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Primary prevention of essential hypertension

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Despite progress in recent years in prevention, detection, and treatment of high blood pressure, hypertension remains an important public health challenge. It affects approximately 50 million persons in the United States and about 1 billion individuals worldwide [1]. In 2002, hypertension was the most common primary diagnosis reported in the outpatient setting in the United States, accounting for more than 35 million office visits [2]. The direct and indirect costs related to treatment and management of hypertension continue to rise with approximately \$50 billion estimated to be spent in 2003 [3]. High blood pressure is associated with an increased risk of mortality and morbidity from stroke, coronary heart disease, congestive heart failure, and end-stage renal disease [4–6]. In addition, a diagnosis of hypertension has also been reported to have a negative impact on patient-reported quality of life [7–9]. Primary prevention of hypertension provides an avenue to interrupt and prevent the continuing costly cycle of managing this disease and its complications [10,11]. This article reviews the new recommendations for classification of hypertension, updated information on the incidence of hypertension, and lifestyle interventions for primary prevention of this chronic disease.

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Classification of hypertension

The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC VII report) recommended a new classification system for hypertension (Table 1) [1]. According to this report, individuals can be classified based on the mean of two or more properly measured seated blood pressure readings on each of two or more office visits. The JNC VII report added a new category designated as “prehypertension” for patients with a systolic blood pressure between 120 and 139 mm Hg or a diastolic blood pressure between 80 and 90 mm Hg. This change in classification is based on the findings from the Framingham Heart study that patients with high normal (according to JNC VI classification: systolic blood pressure of 130 to 139 mm Hg or diastolic blood pressure of 85 to 89 mm Hg) and normal blood pressure (JNC VI classification: systolic blood pressure of 120 to 129 mm Hg or diastolic blood pressure of 80 to 84 mm Hg) were at increased risk for progression to hypertension. The JNC VII report recommends individuals with prehypertension engage in health-promoting lifestyle modifications to prevent the development of hypertension and cardiovascular disease. Hypertension is defined as a confirmed elevation of systolic or diastolic blood pressure (greater than or equal to 140 mm Hg or greater than or equal to 90 mm Hg, respectively). Hypertension is further characterized into two stages based on the person’s systolic or diastolic blood pressure levels. Stage 1 hypertension, the most common form of hypertension, includes systolic blood pressure range of 140 to 159 mm Hg or diastolic blood pressure range of 90 to 99. Stage 2 hypertension includes patients with systolic blood pressure greater than or equal to 160 mm Hg or diastolic blood pressure greater than or equal to 100 mm Hg. (Stage 2 hypertension in the JNC VII report represents

Table 1
Classification of blood pressure for adults 18 years or older

Category	Systolic BP (mm Hg)		Diastolic BP (mm Hg)
Normal	<120	and	<80
Prehypertension	120–139	or	80–90
Hypertension			
Stage 1	140–159	or	90–99
Stage 2	≥160	or	≥110

Based on the average of two or more readings taken at each of two or more visits in individuals not taking antihypertensive drugs and not acutely ill. When systolic and diastolic BP fall into different categories, the higher category should be selected to classify the individual’s BP status. Isolated systolic hypertension is defined as systolic BP \geq 140 mm Hg and diastolic BP $<$ 90 mm Hg and staged appropriately. Based on the recommendations of Seventh Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure.

Abbreviation: BP, blood pressure.

Data from Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, And Treatment of High Blood Pressure. The JNC 7 report. JAMA 2003;289:2560–72.

the collapsing of stage 2 and 3 from the JNC VI report; stage 4 from the JNC VI report has been omitted from the JNC VII report). Although the focus of this article is lifestyle modifications in the context of preventing hypertension, they are also recommended as concurrent treatment for patients diagnosed with hypertension.

Incidence of hypertension

Vasan et al [12] recently estimated the lifetime residual risk for developing hypertension in middle-aged women and men from 1298 participants enrolled in the Framingham Heart Study. According to this study, the residual lifetime risk for incident hypertension (greater than or equal to 140/90 mm Hg) was 90% for both 55- and 65-year-old subjects. The lifetime probability of receiving blood pressure-lowering medication was 60%. Although the risk for women was unchanged between 1976 to 1998 and 1952 to 1975, the risk for men was about 60% higher in the later 1976 to 1998 period compared with the earlier 1952 to 1975 period. This study is somewhat limited in its generalizability to race-ethnic groups because the Framingham Heart Study included only whites. In the Atherosclerosis Risk in Communities (ARIC) study, Pereira et al [13] reported incident hypertension in 7459 black and white adults who participated in a population-based prospective study in four United States clinic centers. The incidence of hypertension was substantially higher among blacks compared with whites in this study. Specifically, the cumulative incidence of hypertension was 16.7% and 25.8% among white and black men and 15% and 28.9% among white and black women [13]. The incidence of hypertension in the San Antonio Heart Study, however, was similar for Mexican-Americans and non-Hispanic whites over 8 years of follow-up [14].

Primary prevention of hypertension

To achieve the Healthy People 2010 goal of reducing the proportion of adults with high blood pressure from 28% to 16% [15], concerted efforts must be undertaken not only in earlier detection and treatment of this chronic disease, but also in implementation of primary prevention strategies. The goal of primary prevention is to preserve health by removing the precipitating causes and determinants of poor health; epidemiologically speaking, the aim of primary prevention is to reduce the incidence of disease [16].

Two strategies for the prevention of essential hypertension have been recommended: a population-based strategy and an intensive targeted strategy directed at those with increased risk of developing hypertension [10,11]. The population-based approach is aimed at achieving a downward shift in the distribution of blood pressure in the general population. Based on results from the Framingham Heart Study, Cook et al [17] reported that

a 2 mm Hg reduction in the population average of diastolic blood pressure for white United States residents aged 35 to 64 years would result in a 17% reduction in the prevalence of hypertension, a 14% decrease in the risk of stroke and transient ischemic attacks, and a 6% reduction in the risk of coronary heart disease. Some examples of population-based approaches to primary prevention may include decreasing sodium content or caloric density in processed food and providing safe and convenient opportunities for exercise [1,11].

Complementary to the population-based approach to prevention is the more intensive targeted approach where interventions are aimed at persons at high risk for developing hypertension. Those at high risk include persons with prehypertension, family history of hypertension, African American ethnicity, overweight, excess consumption of sodium or alcohol, and physical inactivity. There are a number of interventions for which there is documented efficacy: reduced intake of dietary sodium, potassium supplementation, weight loss, moderation of alcohol consumption, increased physical exercise, and modification of eating patterns [11]. The following sections review the evidence for each of these approaches.

Interventions with documented efficacy

Dietary sodium reduction

Over the last several decades, results from animal experiments, observational studies across and within populations, migration studies, and randomized controlled clinical trials have provided considerable support for a causal relationship between dietary sodium intake and elevated blood pressure [18]. The most compelling evidence for a causal relationship comes from properly conducted randomized controlled clinical trials. In the last 10 years there have been at least four meta-analyses of randomized controlled trials that address the efficacy of decreased sodium intake in lowering blood pressure [19–22]. Although the meta-analyses conducted differed in methodology, inclusion-exclusion criteria, and statistical analysis, each of these studies found significant reductions in blood pressure among those assigned to sodium reduction versus usual care. Midgley et al [19] reported on 28 trials conducted in hypertensive patients and 28 trials conducted in normotensive patients. Among normotensive participants, the mean reductions (treatment versus control) in daily urinary excretion, a proxy measure of dietary sodium intake, was 125 mmol (95% CI, 95 to 156 mmol). Compared with the control group, the mean reduction in blood pressure (95% CI) was 1.6 mm Hg (range 2.4 to 0.9 mm Hg) for systolic and 0.5 mm Hg (range 1.2 to 0.1) for diastolic in normotensives. Despite the small differences in the trials that they reviewed, a significant dose-response relationship between net change in urinary sodium and net change in systolic blood pressure was detected [19]. Cutler et al [20]

conducted a meta-analysis of 12 randomized controlled clinical trials conducted in 1689 normotensive participants. It was estimated that an average reduction of 77 mmol/d in dietary intake of sodium resulted in a 1.9 mm Hg (95% CI, 1.2 to 2.6 mm Hg) decrement in systolic blood pressure and a 1.1 mm Hg (95% CI, 0.6 to 1.6 mm Hg) decline in diastolic blood pressure. The most recently published meta-analysis was by He and MacGregor [22]. Among the 11 trials of persons without hypertension they identified, the median participant age was 47 years and the study duration ranged from 4 weeks to 3 years. The median net reduction in urinary sodium excretion was -74 mmol/d among those randomized to sodium reduction versus their counterparts randomized to usual care. The pooled estimates (95% CI) of systolic and diastolic blood pressure reductions among those randomized to the sodium reduction intervention were 2.03 (95% CI, 2.56 to 1.50) and 0.97 (95% CI, 1.39 to 0.55) mm Hg, respectively [22]. Table 2 shows the reductions in systolic and diastolic blood pressure in the four meta-analysis studies standardized to reflect a reduction in sodium intake of 100 mmol/d.

In a more recent randomized controlled feeding trial, the Dietary Approaches to Stop Hypertension (DASH)-Sodium Trial [23], 412 persons with an average systolic blood pressure of 120 to 159 mm Hg and an average diastolic blood pressure of 80 to 95 mm Hg were randomized to either a diet high in fruits, vegetables, and low-fat dairy (DASH) or the usual American diet (control) and were also assigned to spend 30 days receiving each of the three levels of sodium intake in random order based on use of a standard crossover design. A change in sodium intake from a higher level (mean urinary sodium excretion, 142 mmol/d) to an intermediate level (mean urinary sodium excretion, 107 mmol/d) reduced systolic blood pressure by 2.1 mm Hg ($P < .001$) during consumption of a usual American control diet and by 1.3 mm Hg ($P = .03$) during consumption of a DASH diet. Further reductions in sodium intake from the intermediate to a lower level (mean urinary sodium excretion, 65 mmol/d) resulted in an additional decrement in systolic and diastolic blood pressures of 4.6 and 2.4 mm Hg during consumption of the control diet ($P < .001$) and 1.7 and 1 mm Hg reduction during consumption of the DASH diet ($P < .05$) [23]. The evidence from these and other studies has led to the National High Blood Pressure Education Program Coordinating Committee [11] recommending reducing

Table 2
Reduction in systolic and diastolic blood pressure associated with a 100 mmol/d reduction in sodium intake from four meta-analyses

Study	SBP, mm Hg	DBP, mm Hg
Midgely (1996) [19]	-1	-0.1
Cutler (1997) [20]	-2.3	-1.4
Graudal (1998) [21]	-0.75	-0.16
He (2002) [22]	-3.57	-1.66

Abbreviations: DBP, diastolic blood pressure; SBP, systolic blood pressure.

dietary sodium intake to no more than 100 mmol/d (2.4 g sodium or 6 g sodium chloride). Even lower levels of dietary sodium intake (<70 mmol/d) may result in a greater reduction in blood pressure [23].

Potassium supplementation

Over the last several decades, results of observational epidemiologic studies, clinical trials, and meta-analyses indicate that potassium supplementation lowers blood pressure in normotensive and hypertensive individuals. Whelton et al [24,25] conducted a meta-analysis of the results from 12 randomized controlled clinical trials with 1049 normotensive subjects and reported that potassium supplementation (median 75 mmol/d) lowered systolic blood pressure by 1.8 mm Hg (95% CI, 0.6 to 2.9) and diastolic blood pressure by 1 mm Hg (95% CI, 0 to 2.1) (Fig. 1). The blood pressure effects of potassium administration seemed to be greater in those subjects who were concurrently exposed to high sodium intake and in African Americans [24,25]. In a more recent randomized controlled trial of 150 Chinese adults with mild hypertension or high normal blood pressure, Gu et al [26] reported that compared with those randomized to placebo, participants randomized to receive potassium supplements experienced a greater reduction in systolic blood pressure (5 mm Hg, 95% CI, 2.13 to 7.88 mm Hg, $P < .001$) during the 12-week intervention. As a result of these findings, maintaining an adequate intake of dietary potassium (>90 mmol [3500 mg] per day) has been recommended for the primary prevention of hypertension by the National High Blood Pressure Education Program Coordinating Committee [11].

Weight loss

According to data from the two most recent National Health and Examination Surveys, the age-adjusted prevalence of obesity, defined as a body mass index greater than 30, in the United States has increased from 22.9% in the 1988 to 1994 time period to 30.5% ($P < .001$) in 1999 to 2000 [27]. Several large epidemiologic studies and clinical trials of weight reduction have explored the role of obesity in the etiology of hypertension and the effects of weight loss on blood pressure [28–34]. Vasan et al [35] reported that a 5% weight gain over 4 years of follow-up in the Framingham Heart Study was associated with a 20% to 30% increased odds of hypertension. Additionally, in the ARIC study, hazard ratios for hypertension associated with 1 kg weight gain were 1.36 (95% CI, 1.29 to 1.45) and 1.12 (95% CI, 1.03 to 1.21) in white and black women and 1.35 (95% CI, 1.27 to 1.43) and 1.43 (95% CI, 1.27 to 1.61) in white and black men [36].

Data from the Trials of Hypertension Prevention (TOHP)-Phase I and TOHP-II studies revealed that weight loss counseling is an effective approach for the primary prevention of hypertension [31,32]. The TOHP-I weight loss intervention resulted in a 51% decrease (relative risk 0.49; 95%

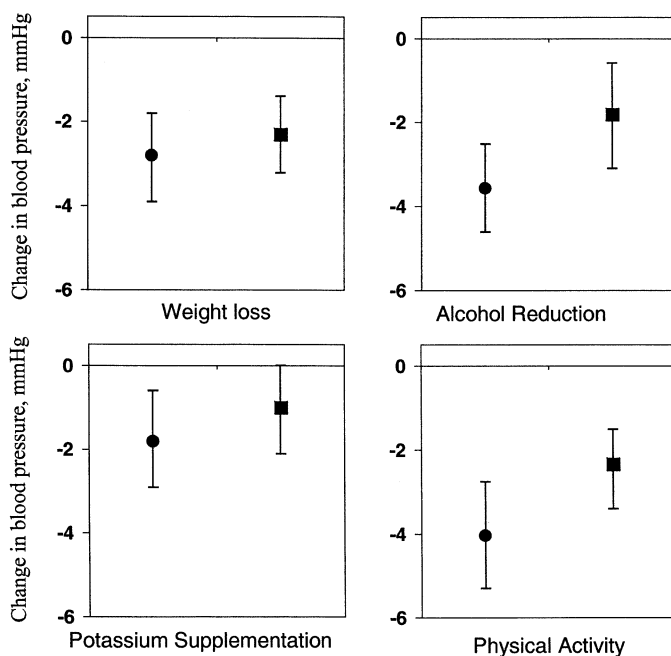


Fig. 1. Net change in systolic (*circle*) and diastolic (*square*) blood pressure comparing individual interventions from meta-analyses of weight loss, potassium intervention, alcohol reduction, and physical activity. Data from (clockwise from top left) Refs. [38,43,24,52].

CI, 0.29 to 0.83) in the incidence of hypertension over 18 months of follow-up [31] in men and women with high normal blood pressure. In the TOHP-II trials, compared with their counterparts who received usual care, participants randomized to weight loss counseling experienced a 21% reduction ($P = .02$) in the incidence of hypertension over 36 months of follow-up [33]. More recently, He et al [37] completed a prospective follow-up of participants at one of the TOHP clinical centers. The initial 18-month weight loss counseling was noted to have a long-lasting effect; over an average follow-up period of 7 years, those assigned to the intervention counseling program experienced 77% decrease (odds ratio 0.23; 95% CI, 0.07 to 0.76, $P = .02$) in the incidence of hypertension compared with their counterparts who were assigned to usual care [37]. In a meta-analysis of four randomized controlled trials of weight reduction in normotensive adults aged 45 years and older with at least 6 months of follow-up, Ebrahim and Smith [38] reported the net (ie, intervention versus control group) systolic and diastolic blood pressure reductions for normotensive participants was 2.8 mm Hg (3.9 to 1.8) and 2.3 mm Hg (3.2 to 1.4), respectively (see Fig. 1). Given the overwhelming evidence from clinical trials and meta-analyses, weight loss intervention is recommended as a strategy for primary prevention of hypertension.

Moderation in alcohol consumption

A close association between alcohol consumption and hypertension has been established in several epidemiologic investigations and randomized trials [39–44]. A number of cross-sectional and prospective cohort studies have demonstrated that alcohol consumption is one of the most important modifiable risk factors for hypertension among populations from a variety of geographic regions, including North America, Europe, and Asia [44–47]. For example, Fuchs et al [44] analyzed data on 8334 participants, aged 45 to 64 years and free of hypertension and coronary heart disease at baseline, in the ARIC Study. After 6 years of follow-up, there was an increased risk of hypertension in those participants who consumed greater than or equal to 210 g of alcohol per week (approximately three drinks per day). The odds ratio was 1.47 (95% CI, 1.15 to 1.89) after adjustment for race, age, body mass index, education, sport index, and diabetes [44]. In addition, consumption of low to moderate amounts of alcohol also seems to be associated with a higher risk of hypertension in black men. [44]. Xin et al [43] conducted a meta-analysis of randomized controlled trials to assess the effects of alcohol reduction on blood pressure. They reported that reduced alcohol consumption was associated with a decrease in blood pressure, and that the relationship between reduction in mean percentage of alcohol and decline in blood pressure is dose-dependent [43]. In a subgroup analyses of 269 normotensive subjects enrolled in six randomized controlled trials, reduced consumption of alcohol was associated with a 3.56 mm Hg (95% CI, 2.51 to 4.61 mm Hg) and 1.80 mm Hg (95% CI, 0.58 to 3.03) reduction of systolic and diastolic blood pressure, respectively (see Fig. 1) [43]. Reduction in alcohol consumption has been recommended as an important means for primary prevention of hypertension [11].

Physical activity

Physical inactivity has been identified as a major risk factor for cardiovascular disease, and persons who are less active and less fit have a 30% to 50% greater risk for developing hypertension [3]. Evidence relating physical activity and blood pressure comes from observational epidemiologic studies and randomized controlled clinical trials [48–53]. Investigators have evaluated various forms of physical activity including occupational or leisure-time physical activity, physical fitness, and aerobic exercise. Results from these prior studies have identified an inverse relationship between physical activity and blood pressure; this relationship has been noted at all ages, in both sexes, in racial subgroups, and has been independent of body weight. Whelton et al [52] reviewed data from 1108 normotensive persons enrolled in 27 clinical trials whose intervention and control groups differed only in aerobic exercise. In the subgroup analysis of 26 clinical trials with normotensive subjects, this meta-analysis identified a 4.04 mm Hg (95% CI, 2.75 to 5.32) decrease in systolic blood pressure in participants assigned to

aerobic exercise compared with their counterparts in the control group [52]. The analogous reduction in diastolic blood pressure was 2.33 mm Hg (95% CI, 1.51 to 3.14) (see Fig. 1). Regular aerobic physical activity (eg, brisk walking) for at least 30 minutes a day for most days of the week has been recommended for primary prevention of hypertension [11].

Modification of dietary patterns

The effect of dietary patterns on blood pressure has been explored in observational epidemiologic studies and randomized controlled clinical trials. In clinical trials of vegetarian diets in which vegetable products have replaced animal products, blood pressure was reduced in normotensive and hypertensive participants [54,55]. The effect of the vegetarian diet on blood pressure reduction is believed to be associated with the increased fiber and mineral content coupled with the low fat content of these diets. Several trials that have tested the blood pressure-lowering effect of these nutrients, however, often given in the form of dietary supplements, have found small and sometimes inconsistent reductions in blood pressure [31,56–58]. More recently, the DASH trial, a multicenter, randomized feeding study that tested the effects of dietary patterns on blood pressure, was conducted [59]. DASH tested the combined effects of nutrients that occur together in food. This trial included participants with a systolic blood pressure of less than 160 mm Hg and a diastolic blood pressure between 80 and 95 mm Hg. Participants were randomly assigned to one of the following dietary interventions: (1) a control diet that was low in fruits, vegetables, and dairy products, with a fat content typical of the average American diet; (2) a fruit and vegetables diet; or (3) a combination diet (ie, the DASH diet), which was rich in fruits, vegetables, and low-fat dairy products but reduced in saturated and total fat [59]. In a subanalysis of the 326 normotensive participants (blood pressure <140/90 mm Hg) in the trial, the DASH diet reduced systolic and diastolic blood pressure by an average of 3.5 mm Hg (95% CI, 5.3 to 1.6) and 2.1 (95% CI, 3.6 to 0.5) mm Hg (each $P < .001$), respectively, when compared with the control diet [59]. These results support the recommendation by the National High Blood Pressure Education Program Coordinating Committee for the primary prevention of hypertension: consumption of a diet rich in fruits, vegetables, and low-fat dairy products and reduced in saturated and total fats [11].

Comprehensive lifestyle modification

A recent clinical trial assessed the effect of a program of simultaneous weight loss, sodium reduction, increased physical activity, and limited alcohol intake on blood pressure conducted between January 2000 and June 2001 [60]. The PREMIER clinical trial included 810 adults with systolic blood pressure between 120 and 159 mm Hg and diastolic blood pressure

between 80 and 95 mm Hg. Participants were randomized to one of three interventions: (1) a one-time 30-minute counseling session, (2) a behavioral intervention that implemented established recommendations for each of these lifestyle changes, and (3) the behavioral intervention plus advice on the DASH diet [60]. After 6 months of follow-up, the decline in systolic blood pressure was 3.1 mm Hg greater among the nonhypertensive participants randomized either to the behavioral intervention or the behavioral intervention plus DASH diet compared with their counterparts randomized to advice only (Fig. 2; each $P < .01$). The analogous differential reductions in diastolic blood pressure were 1.6 and 2 mm Hg (see Fig. 2; each $P < .01$). Additionally, 26%, 17%, and 12% of patients randomized to advice only, behavioral intervention, and behavioral intervention plus DASH diet, respectively, were hypertensive (systolic or diastolic blood pressure $\geq 140/90$ mm Hg or antihypertensive medication usage) at the 6-month follow-up visit, respectively (P -trend $< .001$). This trial demonstrated the feasibility and potential benefits of the adoption of a comprehensive behavioral intervention in the prevention of hypertension [60].

Interventions with uncertain or less proved efficacy

Prior observational studies, randomized trials, and meta-analyses have investigated the association of calcium and fish oil supplementation and reduced caffeine consumption with blood pressure and have found the blood pressure-lowering effects minimal [61,62–67]. Griffith et al [68] updated their

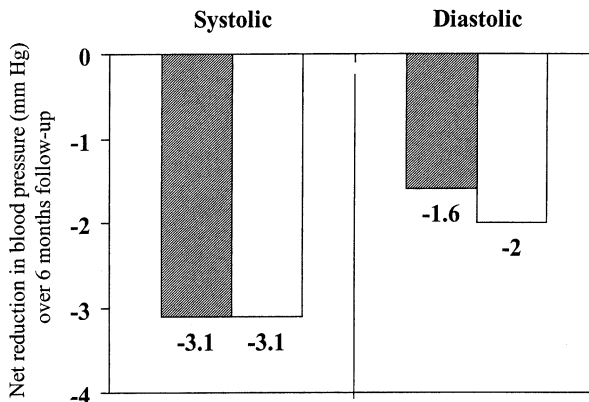


Fig. 2. Net reduction in systolic and diastolic blood pressure levels comparing normotensive participants randomized to an established multicomponent behavioral intervention [(filled bars) weight loss, reduced sodium intake, reduce alcohol consumption, and increased physical activity] and established multicomponent intervention plus the DASH diet (open bars) versus advice only. (Data from Appel LJ, Champagne CM, Harsha DW, Cooper LS, Obarzanek E. Related Articles, Writing Group of the PREMIER Collaborative Research Group: effects of comprehensive lifestyle modification on blood pressure control: main results of the PREMIER clinical trial. JAMA 2003;289:2083–93.)

original meta-analyses [62] of the effect of calcium on blood pressure in nonpregnant adults to include results from newer trials. From the pooled analysis, they reported a significant but small reduction in systolic blood pressure of 1.44 mm Hg (95% CI, 2.20 to 0.68; $P < .001$) and in diastolic blood pressure of 0.84 mm Hg (95% CI, 1.44 to 0.24; $P < .001$) associated with calcium supplementation. The effect has only been observed, however, in individuals with hypertension. Appel et al [67] performed a pooled analysis of 11 trials comparing fish oil supplementation with placebo among 728 normotensive subjects. They reported that fish oil intake (3.4 g/d) reduced systolic blood pressure by 1 mm Hg (95% CI, 0 to 2) and diastolic blood pressure by 0.5 mm Hg (95% CI, 0.2 to 1.2) [67]. In a meta-analysis of 11 controlled trials of predominately normotensive subjects, the median intake of five cups of caffeinated coffee per day was associated with a 2.4 mm Hg (range, 1 to 3.7) increase in systolic blood pressure and 1.2 mm Hg (range, 0.4 to 2.1) increase in diastolic pressure [66]. Although further research is needed, this analysis supports a relationship between coffee intake and high blood pressure. Although adequate calcium intake, fish oil supplementation, and reduced caffeine intake may be important for general health [69–71], the effect of these lifestyle modifications on blood pressure are too small to support a recommendation for primary prevention of hypertension. Although observational studies have found a strong inverse relationship between dietary protein and fiber intake and blood pressure, clinical trial data are limited [72,73]. In the two randomized trials for which blood pressure has been the primary outcome, significant reductions in systolic blood pressure ($P < .05$) were seen for participants randomized to soy protein compared with their counterparts randomized to either carbohydrates or low-protein supplementation [74,75]. Additionally, a small ($N = 41$) randomized controlled trial found 5.9 (95% CI: 8.1 to 3.7) and 1.4 (95% CI: 3 to 0.2) mm Hg reductions in 24-hour systolic and diastolic blood pressure, respectively, among persons with hypertension randomized to receive dietary fiber supplementation compared with their counterparts randomized to placebo [75]. Further research is needed to explore the impact of these nutrients in reducing the incidence of hypertension.

Summary

The best approach to the primary prevention of hypertension is a combination of lifestyle changes: weight loss in overweight persons; increased physical activity; moderation of alcohol intake; and consumption of a diet that is higher in fruits, vegetables, and low-fat dairy products and lower in sodium content than the average American diet (Table 3). Recent randomized controlled trials have demonstrated that these lifestyle changes can be sustained over long periods of time (more than 3 years) and can have blood pressure-lowering effects as large as those seen in drug studies [11].

Table 3
Lifestyle modifications for primary prevention of hypertension

Modification	Recommendation
Weight reduction ^a	Maintain normal body weight (BMI, 18.5–24.9)
Adopt DASH eating plan ^a	Consume a diet rich in fruits, vegetables, and low-fat dairy products with a reduced content of saturated and total fat
Dietary sodium reduction ^a	Reduce dietary sodium intake to no more than 100 mmol/d (2.4 g sodium or 6 g sodium chloride)
Physical activity ^a	Engage in regular aerobic physical activity, such as a brisk walk (at least 30 min/d, most days of the week)
Limit alcohol consumption ^a	Limit consumption to no more than two drinks per day (1 oz or 30 mL ethanol [eg, 24 oz beer, 10 oz wine, or 2 oz of 100 proof whiskey] in most men and no more than one drink per day in women and light-weight persons)
Dietary potassium maintenance	Maintain adequate intake of dietary potassium (>90 mmol [3500 mg] per day)

^a Of note, the recommendations for primary prevention are the same as the lifestyle modifications recommendations for the management of hypertension (JNC VII).

Abbreviations: BMI, body mass index calculated as weight in kilograms divided by the square of height in meters; BP, blood pressure; DASH, dietary approaches to stop hypertension.

Adapted from Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, And Treatment of High Blood Pressure. The JNC 7 report. JAMA 2003;289:2560–72; and Whelton PK, He J, Appel LJ, et al. Primary prevention of hypertension: clinical and public health advisory from the National High Blood Pressure Education Program. JAMA 2002;288:1882–8; with permission.

Hypertension is an important preventable risk factor for cardiovascular disease, the leading cause of mortality in the United States [3,76]. To achieve the Healthy People 2010 goal of reducing the proportion of adults with hypertension from 28% to 16% [15], concerted efforts must be directed toward primary prevention strategies. Lifestyle modifications including weight loss, increased physical activity, and dietary changes in individuals have been shown to reduce the incidence of hypertension and should be recommended for all persons and especially those with prehypertension. In addition, timely adoption of prevention strategies to reduce the incidence of hypertension and its subsequent complications in the general population may interrupt the costly cycle of hypertension and prevent the reductions in quality of life associated with this chronic disease.

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