–54.6%), and 48.2% (95% CI, 45.7%–50.8%) of US adults with hypertension had controlled BP (*P* trend=0.034). Among US adults taking antihypertensive medication, 69.9% (95% CI, 67.8%–72.0%), 69.3% (95% CI, 66.6%–71.9%), and 67.7% (95% CI, 65.2%–70.3%) had controlled BP in 2009 to 2012, 2013 to 2016, and 2017 to 2020, respectively (*P* trend=0.189). Among all US adults with hypertension and those taking antihypertensive medication, a decline in BP control between 2009 to 2012 and 2017 to 2020 occurred among those ≥75 years, women, and non-Hispanic black adults.

CONCLUSIONS: These data confirm that the proportion of US adults with hypertension who have controlled BP has declined.
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Key Words: blood pressure ■ epidemiology ■ female ■ hypertension ■ prevalence

High blood pressure (BP) accounts for more cardiovascular disease events in the United States than any other modifiable risk factor.[1,2] Randomized trials have demonstrated that antihypertensive medication lowers BP and reduces the risk for cardiovascular disease.[3,4] These trials and evidence-based BP guidelines have provided the foundation for ongoing clinical and public health efforts designed to increase BP control among US adults with hypertension.[5–7] In turn, substantial improvements in BP control have occurred.[8,9] Data from the US National Health and Nutrition Examination Survey (NHANES) show that the proportion of US adults with hypertension who had controlled BP, defined by systolic BP (SBP) <140 mm Hg and diastolic BP (DBP) <90 mm Hg, increased from 31.8% in 1999 to 2000 to 53.8% in 2013 to 2014.[8] However, between 2013 to 2014 and 2017 to 2018, the improvement in BP control was reversed. According to NHANES 2017 to 2018, 43.7% of US adults with hypertension had controlled BP.

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NOVELTY AND RELEVANCE

What Is New?

This article provides contemporary data on the proportion of US adults with hypertension who have controlled blood pressure. The prevalence of controlled blood pressure declined from 2009 to 2012 through 2017 to 2020. Declines in blood pressure control were present among US adults ≥75 years of age, non-Hispanic Black adults, and women.

What Is Relevant?

Uncontrolled blood pressure is common among US adults, resulting in an increased risk for cardiovascular disease. Nonpharmacological and pharmacological approaches are available to lower blood pressure among adults with hypertension.

Clinical/Pathophysiological Implications?

Programs are needed to increase blood pressure control among US adults.

Nonstandard Abbreviations and Acronyms

ACC	American College of Cardiology
AHA	American Heart Association
BP	blood pressure
DBP	diastolic blood pressure
NHANES	National Health and Nutrition Examination Survey
SBP	systolic blood pressure

NHANES data collected in January 2019 through March 2020 before the COVID-19 pandemic resulted in the survey being halted or provide the opportunity to assess whether or not the decline in BP control has continued.[10] The primary goal of the current study was to estimate the proportion of US adults with hypertension who had controlled BP in 2009 to 2012, 2013 to 2016, and 2017 to 2020, using the NHANES data preceding the COVID-19 pandemic in the United States. Additionally, we assessed the prevalence of hypertension, or the mean SBP and DBP, the distribution of BP levels, hypertension awareness among those with hypertension, and antihypertensive medication use among those who were aware they had hypertension.

METHODS

NHANES is a cross-sectional survey of the civilian, noninstitutionalized US population, conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention. A description of its design and data collection methods is available on the survey website.[11] The current analysis included six 2-year NHANES cycles, from 2009 to 2010 through 2019 to 2020. Multiple NHANES cycles can be combined to provide more stable statistical estimates.[12] The data collection for the NHANES 2019 to 2020 cycle was stopped in March 2020 due to the COVID-19 pandemic, and consequently the National Center for Health Statistics has only made the 2019 to 2020 data available combined with the 2017 to 2018 data, adjusted to achieve 48 primary sampling units.[10] Therefore, we analyzed data from NHANES 2017 to 2020, and for comparability, we combined earlier NHANES cycles to have three 4-year periods: 2009 to 2012, 2013 to 2016, and 2017 to 2020. The protocols for each NHANES cycle were approved by the National Center for Health Statistics of the Centers for Disease Control and Prevention Institutional Review Board. Written informed consent was obtained from each participant.

Data Collection

Data for the current analysis were collected through interviews conducted in participants' homes followed by a physical examination and laboratory specimen collection in a mobile examination center. Age, sex, and race-ethnicity were self-reported. Before the NHANES 2011 to 2012 cycle, the public use NHANES data set provided information on race-ethnicity as non-Hispanic White, non-Hispanic Black, Hispanic including Mexican American and other Hispanic, and other. Beginning in 2011 to 2012, the public use NHANES data set provided information on non-Hispanic Asian adults as a separate group.

BP Measurement and Antihypertensive Medication Use

For each participant, BP measurements took place during a single examination visit. From 2009 to 2010 through 2017 to 2018, a physician measured BP using a mercury sphygmomanometer (Bauman true gravity mercury wall model) with standard Bauman cuffs.[13] For 2017 to 2018 and 2019 to 2020, a health technician measured BP using a validated oscillometric device (Omron 907 XL).[14] Based on a rigorous evaluation of the differences in mean SBP and DBP when measured by the two devices among 4417 NHANES 2017 to 2018 participants, auscultatory (mercury sphygmomanometer) minus oscillometric (Omron 907XL) was +1.5 mm Hg ($P<0.001$) and −1.3 mm Hg ($P<0.01$), respectively. Based on these data, we added 1.5 mm Hg to oscillometric-measured SBP and subtracted 1.3 mm Hg from oscillometric-measured DBP for participants in 2017 to 2020, to calibrate the oscillometric device values to the mercury device values.[15] The BP measurements from the auscultatory device for participants in the NHANES 2017 to 2018 cycle are not available in the 2017 to 2020 NHANES data set. Consistent with prior NHANES analyses, the average of up to 3 brachial SBP and DBP values was used regardless

of the device.[16,17] If a participant had only 1 or 2 readings, these readings were used.

Definitions of Hypertension, Awareness, Treatment, and BP Control

Hypertension was defined according to the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure guideline as SBP ≥140 mm Hg or DBP ≥90 mm Hg or self-reported antihypertensive medication use.[18] Awareness of having hypertension was defined by answering yes to the question "Have you ever been told by a doctor or other health care professional that you had hypertension, also called high blood pressure?" Taking antihypertensive medication was defined by answering yes to the question "Are you now taking prescribed medication for high blood pressure?" The primary outcome was BP control among all adults with hypertension, which was defined as SBP <140 mm Hg and DBP <90 mm Hg. As a secondary outcome, we assessed BP control among adults taking antihypertensive medication.

Statistical Analysis

We restricted the analyses to NHANES participants who were ≥18 years of age and completed the NHANES interview and examination (n=32 599). Participants who were pregnant (n=347) and those without any SBP and DBP measurements from the NHANES examination (n=1891) were excluded. Also, 50 participants who were missing information on antihypertensive medication use were excluded. After these exclusions were applied, 30 311 participants were included in the analyses (Figure S1).

For each period (2009–2012, 2013–2016, and 2017–2020), we estimated the age-adjusted prevalence of hypertension for the overall population and in subgroups defined by age (18–44, 45–64, 65–74, and ≥75 years), sex, and race-ethnicity (non-Hispanic White, non-Hispanic Black, non-Hispanic Asian, and Hispanic). We estimated the distribution of age, sex, and race-ethnicity and the age-adjusted mean SBP and DBP and age-adjusted distribution of BP categories (SBP/DBP <120/80, 120–129/<80, 130–139/80–89, 140–159/90–99, and ≥160/100 mm Hg) for US adults with hypertension in each period.

For each period, the age-adjusted proportion of US adults who had controlled BP was estimated for those with hypertension and those taking antihypertensive medication in the overall population and in age, sex, and race-ethnicity subgroups. Additionally, we calculated the age-adjusted proportion of US adults with hypertension who were aware of their condition and the age-adjusted proportion taking antihypertensive medication among those aware for the overall population and in age, sex, and race-ethnicity subgroups. In a sensitivity analysis, we estimated the age-adjusted proportion of US adults with hypertension who had controlled BP in 5 time periods (2009–2010, 2011–2012, 2013–2014, 2015–2016, and 2017–2020). In a second sensitivity analysis, the age-adjusted proportion of US adults with hypertension and with controlled BP, among US adults with hypertension and among those taking antihypertensive medication, was estimated without adjusting the oscillometric BP values. The above analyses were repeated defining hypertension and BP control according to the 2017 American College of Cardiology (ACC)/American Heart Association (AHA) BP guideline. Using this guideline, hypertension was defined as SBP ≥130 mm Hg or DBP ≥80 mm Hg, and self-reported antihypertensive medication use and BP control among those with hypertension was defined as SBP <130 mm Hg and DBP <80 mm Hg.[5]

The presence of linear trends from 2009 to 2012 through 2017 to 2020 was assessed using logistic regression and modeling the midpoint of each time period. Age adjustment was performed using direct standardization with the age distribution of the standard population set to all US adults in 2009 to 2020 when estimating the prevalence of hypertension (18–44 years, 45.8%; 45–64 years, 34.9%; 65–74 years, 11.7%; and ≥75 years, 7.6%) and US adults with hypertension in 2009 to 2020 (18–44 years, 13.5%; 45–64 years, 45.3%; 65–74 years, 23.3%; and ≥75 years, 17.8%) for the remainder of the analyses. All estimates were weighted using the NHANES examination sample weights. The calculated variance estimates accounted for the complex survey design by using Taylor series linearization. Data analysis was conducted using Stata V17 (Stata Corporation, College Station, TX).

RESULTS

The age-adjusted prevalence of hypertension was 31.5%, 32.0%, and 32.9% in 2009 to 2012, 2013 to 2016, and 2017 to 2020, respectively (Table 1; *P* trend=0.218). The age-adjusted prevalence of hypertension increased among non-Hispanic Asian adults from 27.0% in 2011 to 2012 to 33.5% in 2017 to 2020 (*P* trend=0.003). Among Hispanic adults, the age-adjusted prevalence of hypertension increased from 29.4% in 2009 to 2012 to 33.2% in 2017 to 2020 (*P* trend=0.029). There was no evidence of a trend in the age-adjusted prevalence of hypertension among non-Hispanic White or non-Hispanic Black adults, in any age group, or among women or men.

The proportion of US adults with hypertension who were non-Hispanic White declined from 70.4% in 2009 to 2012 to 64.8% in 2017 to 2020 (Table 2). In 2009 to 2012, 2013 to 2016, and 2017 to 2020, the age-adjusted mean SBP was 135, 137, and 137 mm Hg, respectively, and the age-adjusted mean DBP was 73, 73, and 78 mm Hg, respectively. The age-adjusted proportion of US adults with SBP/DBP of 140 to 159/90 to 99 mm Hg and ≥160/100 mm Hg was 35.8% and 11.4%, respectively, in 2009 to 2012, 37.4% and 11.3%, respectively, in 2013 to 2016, and 38.5% and 13.2%, respectively, in 2017 to 2020.

Among all US adults with hypertension, the age-adjusted proportion with controlled BP declined from 52.8% in 2009 to 2012 to 48.2% in 2017 to 2020 (Figure [A]; Table S1; *P* trend=0.034). The age-specific proportion of US adults with controlled BP declined among those ≥75 years of age, while the age-adjusted proportion with controlled BP declined among women

Table 1. Age-Specific and Age-Adjusted Prevalence of Hypertension Among US Adults in 2009 to 2012, 2013 to 2016, and 2017 to 2020, overall and in Age, Sex, and Race-Ethnicity Subgroups

Population evaluated	Calendar period			
	2009–2012	2013–2016	2017–2020	*P* trend
Overall	31.5 (30.3–32.8)	32.0 (30.6–33.3)	32.9 (31.0–34.7)	0.218
Age group, y				
18–44	9.2 (8.3–10.2)	10.1 (8.9–11.4)	9.8 (8.3–11.2)	0.570
45–64	40.0 (37.4–42.7)	40.8 (38.5–43.1)	43.6 (40.2–47.0)	0.100
65–74	63.9 (60.2–67.7)	64.2 (60.1–68.3)	64.1 (59.8–68.4)	0.956
≥75	76.8 (74.5–79.1)	73.5 (70.2–76.9)	74.5 (70.8–78.3)	0.318
Sex				
Women	30.8 (29.4–32.1)	30.9 (29.4–32.5)	31.5 (29.6–33.4)	0.493
Men	32.2 (30.3–34.0)	32.8 (31.0–34.6)	34.1 (31.8–36.4)	0.192
Race-ethnicity				
Non-Hispanic White	30.3 (28.7–31.9)	30.6 (28.9–32.4)	30.7 (28.1–33.2)	0.870
Non-Hispanic Black	44.2 (42.4–46.1)	44.1 (42.0–46.2)	46.6 (44.2–49.0)	0.163
Non-Hispanic Asian	27.0 (23.4–30.7)*	28.9 (26.5–31.2)	33.5 (30.7–36.2)	0.003
Hispanic	29.4 (27.2–31.5)	30.0 (27.8–32.2)	33.2 (29.9–36.6)	0.029

Hypertension was defined according to the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure as a SBP ≥140 mm Hg or DBP ≥90 mm Hg or self-reported antihypertensive medication use. Numbers in the table are estimated percentage (95% CI) of the US adult population or subgroup with hypertension. DBP indicates diastolic blood pressure; NHANES, National Health and Nutrition Examination Survey; and SBP, systolic blood pressure.

*Data for non-Hispanic Asian adults in 2009 to 2012 represent 2011 to 2012 as the public use NHANES data set does not provide information for non-Hispanic Asian participants in 2009 to 2010.

and non-Hispanic Black adults (each *P* trend, <0.05). Among US adults with hypertension taking antihypertensive medication, the age-adjusted proportion with controlled BP was 69.9%, 69.3%, and 67.7% in 2009 to 2012, 2013 to 2016, and 2017 to 2020, respectively (Figure [B]; Table S1; *P* trend=0.189). Among US adults ≥75 years of age who were taking antihypertensive medication, the proportion with controlled BP declined and the age-adjusted proportion with controlled BP declined among women and non-Hispanic Black adults (each *P* trend, <0.05). When 5 time periods, from 2009-to-2010 to 2017-to-2020, were analyzed, a decline in the age-specific or age-adjusted proportion with BP control, among all US adults with hypertension and those taking antihypertensive medication, was present for those ≥75 years of age, women, and non-Hispanic Black adults (Table S2; each *P* trend, <0.05). The age-adjusted proportion of US adults with hypertension and with controlled BP among those with hypertension and among those taking antihypertensive medication without calibrating the oscillometric BP values for NHANES 2017 to 2020 participants is shown in Tables S3 and S4.

The age-adjusted proportion of US adults with hypertension who were aware they had hypertension declined from 82.4% in 2009 to 2012 to 79.1% in 2017 to 2020 (Table 3; *P* trend=0.049). Declines in the age-specific or age-adjusted proportion with hypertension awareness occurred among US adults ≥75 years of age, women, and non-Hispanic Black adults (each *P* trend, <0.05). Among those aware they had hypertension, the age-adjusted proportion that were taking antihypertensive medication was 91.9% in 2009 to 2012, 89.2% in 2013 to 2016, and 90.6% in 2017 to 2020 (*P* trend, 0.273). The age-adjusted proportion of non-Hispanic Black adults taking antihypertensive medication declined from 90.9% in 2009 to 2012 to 87.1% in 2017 to 2020 (*P*=0.023).

Results Defining Hypertension and BP Control Using the 2017 ACC/AHA BP Guideline

The age-adjusted prevalence of hypertension defined by the 2017 ACC/AHA BP guideline was 45.8%, 45.3%, and 46.5% in 2009 to 2012, 2013 to 2016, and 2017 to 2020, respectively (Table S5; *P* trend=0.638). The age-adjusted prevalence of hypertension increased among non-Hispanic Asian adults (*P* trend=0.017) while there was no evidence of a trend in the age-specific or age-adjusted prevalence of hypertension in the other subgroups investigated. Demographic characteristics, the mean age-adjusted SBP and DBP, and the age-adjusted distribution of BP categories among US adults with hypertension defined by the 2017 ACC/AHA BP guideline are presented in Table S6. In 2009 to 2012, 2013 to 2016, and 2017 to 2020, the age-adjusted proportion with controlled BP was 25.8%, 24.8%, and 24.3% (*P* trend=0.417), respectively, among all US adults with hypertension and 45.2%, 45.0%, and 43.4% (*P* trend=0.453), respectively, among US adults taking antihypertensive medication (Table S7). There was no evidence of a change in the age-adjusted proportion

Table 2. Demographic Characteristics and Age-Adjusted Mean Blood Pressure and Distribution of Blood Pressure Categories Among US Adults With Hypertension in 2009 to 2012, 2013 to 2016, and 2017 to 2020

Population evaluated	Calendar period		
	2009–2012	2013–2016	2017–2020
Age group, y			
18–44	14.3 (12.8–15.9)	14.6 (12.9–16.5)	13.0 (10.8–15.5)
45–64	46.5 (44.7–48.3)	44.7 (42.6–46.8)	45.5 (43.3–47.8)
65–74	21.0 (19.5–22.5)	23.5 (22.1–25.9)	24.6 (21.9–27.5)
≥75	18.3 (16.8–19.8)	17.2 (15.3–19.4)	16.9 (14.9–19.0)
Sex			
Women	51.6 (49.5–53.6)	51.2 (49.1–53.3)	50.5 (47.7–53.3)
Men	48.4 (46.4–50.5)	48.8 (46.7–50.9)	49.5 (46.7–52.3)
Race-ethnicity			
Non-Hispanic White	70.4 (64.4–75.7)	68.0 (62.5–73.0)	64.8 (58.6–70.6)
Non-Hispanic Black	14.8 (11.4–19.0)	14.3 (11.0–18.3)	14.6 (11.0–19.1)
Non-Hispanic Asian	3.7 (2.4–5.5)*	4.2 (3.2–5.6)	4.9 (3.5–6.8)
Hispanic	9.1 (6.3–12.9)	10.5 (7.6–14.2)	11.5 (9.0–14.4)
SBP, mm Hg	135 (134–136)	137 (135–138)	137 (136–138)
DBP, mm Hg	73 (72–74)	73 (72–74)	78 (77–78)
Blood pressure category†			
<120/80 mm Hg	20.0 (17.9–22.1)	18.7 (16.2–21.2)	17.9 (16.0–19.9)
120–129/<80 mm Hg	14.4 (13.1–15.8)	14.5 (12.8–16.2)	13.4 (11.5–15.3)
130–139/80–89 mm Hg	18.4 (17.2–19.6)	18.1 (15.7–20.4)	16.9 (14.4–19.5)
140–159/90–99 mm Hg	35.8 (33.2–38.4)	37.4 (34.7–40.1)	38.5 (36.2–40.8)
≥160/100 mm Hg	11.4 (9.7–13.1)	11.3 (10.1–12.6)	13.2 (11.7–14.8)
Antihypertensive medication use, %	76.0 (73.5–78.5)	74.6 (72.1–77.0)	71.9 (69.3–74.6)

Numbers in the table are estimated percentage (95% CI) of the specified subgroup of the US population with hypertension except for SBP and DBP which are mean (95% CI). Hypertension was defined according to the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure as a SBP ≥140 mm Hg or DBP ≥90 mm Hg or self-reported antihypertensive medication use. DBP indicates diastolic blood pressure; NHANES, National Health and Nutrition Examination Survey; and SBP, systolic blood pressure.

*Data for non-Hispanic Asian adults in 2009 to 2012 represent 2011 to 2012 as the public use NHANES data set does not provide information for non-Hispanic Asian participants in 2009 to 2010.

†US adults with SBP and DBP in 2 different categories were placed in the higher category.

with controlled BP when 5 periods, from 2009-to-2010 to 2017-to-2020, were evaluated (Table S8). The age-adjusted proportion of US adults with hypertension and with controlled BP without calibrating the oscillometric BP values for NHANES 2017 to 2020 participants is shown in Tables S9 and S10. The age-adjusted proportion of US adults with hypertension who were aware they had the condition was 65.5%, 66.9%, and 64.4% in 2009 to 2012, 2013 to 2016, and 2017 to 2020 (*P* trend=0.963), respectively, and the age-adjusted proportion taking antihypertensive medication among those with hypertension awareness was 85.2%, 82.9%, and 84.2% in 2009 to 2012, 2013 to 2016, and 2017 to 2020 (*P* trend=0.453), respectively (Table S11).

DISCUSSION

According to NHANES data analyzed in the current study, the age-adjusted proportion of US adults with controlled BP, defined by SBP <140 mm Hg and DBP <90 mm Hg, declined between 2009 to 2012 and 2017 to 2020. There was no evidence of a trend from 2009-to-2012 to 2017-to-2020 in the proportion of US adults taking antihypertensive medication who had controlled BP. Among all US adults with hypertension and those taking antihypertensive medication, a decline in BP control occurred among US adults ≥75 years of age, women, and non-Hispanic Black adults.

The decline in, and low proportion with, BP control among US adults ≥ 75 years of age, women and non-Hispanic black adults may contribute to increasing health disparities. The rates of BP-related outcomes including stroke and heart failure are higher in older versus younger adults and non-Hispanic black versus non-Hispanic White adults.[19–21] While women have a lower risk of stroke than men, the association of higher BP with stroke is stronger among women versus men.[22,23] Additionally, the lifetime risk of heart failure is similar among women and men, but the association of hypertension with heart failure was stronger among women versus men in

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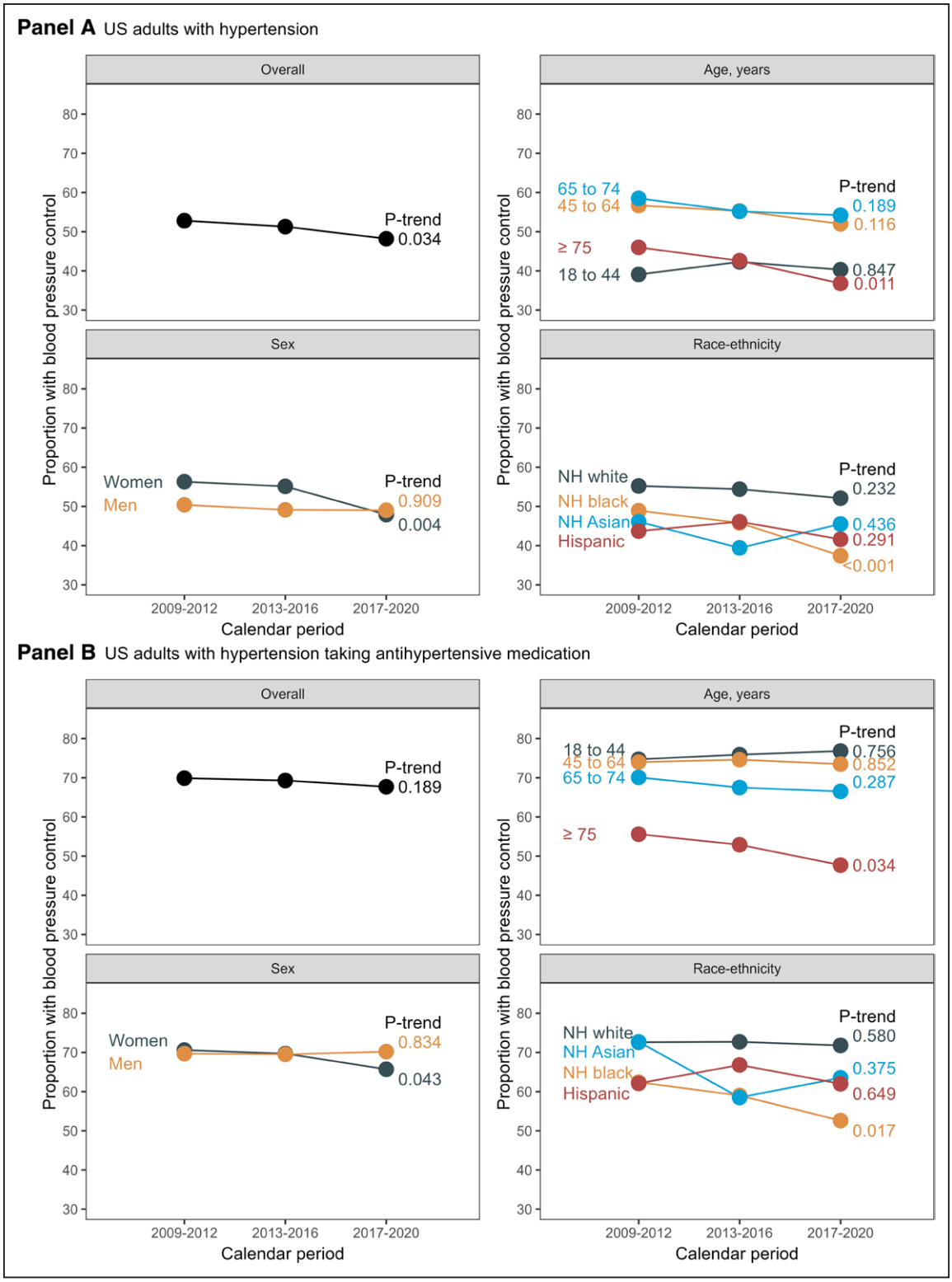

Figure. Age-specific and age-adjusted proportion of US adults with hypertension that had controlled blood pressure. Age-specific and age-adjusted proportion of US adults with hypertension (**A**) and taking antihypertensive medication (**B**) who had controlled blood pressure in 2009 to 2012, 2013 to 2016, and 2017 to 2020, overall and in subgroups. *P* trends were calculated using logistic regression and modeling the midpoint of each time period. NH indicates non-Hispanic.

the Original Framingham Heart Study and Framingham Offspring Study.[24] Antihypertensive medication is equally effective for preventing cardiovascular disease in older and younger adults, women and men, and people who self-identify as being non-Hispanic Black versus those identifying with other race-ethnicity.[25–27]

Table 3. Age-Specific and Age-Adjusted Proportion of US Adults With Hypertension Who Reported Being Aware They Had Hypertension and Were Taking Antihypertensive Medication Among Those Who Were Aware They Had Hypertension in 2009 to 2012, 2013 to 2016, and 2017 to 2020, Overall and in Subgroups

Population evaluated	2009–2012	2013–2016	2017–2020	*P* trend
	Hypertension awareness			
Overall	82.4 (80.2–84.5)	83.4 (81.7–85.1)	79.1 (77.0–81.3)	0.049
Age group, y				
18–44	66.4 (59.8–73.0)	74.5 (70.9–78.1)	70.1 (64.9–75.4)	0.379
45–64	83.3 (80.4–86.4)	83.3 (81.0–85.6)	78.9 (75.2–82.6)	0.059
65–74	86.7 (83.2–90.3)	86.8 (83.2–90.4)	84.5 (80.6–88.3)	0.370
≥75	86.0 (83.0–89.1)	85.8 (82.4–89.2)	79.6 (75.0–84.1)	0.019
Sex				
Women	84.9 (82.1–87.6)	86.4 (84.2–88.7)	79.7 (76.2–83.1)	0.022
Men	80.2 (78.1–82.3)	80.8 (78.5–83.2)	78.8 (74.8–82.7)	0.716
Race-ethnicity				
Non-Hispanic White	82.0 (78.9–85.1)	84.1 (81.6–86.7)	79.5 (76.9–82.1)	0.173
Non-Hispanic Black	86.3 (84.0–88.7)	85.8 (83.8–87.9)	82.0 (78.6–85.4)	0.020
Non-Hispanic Asian	71.7 (66.0–77.4)*	76.3 (70.9–81.7)	77.2 (72.3–82.0)	0.161
Hispanic	80.1 (77.6–82.7)	78.6 (75.4–81.9)	77.2 (72.8–81.6)	0.329
	Taking antihypertensive medication			
Overall	91.9 (90.6–93.1)	89.2 (87.5–90.9)	90.6 (89.0–92.1)	0.273
Age group, y				
18–44	78.9 (73.5–84.2)	74.7 (69.6–79.9)	74.8 (68.4–81.2)	0.343
45–64	91.8 (89.7–93.9)	89.1 (86.3–91.8)	89.7 (87.2–92.1)	0.203
65–74	96.2 (94.1–98.4)	84.3 (92.5–96.1)	96.4 (94.5–98.3)	0.806
≥75	96.2 (94.3–98.0)	93.8 (91.8–95.9)	97.2 (95.9–98.5)	0.405
Sex				
Women	94.5 (93.2–95.8)	91.8 (89.7–93.8)	92.2 (90.7–93.7)	0.081
Men	89.3 (87.4–91.1)	86.7 (84.2–89.3)	89.1 (86.4–91.7)	0.963
Race-ethnicity				
Non-Hispanic White	91.1 (91.9–94.3)	89.4 (87.0–91.9)	92.0 (89.5–94.5)	0.529
Non-Hispanic Black	90.9 (88.6–93.1)	90.4 (88.3–92.6)	87.1 (84.8–89.5)	0.023
Non-Hispanic Asian	86.8 (80.0–83.5)*	87.7 (83.9–91.6)	91.7 (88.6–94.9)	0.073
Hispanic	88.6 (85.4–91.9)	88.5 (86.1–90.9)	87.0 (84.2–89.7)	0.478

Numbers in the table are proportion (95% CI) of the population with hypertension that reported being aware they had hypertension (top) and proportion (95% CI) that were taking antihypertensive medication among those who were aware they had hypertension (bottom). NHANES indicates National Health and Nutrition Examination Survey.

*Data for non-Hispanic Asian adults in 2009 to 2012 represent 2011 to 2012 as the public use NHANES data set does not provide information for non-Hispanic Asian participants in 2009 to 2010.

In 2014, a report from the Panel Members appointed to Eighth Joint National Committee recommended a higher SBP goal, 150 mm Hg, among some older adults compared with the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure guideline.[28] It has been suggested that guidelines have a substantial influence on antihypertensive treatment and achievement of BP goals.[29,30] Concerns were raised that this recommendation in the Eighth Joint National Committee panel member report would result in worsening BP control among US adults.[31] Whether publication of the 2017 ACC/AHA BP guideline, which lowered the BP goal compared with the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure and the Eighth Joint National Committee panel member report, resulted in an increase in BP control and attenuation of health disparities remains to be determined.

The results of the current study are consistent with a previous NHANES analysis that reported the proportion of US adults with hypertension that had controlled BP declined from 2013 to 2014 through 2017 to 2018.[8] Contrasting the current results to the previous study, the age-adjusted prevalence of BP control in 2017 to 2020 as reported in the current study was higher than reported for 2017 to 2018 (48.2% versus 43.7%), similar to 2015 to 2016 (48.2% versus 48.4%) and lower than

in 2013 to 2014, where the prevalence of BP control was 53.8%.[8] Together with the prior NHANES analysis, the current study's results suggest the prevalence of BP control among US adults with hypertension in 2017 to 2020 may be similar to 2015 to 2016 but remains below the peak level achieved in 2013 to 2014.

A decline in BP control also has occurred in other countries. For example, in Canada, the proportion of adults with hypertension who had controlled BP declined from 69.9% in 2012 to 2013 to 58.3% in 2016 to 2017.[32] Additionally, an analysis of 123 national Health Examination Surveys found a plateau or decline in BP control occurred from 2005 to 2019 in the majority of 12 high-income countries studied.[30] Along with the results of the current study, these data emphasize the need for global programs to improve BP control.

NHANES was stopped in March 2020 due to the COVID-19 pandemic.[10] Studies have found that BP may have increased and BP control among US adults with hypertension may have decreased during the pandemic.[33,34] Early in the pandemic, concerns were raised about the renin-angiotensin system inhibitors being associated with more severe COVID-19.[35] While these concerns were determined to be unfounded, this may have led some people to discontinue their antihypertensive medication early in the pandemic.[36,37] In addition, there were 50% fewer office-based visits in April through June 2020 compared with the same period in 2018 and 2019, which was accompanied by a 50% decrease in BP level assessment.[38] While telemedicine visits increased over this period, BP was assessed in <10% of those visits. This could reduce opportunities for intensifying antihypertensive medication for patients with uncontrolled BP.[39] Although a negative impact of the COVID-19 pandemic on BP control has been documented, innovation in health care delivery including remote visits, better technology, and increased use of home BP monitoring has the potential to improve care for patients with hypertension.[40,41]

In October 2020, the US Surgeon General released a Call-to-Action to Control Hypertension.[42] The Call-to-Action provides goals and strategies to improve BP control rates, and recommends focus areas to promote health equity with respect to BP control, particularly in resource-limited settings. Three goals were outlined in the Call-to-Action: (1) making hypertension a national priority; (2) ensuring the places where people live, learn, work, and play support hypertension control; and (3) optimizing patient care for hypertension control. The Call-to-Action recognized the disparities in hypertension prevalence and BP control among different segments of the US population and emphasized the need to address health inequities and disparities so that all members of society can achieve their full health potential. In addition to these approaches, the use of single-pill combination antihypertensive medication, long-acting medications, and longer prescriptions have been shown to be effective in increasing BP control.[5] The National Heart, Lung, and Blood Institute and the AHA have also indicated a commitment to increasing health equity, including reducing disparities in BP and BP-related outcomes.[43,44] Data from the current study suggest these goals are increasing in importance.

This study has several limitations. BP was measured during a single NHANES visit. Some participants with uncontrolled BP based on measurements from that visit may have had controlled BP if multiple visits had been conducted as recommended by guidelines. Out-of-office BP measurement, including ambulatory BP monitoring or home BP monitoring, is recommended for confirming the diagnosis of hypertension and monitoring BP control but was not performed in NHANES.[5] Some participants may have had white coat hypertension or masked hypertension. Among individuals who were approached to participate in NHANES, the proportion that agreed declined between 2009 to 2010 and 2019 to 2020.[45] Although survey weights were used to produce estimates for the US population, the impact of the declining participation rate on the study results is unclear.

PERSPECTIVES

In conclusion, the proportion of US adults with hypertension who had controlled BP declined during the decade before the COVID-19 pandemic. Also, substantial disparities exist with declines in BP control occurring among older adults, women, and non-Hispanic Black adults. These data emphasize the need for the implementation of evidence-based and cost-effective approaches to increase BP control among US adults.

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