ORIGINAL ARTICLE

Characteristics of US Adults Who Would Be Recommended for Lifestyle Modification Without Antihypertensive Medication to Manage Blood Pressure

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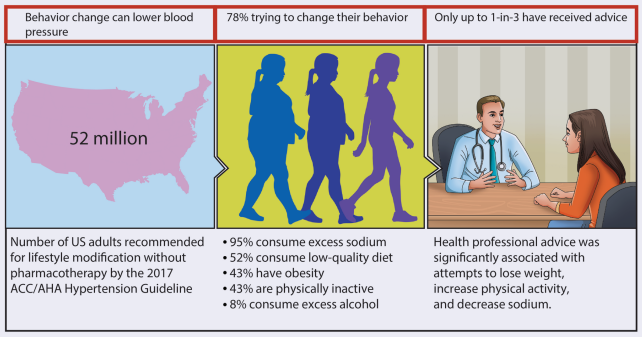
BACKGROUND
The 2017 American College of Cardiology / American Heart Association Guideline for blood pressure (BP) management newly classifies millions of Americans with elevated BP or stage 1 hypertension for recommended lifestyle modification alone (without pharmacotherapy). This study characterized these adults, including their cardiovascular disease risk factors, barriers to lifestyle modification, and healthcare access.

METHODS
This cross-sectional study examined nationally representative National Health and Nutrition Examination Survey data, 2013–2016, on 10,205 US adults aged ≥18, among whom 2,081 had elevated BP or stage 1 hypertension and met 2017 ACC/AHA BP Guideline criteria for lifestyle modification alone.

RESULTS
An estimated 22% of US adults (52 million) would be recommended for lifestyle modification alone. Among these, 58% were men, 43% had obesity, 52% had low-quality diet, 95% consumed excess sodium, 43% were physically inactive, and 8% consumed excess alcohol. Many reported attempting lifestyle changes (range: 39%–60%). Those who reported receiving health professional advice to lose weight (adjusted prevalence ratio 1.21, 95% confidence interval 1.06–1.38), reduce sodium intake (2.33, 2.00–2.72), or exercise more (1.60, 1.32–1.95) were significantly more likely to report attempting changes. However, potential barriers to lifestyle modification included 28% of adults reporting disability, asthma, or arthritis. Additionally, 20% had no health insurance and 22% had no healthcare visits in the last year.

CONCLUSIONS
One-fifth of US adults met 2017 ACC/AHA BP Guideline criteria for lifestyle modification alone, and many reported attempting behavior change. However, barriers exist such as insurance gaps, limited access to care, and physical impairment.

GRAPHICAL ABSTRACT



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Hypertension is a key modifiable risk factor for cardiovascular disease (CVD), the leading cause of death in the United States.[1] It has been estimated that 3 million CVD events might be averted over 10 years if blood pressure (BP) goals were achieved.[2] Lowering the average population diastolic BP by 5 mm Hg could reduce coronary heart disease by one-fifth and strokes by one-third.[3] Improving the prevention and treatment of hypertension is an important strategy for reducing cardiovascular morbidity and mortality, and clinical guidelines support proper classification and management of high BP.

The *2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults* (2017 ACC/AHA BP Guideline) updated the definitions for BP classification, including lowering the thresholds for classifying elevated BP and hypertension, and adjusted recommendations for initiation of lifestyle modification treatment and pharmacotherapy.[4] The 2017 ACC/AHA BP Guideline classified over 100 million US adults as hypertensive, including 32 million newly classified as such. Among these individuals, approximately 60 million had uncontrolled BP and would be recommended lifestyle modification *plus* pharmacotherapy. In addition, approximately 50 million Americans with elevated BP (systolic BP 120–129 mm Hg and diastolic BP <80 mm Hg) or stage 1 hypertension (systolic BP 130–139 mm Hg or diastolic BP 80–89 mm Hg) and without high CVD risk would be recommended lifestyle modification *without* pharmacotherapy (lifestyle modification alone).[5] Recommended lifestyle modification strategies in the 2017 ACC/AHA BP Guideline include weight loss among those with overweight or obesity; eating a heart-healthy diet (such as Dietary Approaches to Stop Hypertension, or DASH); sodium reduction; potassium supplementation (preferably by dietary modification); increased physical activity with a structured exercise program; and moderation in alcohol consumption. Such lifestyle modification could delay, prevent the need for, or supplement pharmacotherapy, and may reduce cardiovascular risk.[4]

Because nearly 1 in 5 US adults would be recommended for lifestyle modification alone, substantial clinical and community resources could be required to fully implement the associated strategies.[5] However, little is known about the characteristics of these adults, including their CVD risk factor profile and behaviors, potential barriers to lifestyle modification, and access to healthcare. Our objective was to characterize these individuals, and to examine factors associated with self-reported lifestyle modification, in order to inform implementation efforts.

METHODS

This cross-sectional study combined data from 2 cycles of the National Health and Nutrition Examination Survey (NHANES), 2013–2016. Analysis was completed in 2020. NHANES conducts household interviews and physical examinations among a nationally representative sample of the civilian US population. We included adults aged ≥18 years (n = 11,659). After excluding those who were pregnant (n = 135) or missing variables described below (n = 1,319), the analytic sample was 10,205. Of these, 2,081 were classified as being recommended for lifestyle modification alone for BP management based on criteria described in the 2017 ACC/AHA BP Guideline; our analyses focused on this population.

For the purposes of this study, adults classified as being recommended for lifestyle modification alone include those who did *not* self-report antihypertensive medication use and either (i) had elevated BP or (ii) had stage 1 hypertension and did *not* meet criteria for pharmacotherapy. Among those with stage 1 hypertension, recommendation for lifestyle modification without pharmacotherapy included those with age <65 years, 10-year atherosclerotic CVD risk score <10% based on pooled cohort equations (only calculated for those age 40–79 years),[6,7] and without the following conditions: diabetes (determined by participant self-report, measured hemoglobin A1c ≥6.5%, or fasting plasma glucose ≥126 mg/dl), chronic kidney disease (estimated glomerular filtration rate <60 ml/min/1.73 m^2 or urine albumin-to-creatinine ratio ≥30 mg/g), or self-reported history of CVD (coronary heart disease, acute myocardial infarction, stable or unstable angina, congestive heart failure, or stroke). BP was based on the mean of up to 4 BP measurements, taken for each participant in the Mobile Examination Center using a standardized protocol.

Health characteristics relevant to the lifestyle modification strategies recommended by the 2017 ACC/AHA BP Guideline include body mass index category [normal/underweight (body mass index <25 kg/m^2), overweight (body mass index 25–29.9 kg/m^2), and obese (body mass index ≥30 kg/m^2)], diet quality (assessed based on the 12-component Healthy Eating Index-2010, including fruit, vegetables, grains and beans, dairy, protein foods, fatty acids, refined grains, sodium, and empty calories; scores ranged from 0 to 100, and low-quality diet was defined as a score of ≤50[8]), sodium intake (exceeding sodium recommendation defined as having *usual* sodium intake >2,300 mg/day, estimated by the National Cancer Institute method),[9] physical activity [inactive with <10 minute/week of physical activity, insufficient activity (≥10 minute/week but not meeting recommendations), or active (meeting recommendations with ≥75 minute/week of vigorous or ≥150 minute/week moderate activity or an equivalent combination)], and excess alcohol intake (averaging >2 drinks/day for men or >1 drink/day for women). In addition, mean *usual* potassium intake was estimated (mg/day).[9] Other health characteristics assessed included current smoking (self-reported smoking every day or some days, or serum cotinine >10 ng/ml), diabetes [diabetes (defined above), prediabetes (fasting glucose ≥100 mg/dl but <126 mg/dl, or HbA1c ≥5.7% but <6.5%), or neither], depression (9-item Patient Health Questionnaire depression screener score ≥10), hypercholesterolemia (self-reported diagnosis or statin use), self-reported health status (poor or fair, good, very good, or excellent), self-reported asthma, self-reported arthritis, and self-reported disability. Sociodemographic characteristics included sex, age group, race and Hispanic origin (non-Hispanic white, non-Hispanic black, non-Hispanic Asian, Hispanic, and other), and employment status (yes/no).

Participants' self-reported attempted behavior changes were assessed per their response to NHANES questions that assessed having tried to lose weight or quit smoking "in the last 12 months," or "currently" trying to increase exercise or reduce sodium intake (see Figure 1). Participants were also asked whether, within the last 12 months, they had received advice from a doctor or health professional to lose weight, increase physical activity, or reduce sodium in the diet (see Table 1 footnote).

Healthcare characteristics included health insurance status [any (private, Medicare, other public) or none], number of healthcare visits in the last year, whether the participant has a usual source of healthcare, and the summary indicator of whether the participant has established linkages to care (i.e., having insurance, at least 1 healthcare visit in the past year, and a usual source of care).

Demographic, health, and healthcare access characteristics were estimated for the population overall, and stratified by age. Supplementary tables were stratified by elevated BP vs. stage 1 hypertension, sex, race/ethnicity, and linkages to care. Proportions were extrapolated to the US population, in millions, by multiplying the estimated prevalence by the average of the 2013–2014 and 2015–2016 2-year population estimates from the U.S. Census Bureau's American Community Survey. Multivariable logistic regressions were performed to examine characteristics associated with behavior change attempts (e.g., trying to lose weight, among those with obesity) for weight loss, smoking cessation, physical activity, and sodium reduction. Because these outcomes were not rare, we estimated model-adjusted prevalence ratios on average marginal predictions. All analyses were conducted in SAS version 9.4 and SUDAAN version 11 (RTI International), accounting for the complex sampling design. Survey weights were used to adjust for nonresponse and differential probability of selection. A P value <0.05 was considered statistically significant. Estimates with a relative standard error ≥30% were suppressed as potentially unreliable. The National Center for Health Statistics research ethics review board approved NHANES, and this study used publicly available, deidentified data.

RESULTS

Of US adults in 2013–2016, 21.7%, or approximately 52.3 million, would be recommended for lifestyle modification alone for BP management under the 2017 ACC/AHA BP Guideline (Table 1). This total includes about 17.1 million young adults between the ages of 18–34 years, 30.6 million adults aged 35–64 years, and 4.6 million adults aged ≥65 years. Among those who would be recommended for lifestyle modification alone, there was a higher proportion of men (58.3%) than women (41.7%). About 3 quarters of the population were classified as adults with overweight or obesity [overweight (31.8%), obesity (42.9%)]; 51.5% had low-quality diet; 94.6% exceeded the recommended sodium intake of 2,300 mg/d; 42.9% were classified as being physically inactive and 15.3% as having insufficient physical activity; and 7.7% had excess alcohol intake. Mean usual potassium intake was 2,931 mg/day for men and 2,366 mg/day for women. Over 1 quarter (28.2%) reported at least one

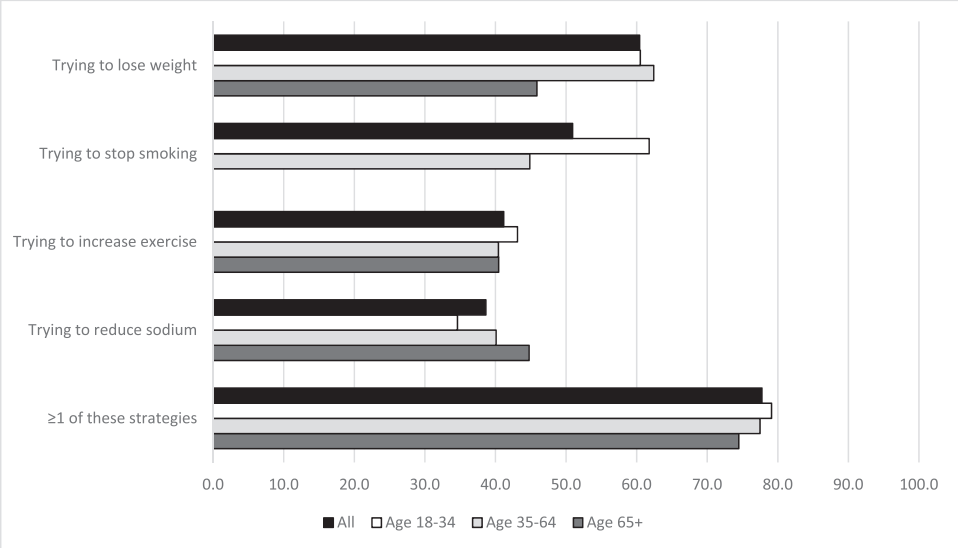

Figure 1. Percent reporting behavior change among US adults who would be recommended for lifestyle modification alone, 2013–2016. The category "≥1 of these strategies" reflects adults who reported attempting to change at least one of these 4 behaviors, among all adults who would be recommended for lifestyle modification without pharmacotherapy (n = 2,081). "Trying to lose weight" reflects adults who reported attempting to lose weight, among those who were obese (n = 869). "Trying to stop smoking" reflects adults reporting attempting to stop smoking, among current smokers (n = 564); the estimate for the subgroup age ≥ 65 was suppressed due to relative standard error >30%. "Trying to increase exercise" reflects adults reporting attempting to increase physical activity, among those who were physically inactive (n = 969). "Trying to reduce sodium" reflects adults reporting trying to reduce sodium intake, among those who were exceeding the sodium intake recommendation (n = 1,816). Specifically, NHANES questions were: "During the past 12 months, have you tried to lose weight?; "During the past 12 months, have you stopped smoking for 1 day or longer because you were trying to quit smoking?"; "To lower your risk for certain diseases, are you now increasing your physical activity or exercise?"; "To lower your risk for certain diseases, are you now reducing the amount of sodium or salt in your diet?" Abbreviation: NHANES, National Health and Nutrition Examination Survey.

Table 1. Demographic and health characteristics of US adults who would be recommended for lifestyle modification alone, 2013–2016

	All				Age 18–34		Age 35–64		Age 65+	
	Sample	Weighted %	SE	Population (in millions)	Weighted %	SE	Weighted %	SE	Weighted %	SE
Total	2,081	21.7	0.7	52.3	24.7	1.1	24.4	0.9	10.1	0.8
Men*	1,224	58.3	1.1	30.5	74.0	1.6	51.2	1.8	47.2	4.2
Women	857	41.7	1.1	21.8	26.0	1.6	48.8	1.8	52.8	4.2
Age group (years)										
18–34	694	32.6	1.3	17.1	100	—	—	—	—	—
35–64	1,182	58.6	1.2	30.6	—	—	100	—	—	—
≥65	205	8.8	0.8	4.6	—	—	—	—	100	—
Race and Hispanic origin*										
NH White	758	63.6	3.0	33.3	55.5	3.4	65.2	3.1	83.1	2.7
NH Black	402	10.7	1.4	5.6	14.0	1.9	9.8	1.2	4.6	1.3
NH Asian	238	5.0	0.7	2.6	4.7	0.9	5.3	0.7	**	
Hispanic	603	17.7	2.3	9.3	21.8	3.1	17.1	2.2	6.4	1.4
Other	80	3.0	0.6	1.6	3.9	0.9	2.6	0.7	**	
Employment status*										
Employed	1,447	74.6	1.7	39.0	79.4	1.8	79.7	2.3	22.8	3.0
Not employed	634	25.4	1.7	13.3	20.6	1.8	20.3	2.3	77.2	3.0
BMI category										
Normal/underweight	576	25.4	1.6	13.3	27.8	1.4	23.3	2.0	30.3	4.6
Overweight	636	31.8	1.4	16.6	28.5	2.3	33.9	2.2	29.4	4.6
Obese	869	42.9	1.9	22.4	43.7	2.5	42.8	2.2	40.3	4.8
Low-quality diet (HEI-2010 ≤50)*,[a]										
Yes	1,015	51.5	1.8	26.9	61.0	2.1	47.6	2.4	41.6	4.9
No	929	48.5	1.8	25.4	39.0	2.1	52.4	2.4	58.4	4.9
Exceeding sodium recommendation (2,300 mg/day)*,[a]										
Yes	1,816	94.6	0.6	49.5	96.7	0.8	93.8	0.8	91.9	2.5
No	128	5.4	0.6	2.8	3.3	0.8	6.2	0.8	**	
Mean potassium (mg/day)[a]										
Men	1,124	2,931.4	44.7	—	2,854.3	76.3	2,982.7	57.6	3,009.6	188.1
Women	777	2,366.3	42.3	—	2,140.7	67.3	2,441.0	50.3	2,271.8	83.5
Physical activity*										
Inactive	969	42.9	1.8	22.5	35.7	2.1	45.6	2.1	51.7	5.9

Table 1. Continued

	All				Age 18–34		Age 35–64		Age 65+	
	Sample	Weighted %	SE	Population (in millions)	Weighted %	SE	Weighted %	SE	Weighted %	SE
	All				Age 18–34		Age 35–64		Age 65+	
	Sample	Weighted %	SE	Population (in millions)	Weighted %	SE	Weighted %	SE	Weighted %	SE
Insufficient activity	314	15.3	1.0	8.0	11.3	1.1	16.4	1.3	22.7	4.9
Active	798	41.8	2.0	21.8	53.0	2.2	38.0	2.6	25.5	4.0
Excess alcohol intake[a]										
Yes	122	7.7	0.8	4.0	7.3	1.4	8.2	1.3	6.0	1.8
No	1,803	92.3	0.8	48.3	92.7	1.4	91.8	1.3	94.0	1.8
Received advice to[b]:										
Lose weight*	511	24.7	1.2	12.9	19.3	2.2	26.9	1.5	30.0	3.5
Exercise*	694	33.1	1.3	17.3	28.6	2.0	34.4	2.2	40.9	3.9
Reduce sodium*	354	14.5	0.9	7.6	12.1	1.5	14.1	1.1	25.5	4.5
Current smoker*										
Yes	564	26.6	1.7	13.9	34.4	2.2	24.4	2.1	11.7	2.7
No	1,517	73.4	1.7	38.4	65.6	2.2	75.6	2.1	88.3	2.7
Diabetes mellitus*										
Diabetes	165	6.0	0.7	3.2	**		6.6	1.0	19.2	3.5
Prediabetes	757	33.3	1.3	17.4	22.8	1.8	36.8	1.6	48.9	4.6
Neither	1,159	60.7	1.5	31.7	75.7	1.8	56.6	2.2	32.0	4.3
Chronic kidney disease*										
Yes	123	5.4	0.8	2.8	**		4.4	0.9	26.1	3.9
No	1,958	94.6	0.8	49.5	98.5	0.6	95.6	0.9	73.9	3.9
ASCVD risk[c]										
≥10%	195	15.1	1.5	7.9	—	—	7.3	1.1	70.8	5.6
<10%	925	84.9	1.5	44.4	—	—	92.7	1.1	29.2	5.6
General health										
Poor or fair	399	15.0	1.0	7.8	13.6	1.5	15.4	1.2	17.2	3.3
Good	818	37.8	1.5	19.8	42.0	2.3	36.5	2.0	30.5	4.2
Very good or excellent	864	47.2	1.8	24.7	44.4	2.6	48.0	2.4	52.3	3.9
Depression[a]										
Yes	139	6.8	0.8	3.5	7.8	1.3	5.8	1.1	8.8	2.6
No	1,774	93.2	0.8	48.7	92.2	1.3	94.2	1.1	91.2	2.6

Table 1. Continued

	All			Age 18–34		Age 35–64		Age 65+	
	Sample	Weighted %	SE	Population (in millions)	Weighted %	SE	Weighted %	SE	Weighted %	SE
Hypercholesterolemia*										
Yes	539	27.6	1.1	14.4	10.4	1.0	33.2	1.8	54.0	4.8
No	1,542	72.4	1.1	37.9	89.6	1.0	66.8	1.8	46.0	4.8
Physical limitations										
Disability*	155	7.3	0.8	3.8	3.5	0.6	8.0	1.3	16.6	2.8
Asthma	294	15.9	0.8	8.3	18.6	1.6	15.0	1.3	**	
Arthritis*	214	12.7	1.0	6.7	2.3	0.6	15.8	1.5	34.0	5.1
At least 1 of these*	537	28.2	1.0	14.7	22.1	1.6	29.2	1.8	44.4	4.6

Abbreviations: ASCVD, atherosclerotic cardiovascular disease; BMI, body mass index; HEI, Healthy Eating Index; NH, non-Hispanic. Percentages are column percentages.
[a]Due to missing data, rows do not sum to 2081.
[b]Questions were: "To lower your risk for certain diseases, during the past 12 months have you ever been told by a doctor or health professional to control your weight or lose weight?"; "To lower your risk for certain diseases, during the past 12 months have you ever been told by a doctor or health professional to increase your physical activity or exercise?"; "To lower your risk for certain diseases, during the past 12 months have you ever been told by a doctor or health professional to reduce the amount of sodium or salt in your diet?"
[c]Among those age 40–79 and able to calculate risk (sample size 1,120).
*Indicates statistically significant difference by age category ($P < 0.05$).
**Indicates relative standard error (RSE) ≥30%, and the estimate has been suppressed.

of the following potential barriers to physical activity: disability, asthma, or arthritis. Risk factors differed significantly across age groups; for example, the highest prevalence of low-quality diet was among young adults aged 18–34 years (61.0%), whereas the highest prevalence of physical inactivity was among adults aged 65 and older (51.7%). In sensitivity analyses, demographic and health characteristics were largely similar among those who had elevated BP (58.8%) and those who had stage 1 hypertension (40.2%) (Supplementary Table S1 online). Characteristics were also stratification by race/ethnicity in Supplementary Table S1 online.

To reduce disease risk, 24.7% reported having been told by their health professional to lose weight (43.3% among those with obesity), 33.1% to exercise (37.0% among those who were physically inactive), and 14.5% to reduce sodium (14.1% among those exceeding recommended intake; Table 1 and Supplementary Table S2 online). One in 5 (20.0%) had no health insurance (10.5 million adults), and a similar percentage reported having had no healthcare visits in the last year (22.4%) or having no usual source of healthcare (22.1%) (Table 2). Nearly 40%, or 20.7 million US adults, did not meet criteria for having established linkages to care. Among those aged 18–34 years, 55.0% did not have established linkages to care.

Some of the adults who would be recommended for lifestyle modification alone reported attempts to change behaviors (Figure 1). Among adults with obesity, 60.4% reported trying to lose weight in the last year; among current smokers, 50.9% reported trying to stop smoking in the last year; among those who were physically inactive, 41.2% reported trying to increase their exercise; and among those who exceeded sodium recommendations, 38.6% reported trying to reduce their sodium intake. Among all adults who would be recommended lifestyle modification alone, 77.8% reported attempting to change behavior in at least one of these areas. Areas of focus for behavior change appeared to differ across age groups; for example, adults age ≥65 years were the least likely to report trying to lose weight, and the most likely to report trying to reduce sodium intake. Stratifications by sex, race, and linkages to healthcare are presented in Supplementary Table S3 online.

Characteristics associated with self-reported attempts to change behavior were examined in multivariable models (Table 3). Having received advice from a health professional to change behavior was associated with self-reported attempts to lose weight (adjusted prevalence ratio 1.21, 95% confidence interval 1.06–1.38), reduce sodium (adjusted prevalence ratio 2.33, 2.00–2.72), and increase physical activity (adjusted prevalence ratio 1.60, 1.32–1.95). Other factors associated with self-reported attempts to change certain behaviors included sex, smoking status, and weight status.

DISCUSSION

This study used a large, nationally representative sample of US adults, including measurements on numerous demographic, clinical, and healthcare access characteristics, and is the first to describe the population of 52 million adults who would be recommended for lifestyle modification without

Table 2. Healthcare access among US adults who would be recommended for lifestyle modification alone, 2013–2016

	All				Age 18–34		Age 35–64		Age 65+	
	Sample	Weighted %	SE	Population (in millions)	Weighted %	SE	Weighted %	SE	Weighted %	SE
Health insurance*										
Any	1,549	80.0	1.5	41.8	71.4	2.5	82.1	1.9	98.0	1.0
Private	1,101	63.0	2.2	32.9	55.1	3.1	68.3	2.5	57.3	5.1
Medicare	128	4.9	0.5	2.5	**		2.0	0.5	39.9	5.1
Other public	320	12.1	1.1	6.3	15.7	1.9	11.9	1.3	**	
None	532	20.0	1.5	10.5	28.6	2.5	17.9	1.9	**	
Healthcare visits past year[a,*]										
0	518	22.4	1.2	11.7	30.1	1.8	20.6	1.5	**	
1	468	21.5	1.2	11.2	25.0	1.5	21.2	1.8	10.4	2.4
2–3	570	28.7	1.3	15.0	24.2	1.6	30.9	1.9	31.3	3.8
4+	525	27.4	1.4	14.3	20.7	1.6	27.4	1.7	52.9	4.2
Usual source of care[b,*]										
Yes	1,580	77.9	1.3	40.7	64.7	2.3	82.6	1.4	95.1	1.4
No	501	22.1	1.3	11.6	35.3	2.3	17.4	1.4	4.9	1.4
Established linkages to care[c,*]										
Yes	1,154	60.4	1.6	31.6	45.0	2.3	64.5	1.9	90.7	2.4
No	927	39.6	1.6	20.7	55.0	2.3	35.5	1.9	9.3	2.4

[a]Reflects response to: "During the last 12 months, how many times have you seen a doctor or other health professional about your health at a doctor's office, a clinic, hospital emergency room, at home or some other place? Do not include times you were hospitalized overnight."

[b]Indicates "yes" to the question: "Is there a place that you usually go when you are sick or need advice about your health?"

[c]Reflects whether the participant reported having insurance, at least 1 healthcare visit in the past year, and a usual source of care.

*Indicates statistically significant difference by age category ($P < 0.05$).

**Indicates relative standard error (RSE) ≥30%, and the estimate has been suppressed.

Table 3. Characteristics associated* with self-reported behavior change among US adults who would be recommended for lifestyle modification alone, 2013–2016

	Tried to lose weight, among those with obesity		Tried to stop smoking, among current smokers		Tried to increase physical activity, among inactive		Tried to reduce sodium, among those exceeding recommended intake	
	N = 869		*N* = 564		*N* = 969		*N* = 1,816	
	aPR	95% CI	aPR	95% CI	aPR	95% CI	aPR	95% CI
Men	0.83	(0.69–0.99)	0.73	(0.55, 0.97)	0.83	(0.67, 1.04)	0.86	(0.72, 1.04)
Age group (years)								
18–34 (ref)	—	—	—	—	—	—	—	—
35–64	1.00	(0.80, 1.27)	0.78	(0.59, 1.03)	0.91	(0.73, 1.13)	1.18	(0.97, 1.44)
≥65	0.75	(0.50, 1.12)	0.78	(0.59, 1.03)	0.93	(0.67, 1.31)	1.42	(1.04, 1.93)
Race and Hispanic origin								
Non-Hispanic White (ref)	—	—	—	—	—	—	—	—
Non-Hispanic Black	1.05	(0.87, 1.28)	1.23	(0.95, 1.59)	1.20	(0.98, 1.47)	1.76	(1.50, 2.05)
Non-Hispanic Asian	1.11	(0.85, 1.46)	1.13	(0.66, 1.94)	1.38	(1.10, 1.74)	1.28	(1.02, 1.60)
Hispanic	0.95	(0.77, 1.17)	1.34	(1.00, 1.79)	1.12	(0.90, 1.41)	1.64	(1.37, 1.96)
Other	1.43	(1.08, 1.90)	1.44	(0.98, 2.13)	1.20	(0.69, 2.08)	1.42	(1.02, 1.96)
BMI category								
Normal/underweight (ref)	—	—	—	—	—	—	—	—
Overweight	—	—	0.84	(0.60, 1.16)	1.75	(1.30, 2.35)	1.63	(1.36, 1.97)
Obese	—	—	0.90	(0.62, 1.30)	1.37	(0.99, 1.89)	1.83	(1.50, 2.23)
Current smoker	0.55	(0.40, 0.74)	—	—	0.85	(0.67, 1.10)	0.91	(0.77, 1.07)
Physical activity								
Inactive (ref)	—	—	—	—	—	—	—	—
Insufficient activity	1.14	(0.87, 1.49)	1.16	(0.86, 1.57)	—	—	1.30	(1.03, 1.64)
Active	1.16	(0.94, 1.45)	0.98	(0.69, 1.38)	—	—	1.21	(1.02, 1.44)
Established linkages to care	1.13	(0.91, 1.41)	0.87	(0.66, 1.14)	1.19	(0.91, 1.56)	1.28	(1.10, 1.49)
Received advice to lose weight	1.21	(1.06, 1.38)	1.26	(0.85, 1.86)	1.18	(0.89, 1.55)	1.57	(1.33, 1.85)
Received advice to exercise	1.11	(0.96, 1.29)	1.41	(1.07, 1.86)	1.60	(1.32, 1.95)	1.30	(1.12, 1.51)
Received advice to reduce sodium	1.11	(0.88, 1.40)	1.39	(1.02, 1.87)	1.40	(1.09, 1.80)	2.33	(2.00, 2.72)

Abbreviations: aPR, adjusted prevalence ratio; BMI, body mass index; CI, confidence interval. *Models also adjusted for employment, depression, general health status, diabetes status, and having 1 or more of the following: disability, asthma, or arthritis.

pharmacotherapy for BP management by the 2017 ACC/AHA BP Guideline. Lifestyle modification can substantially impact BP; for example, among individuals with hypertension, it is estimated that losing weight can lower systolic BP 5 mm Hg, reducing sodium intake 5–6 mm Hg, and increasing physical activity 4–8 mm Hg.[4] Among adults who would be recommended for lifestyle modification alone, CVD risk factors were common, including obesity (43%), physical inactivity (43%), diabetes or prediabetes (39% combined), and smoking (27%). Over 3 quarters reported attempting at least one of the 4 lifestyle changes assessed (losing weight, reducing sodium, increasing physical activity, and stopping smoking), and having received advice from a health professional was associated with self-reported attempts to change behavior.

These results are consistent with other studies that have shown a positive association between receiving health professional advice and behavior change.[10–12] However, lack of access to healthcare may pose a barrier to BP screening as well as receipt of recommendations for lifestyle modification and referral to relevant programs. We estimated that two-fifths of adults who would be recommended for lifestyle modification alone do not have established linkages to healthcare. This percentage is even higher (55%) among adults aged 18–34 years. Therefore, improving engagement with the healthcare system, particularly among young adults, may be an opportunity to further implementation of the 2017 ACC/AHA BP Guideline.

Even among those with regular access to primary care, hypertension is less likely to be diagnosed among young adults, which may be related to clinical inertia and competing priorities for time during clinic visits.[13] Declining primary care provider visit rates and the accompanying demands of providing increasingly comprehensive care during visits may also be a barrier to the provision of lifestyle counseling.[14,15] Additionally, there may be little financial incentive for providers to offer counseling as many insurers do not cover these services.[16] For example, a study of primary care providers suggested that only half discussed physical activity with most of their at-risk patients, and only 14% referred patients to intensive behavioral counseling.[17] Even fewer providers report counseling all adults to consume less sodium (23%), although as many as 74% report counseling hypertensive patients to reduce sodium intake.[18] In addition to limited time for counseling, providers may lack sufficient training in nutrition, behavioral interventions, and effective strategies such as motivational interviewing.[16] Furthermore, they may be unaware of the availability of local services,[19] doubt the effectiveness of advice,[20] or fear alienating patients by bringing up a stigmatized topic such as obesity or alcohol use.[21,22]

Medicare covers intensive behavioral therapy for obesity for certain beneficiaries,[23] and adult Medicaid beneficiaries may have coverage for some obesity-related services, which can vary by state and Medicaid eligibility category.[24] Additionally, the Affordable Care Act requires many private insurance plans to cover certain preventive services,[25] including obesity screening and counseling.[26,27] Despite such coverage, implementation of these services has been inconsistent.[28] Access is limited by the supply of primary care physicians and their demanding workloads, and it is uncertain whether covered 15-minute visits would be intensive enough to support effective lifestyle modification.[29] In addition, referrals to community-based programs, such as obesity interventions, nutrition counseling, or structured physical activity programs, may be underutilized,[19,30] and perceived affordability may limit both physician decisions to refer and patient decisions to participate.[31] Thus, although 80% of adults who would be recommended for lifestyle modification alone have health insurance, effective counseling may not be available and cost sharing may pose a barrier to use.[32] The emergence of new payment models, team-based approaches, and telehealth interventions may support improvements in receipt of lifestyle counseling, referrals, and programs.[33]

In addition to factors related to access and reimbursement, US adults may have other facilitators and barriers to participation in lifestyle change. For example, approximately 80% of adults under age 65 who would be recommended for lifestyle modification reported being employed. Employed adults may have access to lifestyle modification programs through employer-sponsored health insurance or workplace wellness programs; such programs may vary across a continuum of investment, from low-cost interventions that promote small bouts of physical activity (e.g., prompts to take the stairs) to more comprehensive onsite programs and/or employer-supported community-based interventions.[34] Socioeconomic disadvantage may be a barrier to lifestyle modification; for example, higher costs may hinder efforts to increase consumption of foods that are naturally low in sodium and high in potassium, such as fruits and vegetables.[35] Another potential challenge is that over 1 quarter of US adults who would be recommended for lifestyle modification for BP management reported having disability, asthma, and/or arthritis that might affect willingness or ability to participate in a structured physical activity program. While physical activity has benefits for adults with arthritis and other chronic conditions, such as pain management, improved physical function, and improved health-related quality of life,[36] lifestyle modifications may need to be tailored appropriately.[36,37] Similarly, for those facing language or cultural barriers, adaptation of lifestyle change programs may be possible.[38]

Limitations

This study has several limitations. First, the 2017 ACC/AHA BP Guideline criteria were applied to data from 2013 to 2016, providing a snapshot of the characteristics and behaviors of US adults who *would be* recommended for lifestyle modification without pharmacotherapy for BP management. However, because data used were from years *prior to* the release of the 2017 ACC/AHA BP Guideline, the guideline's contemporaneous effects on increases in health professionals' recommendations for lifestyle modification or increases in behavior change efforts among adults could not be examined. Second, self-reported data are subject to social desirability bias, which may have influenced results if participants felt social pressure to under-report engaging in a stigmatized behavior (such as smoking) or over-report attempting to

change a stigmatized behavior (such as attempting to lose weight). Third, self-reported attempts to change a particular behavior do not necessarily indicate a successful behavior change, nor do they necessarily indicate willingness to participate in a structured lifestyle modification program. Lastly, while this work examined individual-level behavior change efforts, it is important to note that individual-level interventions, such as counseling and education, may have less population-level health impact than broader interventions, such as making default options healthier (i.e., changing the built environment to promote physical activity and changing the food supply to lower sodium intake) or interventions that target socioeconomic factors and social determinants of health.

This study examined the one-fifth of US adults who would be recommended for lifestyle modification without pharmacotherapy for BP management according to the 2017 ACC/AHA BP Guideline. Modifiable CVD risk factors were common among these adults, and 3 quarters reported attempting to change at least one of 4 measured behaviors. Barriers such as healthcare access, health insurance coverage gaps, and physical impairments face many individuals. Better prevention and management of hypertension may help to address stagnating declines in premature heart disease mortality[39] and stroke mortality.[40] While the 2017 ACC/AHA BP Guideline creates new opportunities to support populations at high risk for hypertension and CVD progression, challenges exist in effectively promoting the recommended lifestyle modification strategies.

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S.L.J. and S.P. had full access to the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: S.L.J. and M.R. Analysis and interpretation of data: S.P., M.R., and S.L.J. Drafting of the manuscript: S.L.J. Critical revision of the manuscript for important intellectual content: S.P., F.L., A.M.T.-P., Y.H., M.R., and S.L.J.

DISCLOSURE

The authors declared no conflict of interest.

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