2015 Evidence Analysis Library Evidence-Based Nutrition Practice Guideline for the Management of Hypertension in Adults

Shannon L. Lennon, PhD, RDN, LDN; Diane M. DellaValle, PhD, RDN, LDN; Susan G. Rodder, MS, RDN, LD; Melissa Prest, MS, RDN, CSR, LDN; Rachel C. Sinley, PhD, RDN; M. Katherine Hoy, EdD, RDN; Constantina Papoutsakis, PhD, RD

ABSTRACT
Hypertension (HTN) or high blood pressure (BP) is among the most prevalent forms of cardiovascular disease and occurs in approximately one of every three adults in the United States. The purpose of this Evidence Analysis Library (EAL) guideline is to provide an evidence-based summary of nutrition therapy for the management of HTN in adults aged 18 years or older. Implementation of this guideline aims to promote evidence-based practice decisions by registered dietitian nutritionists (RDNs), and other collaborating health professionals to decrease or manage HTN in adults while enhancing patient quality of life and taking into account individual preferences. The systematic review and guideline development methodology of the Academy of Nutrition and Dietetics were applied. A total of 70 research studies were included, analyzed, and rated for quality by trained evidence analysts (literature review dates ranged between 2004 and 2015). Evaluation and synthesis of related evidence resulted in the development of nine recommendations. To reduce BP in adults with HTN, there is strong evidence to recommend provision of medical nutrition therapy by an RDN, adoption of the Dietary Approaches to Stop Hypertension dietary pattern, calcium supplementation, physical activity as a component of a healthy lifestyle, reduction in dietary sodium intake, and reduction of alcohol consumption in heavy drinkers. Increased intake of dietary potassium and calcium as well as supplementation with potassium and magnesium for lowering BP are also recommended (fair evidence). Finally, recommendations related to lowering BP were formulated on vitamin D, magnesium, and the putative role of alcohol consumption in moderate drinkers (weak evidence). In conclusion, the present evidence-based nutrition practice guideline describes the most current recommendations on the dietary management of HTN in adults intended to support the practice of RDNs and other health professionals.
J Acad Nutr Diet. 2017;■:■-■.

HYPERTENSION (HTN) OR high blood pressure (BP) is one of the most prevalent forms of cardiovascular disease and occurs in approximately one of every three adults in the United States.[1] HTN is a major risk for cardiovascular disease and stroke.[2] HTN is defined as having either an elevated systolic BP (SBP) and/or diastolic BP (DPB). SBP of 140 mm Hg or higher and/or DBP of 90 mm Hg or higher meets this definition as well as taking anti-HTN medicine or having been told by a physician at least twice that one has high BP.[3] Untreated HTN can lead to a myocardial infarction, stroke, renal failure, and death.[4] The latest American Heart Association statistics show that almost 72,000 individuals died of HTN in 2013 and the estimated cost of HTN is more than $48 billion.[1] Hence, treatment and prevention of HTN is an important issue for the US population from both a health and fiscal standpoint.

Numerous risk factors exist for HTN, including age, race or ethnicity, family history of HTN, lower education and socioeconomic status, overweight or obesity, lower levels of physical activity, smoking, sleep apnea, and suboptimal dietary intake.[1] The purpose of the present Academy of Nutrition and Dietetics (Academy) Evidence Analysis Library (EAL) guideline is to provide an evidence-based summary of effective practice in the nutrition therapy of HTN in adults. Populations included in this guideline consist of individuals with unhealthy lifestyles, obesity, cardiovascular disease, type 2 diabetes, older adults, and African Americans, as these populations have a high prevalence of HTN.[1] However, this guideline does not include specific recommendations for various races or ethnicities as this aspect is beyond the scope of the project. Also, the guideline does not address HTN in persons with chronic kidney disease, given that nutrition care in chronic kidney disease can be complex depending on existing comorbidities, and this is covered in the EAL chronic kidney disease guideline (https://www.andeal.org/topic.cfm?menu=5303). In addition, other lifestyle modifications or adjunct therapies such as stress management, tobacco cessation, and use of anti-HTN medication, although important in the management and treatment of HTN, are outside the scope of the guideline. Practitioners interested in more specific information on BP goals, special populations, and anti-HTN medications are encouraged to review the report from the Panel Members Appointed to the Eighth Joint National Committee.[4]

Using the Nutrition Care Process (NCP)[5] as a framework for practice, the presented recommendations include guidance on medical nutrition therapy (MNT) and referral to a registered dietitian nutritionist (RDN) for individualized nutrition care. Implementation of this guideline aims to facilitate evidence-

Supplementary materials: *Figures 1, 3, and 5 are available at www.jandonline.org*

http://dx.doi.org/10.1016/j.jand.2017.04.008

based nutrition practice decisions by RDNs and other collaborating health professionals to decrease/manage HTN in adults, reduce variations in practice among RDNs, and enhance patient quality of life while taking into account individual preferences, different lifestyles, and personal goals.

The EAL evidence-based nutrition practice guideline for adults with HTN targets the following high-priority areas for RDNs:

- MNT
- Vitamin D
- Potassium
- Calcium
- Magnesium
- Sodium
- The Dietary Approaches in Stopping Hypertension (DASH) dietary pattern
- Alcohol
- Physical activity

REVIEW METHODOLOGY

In 2012, the Academy Evidence-Based Practice Committee[6] appointed six volunteer expert workgroup members with relevant HTN clinical and/or research experience in the area of HTN to update the HTN evidence-based nutrition practice guideline originally published online in 2008. The guideline workgroup also included an Academy staff project manager and lead analyst. The expert panel identified questions that addressed major nutrition-related factors for the management of HTN, including effectiveness of MNT, vitamin D, potassium, calcium, magnesium, sodium, the DASH dietary pattern, and related weight management, alcohol, and physical activity. The expert panel conducted a systematic search on the effect of the Mediterranean diet on HTN. However, the definition of Mediterranean diet was inconsistently defined in the available literature at the time of review. Thus, the expert panel did not formulate a recommendation on the Mediterranean-style diet. Several topics from the previous EAL hypertension guideline (https://www.andeal.org/topic.cfm?menu=5285&cat=5582) were considered, but it was determined that no new research had been conducted since publication of the previous project that would add to existing knowledge or strengthen current recommendations. These topics included relationships between HTN, BP, and the intake of B vitamins, vitamins C and E, and n-3 fatty acids. The workgroup did not complete a systematic review on physical activity; instead, it reviewed and included an external guideline[7] for the development of a consensus recommendation.

The evidence review focused on adults aged 18 years or older with HTN. Only studies published in peer-reviewed journals in the English language were considered. Studies reporting sample sizes <10 subjects per study group or studies with a dropout rate of 20% or greater were excluded. The workgroup considered studies utilizing multiple study designs, including randomized controlled trials (RCTs), cross-sectional studies, cohort studies, and time control studies, although greater weight was placed upon studies using an RCT design. Although meta-analyses were included, primary studies reported in those meta-analyses were included only once as part of those meta-analyses.

Case study reports were excluded. Search dates for the literature review ranged from July 2004 to March 2015 (specific date ranges per search are shown in Figure 1 [available online at www.jandonline.org]). For those questions whose evidence base was updated since the previous EAL guideline (ie, sodium, potassium, calcium, and magnesium), the beginning search date was 1 month before the last search date. Using the above criteria, the search strategy for each question was developed (Figure 1, available online at www.jandonline.org), and searches were conducted using PubMed. Additional studies were identified by manually searching reference lists of review articles, and the American College of Cardiology/American Heart Association (ACC/AHA) Task Force Report.[7] Also, studies in the previous EAL hypertension and sodium projects (http://www.andeal.org/), and studies in the US Department of Agriculture Nutrition Evidence Library cardiovascular systematic review were reviewed (Figure 1, available online at www.jandonline.org).[8] A total of 70 research studies were included (Figure 2), analyzed, and rated for quality by trained evidence analysts.[9] The panel and data analyst then summarized the evidence in 13 conclusion statements (Figure 3, available online at www.jandonline.org). By applying an iterative expert consensus process,[6] nine major evidence-based recommendations that included 15 recommendations (Figure 4) were formulated from the conclusion statements (Figure 3, available online at www.jandonline.org). All recommendations were categorized in the intervention step of the Academy's NCP.[5] Recommendations were rated as Strong, Fair, Weak, Consensus, or Insufficient Evidence, according to the Academy's rating scheme of recommendations, and classified (as either imperative or conditional).[6] The guideline was reviewed internally and externally during September 2015. The external reviewers consisted of an interdisciplinary group of 13 health professionals who are recognized authorities in HTN. The expert panel completed its work through regularly scheduled conference calls and a shared virtual workspace.

GUIDELINE RECOMMENDATIONS

The nine major recommendations (Figure 4) that make up the 2015 EAL evidence-based nutrition practice guideline for the management of HTN in adults are based on the review[9] and guideline development[6] methodology described above. Recommendation 1 addresses MNT (effectiveness, duration, and frequency of encounters). Recommendations 2 through 6 focus on the influence vitamin D, potassium, calcium, magnesium, and sodium from dietary, and, when applicable, from supplemental sources, on BP in adults with HTN. The DASH diet is a plant-based dietary pattern that emphasizes the intake of fruit, vegetables, beans, whole grains, and low- or nonfat dairy with moderate amounts of low-fat animal protein (eg, lean meats, chicken, and fish). Recommendation 7 is a summary of related evidence on the DASH dietary pattern, including the reported influence of DASH on weight reduction. Recommendation 8 describes current knowledge on alcohol, and finally recommendation 9 is a summary of evidence-based strategies on physical activity that aims to incorporate physical activity as a component of a healthy lifestyle to decrease or manage HTN. The evidence summaries (Figure 5, available online at www.jandonline.org) formed the synthesized evidence base that led to

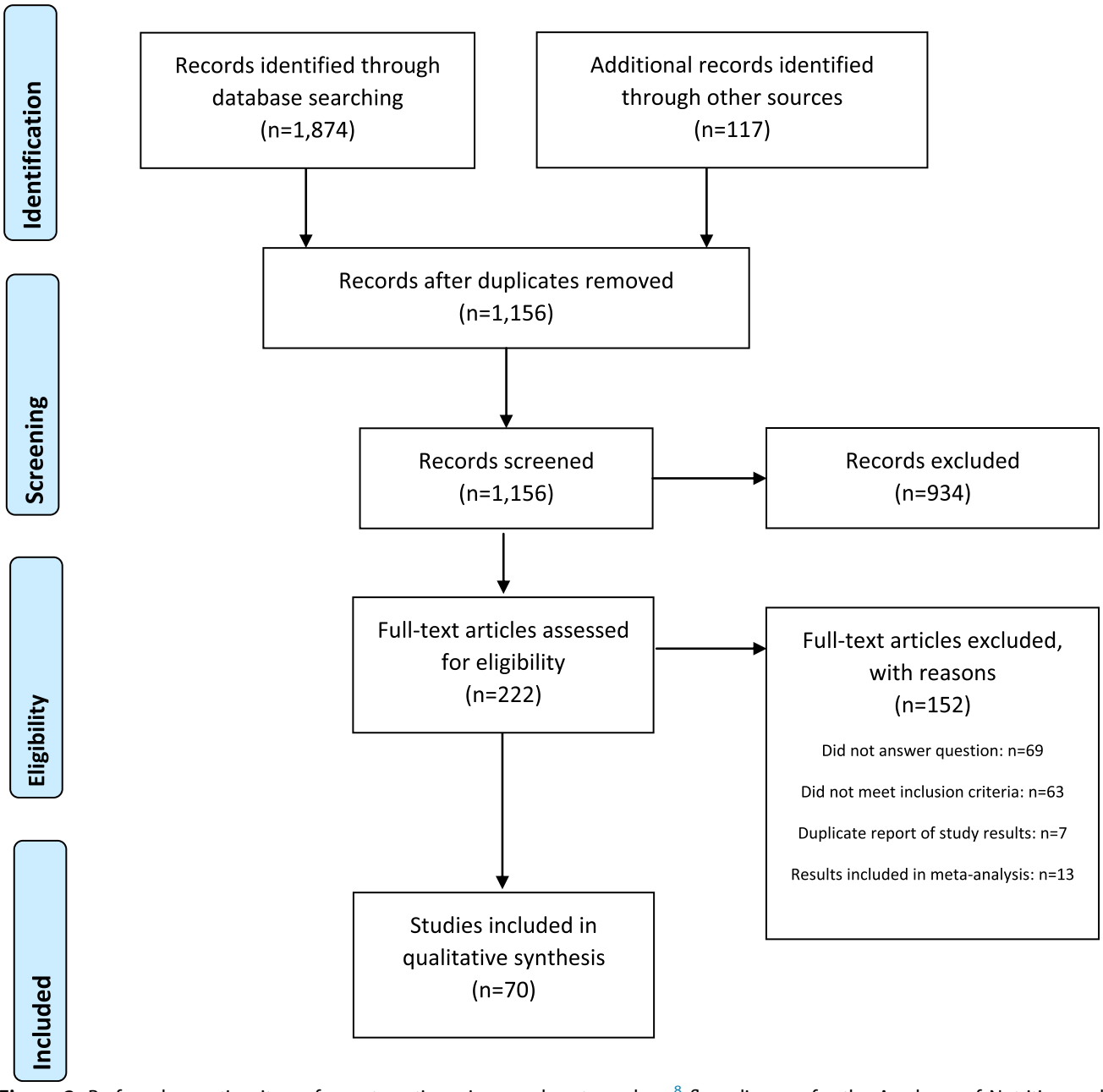

Figure 2. Preferred reporting items for systematic reviews and meta-analyses[8] flow diagram for the Academy of Nutrition and Dietetics Evidence Analysis Library evidence-based systematic review for the management of hypertension in adults.

the conclusion statements (Figure 3, available online at www.jandonline.org).

Recommendation 1

MNT. Guiding Question: In persons with HTN, how effective is MNT provided by an RDN compared with no or other interventions on BP?

Effectiveness of MNT. **EAL Recommendation 1.1:** MNT provided by an RDN is recommended to reduce BP in adults with HTN. A strong body of research indicates that MNT provided by an RDN using individual or group sessions reduces BP in persons with HTN or pre-HTN. **Rating: Strong (Imperative)**

Duration and Frequency of MNT Encounters. **EAL Recommendation 1.2:** To reduce BP in adults with HTN, RDNs should provide MNT encounters at least monthly for the first year. After the first year, an RDN should schedule follow-up sessions at least two to three times per year to maintain reductions in BP. A strong body of research indicates that reductions in SBP up to 10 mm Hg and in DBP up to 6 mm Hg were achieved during the first 3 months of MNT provided every other week for at least three sessions. Similar significant reductions in BP were reported at 6 to 12 months when MNT

Recommendation	Rating[6] (classification)
Recommendation 1 **MNT**[a]	
EAL recommendation 1.1: Effectiveness of MNT MNT provided by an RDN[b] is recommended to reduce BP[c] in adults with HTN. A strong body of research indicates that MNT provided by an RDN using individual or group sessions reduces BP in persons with HTN or pre-HTN.	Strong (Imperative)
EAL recommendation 1.2: Duration and frequency of MNT encounters To reduce BP in adults with HTN, the RDN should provide MNT encounters at least monthly for the first year. After the first year, the RDN should schedule follow-up sessions at least 2 to 3 times per year to maintain reductions in BP. A strong body of research indicates that reductions in SBP[d] up to 10 mm Hg and in DBP[e] up to 6 mm Hg were achieved in the first 3 months of MNT provided every other week for at least 3 sessions. Similar significant reductions in BP were reported at 6 to 12 months when MNT was provided at least monthly, or with follow-up provided after 5 or more sessions. Sustained reductions in BP for up to 4 years were reported when MNT was provided at least 2 to 3 times per year.	Strong (Imperative)
EAL recommendation 2: Vitamin D The RDN should encourage adults with HTN to consume adequate amounts of vitamin D to meet the DRI[f]. While important for health, vitamin D may or may not aid in BP control. Data from observational and intervention studies are inconclusive regarding the association between vitamin D status or intake (from supplements or food sources) and BP in individuals with HTN.	Weak (Imperative)
Recommendation 3 **Potassium**	
EAL recommendation 3.1: Dietary potassium The RDN should encourage adults with HTN to consume adequate amounts of dietary potassium to meet the DRI to aid in BP control. Research indicates that potassium excretion as a marker of dietary intake was inversely associated with BP. In a dietary intervention study, increasing potassium intake up to an additional 2,000 mg/d increased the likelihood of DBP control.	Fair (Imperative)
EAL recommendation 3.2: Potassium supplementation If an adult with HTN is unable to meet the DRI for potassium with diet and food alone, and if not contraindicated by risks and harms, the RDN may consider recommending potassium supplementation of up to 3,700 mg/d to aid in BP control. Research indicates that potassium supplementation up to approximately 3,700 mg/d reduced SBP and DBP by 3 to 13 mm Hg and 0 to 8 mm Hg, respectively, in adults with HTN.	Fair (Conditional)
Recommendation 4 **Calcium**	
EAL recommendation 4.1: Dietary calcium The RDN should encourage adults with HTN to consume adequate amounts of dietary calcium to meet the DRI to aid in BP control. Research indicates that dietary calcium intake of 800 mg or more per day reduced SBP up to 4 mm Hg and DBP up to 2 mm Hg in adults with HTN.	Fair (Imperative)

(continued on next page)

Figure 4. Recommendations of the Academy of Nutrition and Dietetics Evidence Analysis Library (EAL) evidence-based nutrition practice guideline for the management of hypertension (HTN) in adults.

Recommendation	Rating[6] (classification)
EAL recommendation 4.2: Calcium supplementation If an adult with HTN is unable to meet the DRI for calcium with diet and food alone, the RDN may consider recommending calcium supplementation of 1,000 to 1,500 mg/d to aid in BP control. A strong body of research indicates that calcium supplementation of 1,000 to 1,500 mg/d reduced SBP up to 3.0 mm Hg and DBP up to 2.5 mm Hg in adults with HTN.	Strong (Imperative)
Recommendation 5 **Magnesium**	
EAL recommendation 5.1: Dietary magnesium The RDN should encourage adults with HTN to consume adequate amounts of dietary magnesium to meet the DRI. While important for health, adequate dietary magnesium may or may not aid in BP control. Results from 2 studies suggest that the relationship between magnesium intake from food sources and BP in adults with HTN is unclear.	Weak (Imperative)
EAL recommendation 5.2: Magnesium supplementation If an adult with HTN is unable to meet the DRI for magnesium through food and diet alone, the RDN may consider recommending magnesium supplementation of up to 350 mg/d to aid in BP control. Research indicates that magnesium supplementation of 240 mg/d up to 1,000 mg/d reduced SBP by 1.0 to 5.6 mm Hg and DBP by 1.0 to 2.8 mm Hg in adults with HTN.	Fair (Conditional)
EAL recommendation 6: Sodium The RDN should counsel on reducing sodium intake for BP reduction in adults with HTN. Research indicates that lowering dietary sodium intake to 1,500 to 2,000 mg/d reduced SBP and DBP up to 12 and 6 mm Hg, respectively.	Strong (Imperative)
Recommendation 7 **DASH[g] dietary pattern**	
EAL recommendation 7.1: DASH diet The RDN should counsel on a DASH dietary pattern plus reduced sodium intake for BP reduction in adults with HTN. Research indicates that in adults with pre-HTN and HTN, the DASH dietary pattern, compared with the typical American diet, lowered SBP by 5 to 6 mm Hg and DBP by 3 mm Hg. Reducing sodium intake in those consuming the typical American diet or DASH diet also lowered BP. DASH in combination with a reduced sodium diet lowered BP more than reduced sodium intake alone. The effect was greater in those with HTN.	Strong (Imperative)
EAL recommendation 7.2: DASH diet and weight reduction For overweight or obese adults with HTN, the RDN should counsel on a calorie-controlled DASH dietary pattern for weight management and BP reduction. Research indicates that the DASH diet with a sodium range of 1,500 to 2,400 mg/d reduced SBP by 2 to 11 mm Hg and DBP by 0 to 9 mm Hg in overweight or obese hypertensive adults, regardless of anti-hypertensive medications. DASH plus weight reduction resulted in greater reductions in SBP of 11 to 16 mm Hg and DBP of 6 to 10 mm Hg than weight reduction alone.	Strong (Imperative)

(continued on next page)

Figure 4. *(continued)* Recommendations of the Academy of Nutrition and Dietetics Evidence Analysis Library (EAL) evidence-based nutrition practice guideline for the management of hypertension (HTN) in adults.

Recommendation	Rating[6] (classification)
Recommendation 8 **Alcohol**	
EAL recommendation 8.1: Alcohol intake in moderate drinkers If an adult with HTN is a moderate drinker, the RDN should advise that reducing or refraining from alcohol may or may not aid in BP management. Research indicates that the effect of alcohol on BP is unclear in moderate drinkers with HTN, since studies in this population yielded contradictory results.	Weak (Conditional)
EAL recommendation 8.2: Alcohol intake in heavy drinkers If an adult with HTN is a heavy drinker, the RDN should recommend abstinence from alcohol to aid in BP management. Research indicates that abstinence from alcohol resulted in a decrease in SBP of up to 28 mm Hg and a decrease in DBP of up to 18 mm Hg in chronic heavy drinkers with HTN.	Strong (Conditional)
EAL recommendation 9: Physical activity The RDN should encourage adults with HTN to engage in regular aerobic activity to lower BP. Physical activity should be of moderate intensity to vigorous intensity 3 to 4 times per week for an average of 40 minutes per session. Research indicates that among adult men and women at all BP levels, including individuals with HTN, aerobic physical activity decreases systolic BP and diastolic BP, on average by 2 to 5 mm Hg and 1 to 4 mm Hg, respectively. Typical interventions shown to be effective for lowering BP include aerobic physical activity of, on average, at least 12-wk duration, with 3 to 4 sessions per week, lasting on average 40 minutes per session and involving moderate-intensity to vigorous-intensity physical activity.	Strong (Imperative)

[a]MNT=medical nutrition therapy.

[b]RDN=registered dietitian nutritionist.

[c]BP=blood pressure.

[d]SBP=systolic blood pressure.

[e]DBP=diastolic blood pressure.

[f]DRI=Dietary Reference Intake.

[g]DASH=Dietary Approaches to Stop Hypertension.

Figure 4. *(continued)* Recommendations of the Academy of Nutrition and Dietetics Evidence Analysis Library (EAL) evidence-based nutrition practice guideline for the management of hypertension (HTN) in adults.

was provided at least monthly, or with follow-up provided after five or more sessions. Sustained reductions in BP for up to 4 years was reported when MNT was provided at least 2 to 3 times per year. **Rating: Strong (Imperative)**

Rationale: The effectiveness of MNT provided by an RDN on reducing the BP of adults with HTN is rated as Strong based on 15 studies reported in 17 publications.[10-26] Specifically, these include 11 randomized crossover trials reported in 13 publications, two nonrandomized trials,[22,24] one prospective cohort study,[23] and one time control study.[25] These studies provide robust evidence that MNT provided by an RDN using individual or group counseling methods reduces BP in persons with HTN or pre-HTN.[10-26] When provided by an RDN, counseling on DASH diets,[10,17,22,23,25] low-sodium diets,[11,12,16-21,23-25] weight control,[12,13,21,23,25,26] national dietary recommendations,[14] and a Mediterranean-style diet[15] have led to reductions in BP. One to 3 months of MNT resulted in reductions of SBP up to 10 mm Hg and reductions in DBP of up to 6 mm Hg when MNT was provided at least every other week for at least three sessions.[10,12-14,26] MNT provided over the course of 6 to 12 months resulted in similar reductions in both SBP and DBP, with average reductions of 6 mm Hg for SBP and 3 mm Hg for DBP when follow-ups occurred either monthly or after five or more sessions.[11,16,24-26] These same significant reductions in BP were sustained for up to 4 years when MNT was provided at least 2 to 3 times per year, with an average reduction of 3 mm Hg in SBP and 4 mm Hg in DBP.[15,18,20,25] Evidence suggests that more frequent MNT contact with an RDN is associated with significant reductions in BP.[20,22] In summary, MNT provided by an RDN is recommended to reduce BP in adults with HTN and is supported by a strong body of evidence.

Recommendation 2

Vitamin D. Guiding Question: What is the relationship of vitamin D status or intake (from supplements or food sources) and HTN in adults with HTN?

EAL Recommendation 2: RDNs should encourage adults with HTN to consume adequate amounts of vitamin D to meet the dietary reference intakes (DRIs). Although important for health, vitamin D may or may not aid in BP control. Data from observational and intervention studies are inconclusive regarding the association between vitamin D status or intake (from supplements or food sources) and BP in individuals with HTN. **Rating: Weak (Imperative)**

Rationale: The effect of vitamin D status or intake on BP in adults with HTN is rated as Weak based on seven studies. Specifically, these include three observational studies,[27-29] three RCTs,[30-32] and two analyses reported in the same publication by Bernini and colleagues[33] who included one nonrandomized and one noncontrolled trial. Cross-sectional studies revealed a positive relationship between vitamin D deficiency and HTN.[27,28] Baseline differences in plasma vitamin D levels were observed between individuals without HTN and with HTN, suggesting that vitamin D deficiency (<30 ng/mL) was associated with HTN.[29,33]

In intervention studies, whereas vitamin D supplementation resulted in significant increases in serum vitamin D levels ranging from 12 to 21 ng/mL (30 to 52 mmol/L),[30-33] SBP or DBP was not significantly impacted in four of five trials.[30-33] Overall, data from observational and intervention studies are inconclusive regarding the association between vitamin D status or intake and BP in individuals with HTN.

Recommendation 3

Potassium. Guiding Question (a): What is the relationship between potassium intake from food sources and BP in adults with HTN?

Guiding Question (b): What is the relationship between potassium intake from supplements and BP in adults with HTN?

Dietary Potassium. **EAL Recommendation 3.1:** RDNs should encourage adults with HTN to consume adequate amounts of dietary potassium to meet the DRI to aid in BP control. Research indicates that potassium excretion, as a marker of dietary intake was inversely associated with BP. In a dietary intervention study, increasing potassium intake up to 2,000 mg increased the likelihood of DBP control. **Rating: Fair (Imperative)**

Rationale: The current evidence for a relationship between dietary potassium and BP in adults with HTN is rated as Fair. This recommendation is based on evaluation of eight studies including five cross-sectional analyses,[34-38] one case control,[39] one RCT,[40] and one secondary analysis of several randomized crossover trials.[41] Three cross-sectional studies revealed that dietary intake of potassium ranging from 1,900 to 3,700 mg (49 to 95 mmol) did not differ between individuals without HTN and those with HTN.[35,37,38] However, in one cross-sectional study using 24-hour urinary potassium excretion as a marker of intake, increased potassium excretion correlated with lower DBP and individuals without HTN were shown to consume more potassium than individuals with HTN.[39] Results from two RCTs were inconsistent. In one study, increasing dietary potassium intake up to an additional 2,000 mg (51 mmol) per day was associated with maintaining nonpharmacologic control of BP and was greatest in those with a higher DBP.[41] In contrast, nonsignificant changes in BP were observed when additional dietary potassium of 780 to 1,560 mg (20 to 40 mmol) per day was added to dietary intake.[40]

Included in five of these studies was an assessment of the relationship between the urinary sodium-to-potassium excretion ratio and BP.[34-36,38,39] The sodium-to-potassium ratio was correlated with BP (either SBP or DBP) in both individuals without and with HTN in four of these studies.[34,36,38,39] In particular, significant increases were seen in SBP and DBP (1.16 mm Hg and 0.84 mm Hg, respectively) for each 3-unit increase in the urinary sodium-to-potassium excretion ratio.[34] In conclusion, results from six of eight studies showed a significant inverse relationship between potassium intake from food sources and BP in adults with HTN. Potassium excretion as a marker of dietary intake was inversely associated with BP in four of five studies. In one of two dietary intervention studies, increasing potassium intake up to 2,000 mg above baseline increased the likelihood of DBP control.

Potassium Supplementation. **EAL Recommendation 3.2:** When an adult with HTN is unable to meet the DRI for potassium with diet and food alone, and when not contraindicated by risks and harms, RDNs may consider recommending potassium supplementation

of up to 3,700 mg (95 mmol) per day to aid in BP control. Research indicates that potassium supplementation up to approximately 3,700 mg (95 mmol) per day reduced SBP and DBP by 3 to 13 mm Hg and 0 to 8 mm Hg, respectively, in adults with HTN. **Rating: Fair (Conditional)**

Rationale: Current evidence for a relationship between potassium intake from supplements and BP in hypertensive adults is rated as Fair. Seven studies were evaluated, including one noncontrolled trial, results of which were reported in two publications,[42,43] one nonrandomized trial,[44] one RCT,[45] three randomized crossover trials,[40,46,47] and one meta-analysis.[48] The level of potassium supplementation varied widely from 780 to 1,560 mg (20 to 40 mmol),[40,44] 2,340 mg (60 mmol),[42,43,46] or 3,744 mg (96 mmol)[47] per day for 1 to 6 weeks, and the meta-analysis included six RCTs that were 8 weeks or longer.[48] In four studies, significant reductions in SBP and DBP of 3 to 13 mm Hg and 0 to 5 mm Hg, respectively, were observed with potassium supplementation.[42,44,45,47] However, two RCTs did not observe any significant changes over 4 or 6 weeks.[40,47] In the meta-analysis, there were large but nonsignificant reductions in SBP and DBP.[48] These inconclusive effects of potassium supplementation on BP[48] were attributed to small sample sizes in high-quality trials with short durations of follow-up (8 to 16 weeks). The effects of potassium supplementation were shown to increase with aging for SBP[9] and the effects were greater with higher baseline SBP and DBP.[42] The relationship between the urinary sodium-to-potassium excretion ratio and BP was evaluated in one study and it was found that 1,170 mg (30 mmol) potassium per day positively reduced SBP and the ratio.[44] In summary, potassium supplementation up to approximately 3,700 mg per day reduced SBP and DBP by 3 to 13 mm Hg and 0 to 8 mm Hg, respectively, in adults with HTN.

Recommendation 4

Calcium. Guiding Question (a): What is the relationship between calcium intake from food sources and BP in adults with HTN?

Guiding Question (b): What is the relationship between calcium intake from supplements and BP in adults with HTN?

Dietary Calcium. **EAL Recommendation 4.1:** RDNs should encourage adults with HTN to consume adequate amounts of dietary calcium to meet the DRI to aid in BP control. Research indicates that dietary calcium intake of 800 mg or more per day reduced SBP up to 4 mm Hg and DBP up to 2 mm Hg in adults with HTN. **Rating: Fair (Imperative)**

Rationale: The effect of calcium intake from food sources on BP in adults with HTN is rated Fair based on inconsistent evidence from six studies: three cross-sectional,[37,38,49] one prospective cohort,[50] one meta-analysis,[51] and one RCT.[52] A significant inverse relationship between calcium intake and SBP and DBP was observed in normotensive, nonmedicated, and medicated subjects with HTN[38] and in participants enrolled in the PREDIMED (PREvention with MEDiterranean Diet) prospective cohort.[50] In a second cross-sectional study,[49] 31.5% of postmenopausal women with HTN had a low calcium intake ($\leq$7 dairy servings/wk) compared with 24.3% without HTN who had a high calcium intake ($\geq$16 dairy servings/wk). In a meta-analysis[51] that considered the effect of dietary or supplemental calcium on BP, an increase in dietary calcium intake had a significant lowering effect on SBP (−2.56 mm Hg). However, in the Geisinger Rural Aging Study, calcium intake (contributed by dairy consumption, and not other sources) was not significantly different between those with or without HTN.[37] In addition, a reduction in SBP and DBP was observed in subjects randomized to diets higher in fruits and vegetables regardless of dairy intake.[52] In conclusion, four of six studies demonstrated that dietary calcium intake of 800 mg or more per day (primarily from dairy sources) reduced SBP up to 4.0 mm Hg and DBP up to 2.0 mm Hg in adults with HTN.

Calcium Supplementation. **EAL Recommendation 4.2:** When an adult with HTN is unable to meet the DRI for calcium with diet and food alone, RDNs may consider recommending calcium supplementation of 1,000 to 1,500 mg (25 to 38 mmol) per day to aid in BP control. A strong body of research indicates that calcium supplementation of 1,000 to 1,500 mg (25 to 38 mmol) per day reduced SBP up to 3.0 mm Hg and DBP up to 2.5 mm Hg in adults with HTN. **Rating: Strong (Imperative)**

Rationale: The effect of calcium supplementation on BP in adults with HTN is rated Strong based on two meta-analyses[51,53] and one small RCT.[54] In one meta-analysis, calcium supplementation of 1,200 mg (30 mmol) per day for an average of 9 weeks lowered SBP by 1.8 mm Hg and DBP by 0.99 mm Hg in individuals without and with HTN.[51] Reduction in BP was more evident in those with an initial intake of calcium <800 mg (20 mmol) per day compared with those consuming >800 mg/day.[51] In a second meta-analysis[53] of individuals with HTN, calcium supplementation at 1,100 mg (28 mmol) per day for 8 to 15 weeks resulted in a significant reduction in SBP (2.5 mm Hg), but not in DBP.[53] One RCT found no reduction in either SBP or DBP with use of 1,500 mg (38 mmol) supplemental calcium per day for 8 weeks.[54] In summary, two meta-analyses demonstrated that calcium supplementation of 1,000 to 1,500 mg/day reduced SBP up to 3.0 mm Hg and DBP up to 2.0 mm Hg in adults with HTN. However, one RCT did not find significant effects on BP with calcium supplementation.

Recommendation 5

Magnesium. Guiding Question (a): What is the relationship between magnesium intake from food sources and BP in adults with HTN?

Guiding Question (b): What is the relationship between magnesium intake from supplements and BP in adults with HTN?

Dietary Magnesium. **EAL Recommendation 5.1:** RDNs should encourage adults with HTN to consume adequate amounts of dietary magnesium to meet the DRI. Although important for health, adequate dietary magnesium may or may not aid in BP control. Results from two studies suggest that the relationship between magnesium intake from food sources and BP in adults with HTN is unclear. **Rating: Weak (Imperative)**

Rationale: Supporting evidence for a relationship between magnesium intake from food sources and BP in adults with HTN is rated as Weak, based on conflicting results from three cross-sectional studies.[37,38,55] Small

but significant reductions in SBP of 0.98 mm Hg were observed in individuals with higher urinary magnesium excretion,[55] but not in those with dietary intake at or above the Recommended Dietary Allowance for magnesium (280 mg for women and 350 mg for men).[37,38] For DBP, significant reductions of 0.63 to 1.04 mm Hg were observed in those with higher urinary magnesium excretion[55] and dietary intake above the Recommended Dietary Allowance.[38] In summary, results from these studies suggested that the relationship between magnesium intake from food sources and BP in adults with HTN was unclear.

Magnesium Supplementation. **EAL Recommendation 5.2:** When an adult with HTN is unable to meet the DRI for magnesium through food and diet alone, RDNs may consider recommending magnesium supplementation of up to 350 mg (15 mmol) per day to aid in BP control. Research indicates that magnesium supplementation of 240 mg (10 mmol) up to 1,000 mg (42 mmol) per day reduced SBP by 1.0 to 5.6 mm Hg and DBP by 1.0 to 2.8 mm Hg in adults with HTN. **Rating: Fair (Conditional)**

Rationale: Available evidence for a relationship between magnesium supplementation and BP in adults with HTN is rated as Fair. Results from three studies were evaluated, including one nonrandomized trial,[56] one randomized trial,[57] and one meta-analysis of 12 randomized controlled trials.[58] A one-time intravenous administration of 1,500 mg (63 mmol) magnesium to patients with HTN resulted in significant decreases of 30 to 50 and 20 to 30 mm Hg in SBP and DBP, respectively.[57] Magnesium supplementation in combination with lifestyle recommendations resulted in significant decreases of 5.6 and 2.8 mm Hg for SBP and DBP, respectively, which were significantly higher than reductions in those following lifestyle recommendations alone.[56] In a meta-analysis of 12 randomized controlled trials conducted over periods of 8 to 26 weeks, mean differences between baseline and follow-up were 1.3 mm Hg for SBP (nonsignificant) and 2.2 mm Hg for DBP.[58] Median level of magnesium supplementation in these studies was 400 mg/day (range=240 to 1,000 mg [10 to 42 mmol]).[58] Overall, magnesium supplementation of 240 to 1,000 mg per day reduced SBP by 1.0 to 5.6 mm Hg and DBP by 1.0 to 2.8 mm Hg in adults with HTN.

Recommendation 6

Sodium. Guiding Question: What is the effect of reduced sodium intake on BP in adults with HTN?

EAL Recommendation 6: RDNs should counsel on reducing sodium intake for BP reduction in adults with HTN. Research indicates that lowering dietary sodium intake to 1,500 to 2,000 mg (65 to 87 mmol) per day reduced SBP and DBP up to 12 mm Hg and 6 mm Hg, respectively. **Rating: Strong (Imperative)**

Rationale: Current evidence supporting the relationship between sodium intake and BP in adults with HTN is rated as Strong. Results from 13 studies were evaluated, including one nonrandomized trial,[59] one case-control study,[39] two randomized crossover trials,[42,60] three meta-analyses of RCTs,[61-63] and six cross-sectional studies.[35-38,64,65] Results from all 16 studies demonstrated a positive relationship between sodium intake and BP in adults with HTN. Furthermore, significant decreases in BP were observed with reduced sodium intake in three studies[42,59,60] and three meta-analyses of RCTs.[61-63] In five studies, including two meta-analyses,[60,61] a decrease in dietary sodium intake to 1,500 to 2,000 mg (65 to 87 mmol) per day reduced SBP and DBP up to 12 mm Hg and 6 mm Hg, respectively. A meta-analysis of four studies[61] demonstrated that compared with a low sodium intake (2,070 mg [<90 mmol]), there was a significant increase in BP with increasing levels of sodium intake in individuals with HTN: intakes of 2,070 to 3,656 mg (90 to 159 mmol) were associated with a SBP/DBP increase of 4.65/2.44 mm Hg; intakes of 3,657 to 5,700 mg (159 to 248 mmol) were associated with an increase in SBP/DBP of 6.87/3.61 mm Hg; and intakes >5,700 mg (248 mmol) were associated with an increased SBP/DBP of 10.03/5.55 mm Hg. In conclusion, these 13 studies demonstrate a relationship between sodium intake and BP in adults with HTN. In four studies, BP increased with higher levels of sodium intake. In five studies, including two meta-analyses, a decrease in dietary sodium intake to 1,500 to 2,000 mg/day reduced SBP and DBP up to 12 and 6 mm Hg, respectively.

Recommendation 7

DASH Dietary Pattern. Guiding Question: What is the effect of the DASH diet pattern on BP in adults with HTN?

DASH Diet. **EAL Recommendation 7.1:** RDNs should counsel on a DASH dietary pattern plus reduced sodium intake for BP reduction in adults with HTN. Research indicates that in adults with pre-HTN and HTN, the DASH dietary pattern, compared with the typical American diet, lowered SBP by 5 mm Hg to 6 mm Hg and DBP by 3 mm Hg. Reducing sodium intake in those consuming the typical American diet or DASH diet also lowered BP. DASH in combination with a reduced sodium diet lowered BP more than reduced sodium intake alone. The effect was greater in those with HTN. **Rating: Strong (Imperative)**

Rationale: The effect of DASH on BP in adults with HTN is rated as strong based on evidence summarized in a recent ACC/AHA Task Force Report,[7] as well as evidence from two randomized crossover trials,[17,66] six RCTs,[67-72] and a subanalysis of a data set by Epstein and colleagues[73] reported by Blumenthal and colleagues on the ENCORE (Exercise and Nutritional Interventions for Cardiovascular Health) trial.[68] Although study methodology varied widely among the studies reviewed for this recommendation (eg, level of sodium reduction and/or intake, whether or not dietary advice was included, supplemental vs dietary potassium and magnesium, or weight reduction component), reductions observed in SBP ranged from 5 to 25 mm Hg and reductions in DBP ranged from 4 to 17 mm Hg. Nonsignificant differences were observed between those receiving anti-HTN therapy compared with those not receiving it while following the DASH diet. In summary, although there were no DASH studies on normal weight adults with HTN that met the search inclusion criteria, the DASH diet with a sodium intake of 1,500 to 2,400 mg, reduced SBP by 2 to 11 mm Hg and DBP by 0 to 9 mm Hg in overweight or obese adults with HTN regardless of anti-HTN medications.

DASH Diet and Weight Reduction. **EAL Recommendation 7.2:** For overweight or obese adults with HTN, RDNs should counsel on a calorie-controlled DASH dietary pattern for weight management and BP reduction. Research indicates that the DASH diet with a sodium range of 1,500 to 2,400 mg/day reduced SBP by 2 to 11 mm Hg and DBP by 0 to 9 mm Hg in overweight or obese adults with HTN, regardless of anti-HTN medications. In summary, DASH plus weight reduction resulted in greater reductions in SBP of 11 to 16 mm Hg and DBP of 6 to 10 mm Hg than weight reduction alone. **Rating: Strong (Imperative)**

Rationale: The effect of DASH on weight reduction in overweight and obese adults with HTN is based on Strong evidence from seven RCTs,[67-73] and two randomized crossover trials.[17,66] These nine studies provide evidence that the DASH diet with a sodium intake range of 1,500 to 2,400 mg reduced SBP by 2 to 11 mm Hg and DBP by 0 to 9 mm Hg in overweight or obese adults with HTN, regardless of anti-HTN medications. DASH plus weight loss resulted in reductions in SBP of 11 to 16 mm Hg and DBP of 6 to 10mm Hg. In two studies, the reductions in BP were greater in those who lost weight and reduced sodium intake compared with weight reduction alone suggesting the importance multiple lifestyle factors have on influencing BP.[67,72] In these studies, weight loss ranged from 4.9 kg over 12 weeks[72] and 15 to 16 kg over 6 months.[67] This was also reported in the ENCORE trial,[68] because DASH plus weight reduction improved BP reductions more than DASH alone with average weight losses of 8.7 kg over 4 months. These studies cumulatively suggest that a weight loss of 1.5 to 2.5 kg/month can significantly improve BP and are additive to the BP-lowering effects of DASH.

Recommendation 8

Alcohol. Guiding Question (a): How does alcohol intake affect BP in moderate drinkers with HTN?

Guiding Question (b): How does alcohol intake affect BP in heavy drinkers with HTN?

Alcohol Intake in Moderate Drinkers. **EAL Recommendation 8.1:** When an adult with HTN is a moderate drinker, RDNs should advise that reducing or refraining from alcohol may or may not aid in BP management. Research indicates that the effect of alcohol on BP is unclear in moderate drinkers with HTN, because studies in this population yielded contradictory results. **Rating: Weak (Conditional)**

Rationale: Supporting evidence investigating the relationship between moderate alcohol consumption and BP in adults with HTN is rated as Weak. Two studies evaluated the effect of moderate alcohol intake on BP in adults with HTN, including one randomized crossover trial,[74] and one time-course study.[75] Acutely, alcohol consumption of 1.0 g/kg can increase SBP and DBP by 25 and 15 mm Hg, respectively, in individuals with HTN.[74] However, in the time-course study, alcohol consumption at dinner resulted in a decline in SBP by 15 mm Hg compared with the abstinence control period.[75] In summary, in moderate drinkers with HTN, the effect of alcohol is unclear. Two studies measuring the effect of a relatively high dose of alcohol (1 g or 1 mL/kg body weight) on BP yielded contradictory results. Confounders such as ethnic origin, use of sodium restriction and differences in measurement times do not allow for direct comparison of the two studies. More research is needed to discern the shorter- and longer-term effect of alcohol intake alone, in moderate drinkers with HTN.

Alcohol Intake in Heavy Drinkers. **EAL Recommendation 8.2:** When an adult with HTN is a heavy drinker, RDNs should recommend abstinence from alcohol to aid in BP management. Research indicates that abstinence from alcohol resulted in a decrease in SBP of up to 28 mm Hg and a decrease in DBP of up to 18 mm Hg in chronic heavy drinkers with HTN. **Rating: Strong (Conditional)**

Rationale: The evidence describing the relationship between chronic heavy alcohol drinkers and BP in adults with HTN is rated as Strong. Three studies evaluated effects of alcohol withdrawal in chronic heavy drinkers with HTN, including one before–after study,[76] one nonrandomized trial,[77] and one time course study.[78] In patients with HTN consuming >200 g/day alcohol on average, abstinence resulted in BP reductions ranging from 10 to 28 mm Hg for SBP, and 7 to 18 mm Hg for DBP.[77] Further, both 4 and 12 weeks of alcohol abstinence resulted in significant decreases in SBP and DBP of 10 to 12 mm Hg and 7 to 8 mm Hg, respectively.[76,78] In conclusion, there were no studies directly examining the effect of alcohol intake on BP in heavy drinkers with HTN. However, three studies in chronic heavy drinkers with HTN found that abstinence reduced SBP from 10 to 28 mm Hg and DBP from 7 to 18 mm Hg.

Recommendation 9

Physical Activity. EAL Recommendation 9: RDNs should encourage adults with HTN to engage in regular aerobic activity to lower BP. Physical activity should be of moderate intensity to vigorous intensity three to four times per week for an average of 40 minutes per session. Research indicates that among adult men and women at all BP levels, including individuals with HTN, aerobic physical activity decreases SBP and DBP, on average by 2 to 5 mm Hg and 1 to 4 mm Hg, respectively. Typical interventions shown to be effective for lowering BP include aerobic physical activity of, on average, at least 12 weeks' duration, with three to four sessions per week lasting on average 40 minutes per session and involving moderate-intensity to vigorous-intensity physical activity. **Rating: Strong (Imperative)**

Rationale: The recommendation for routine physical activity and HTN is rated as Strong and is based on the ACC/AHA Lifestyle Management Guideline.[7] The ACC/AHA Lifestyle Full Work Group reviewed meta-analyses from 2001 onward examining the evidence supporting the use of physical activity for BP reduction.[7] The ACC/AHA Lifestyle Full Work Group compared results of 11 meta-analyses targeting physical activity alone vs no physical activity or other types of intervention and considered a range of exercise modalities as well as specific subgroups (eg, older persons, postmenopausal women, and patients with coronary heart disease or type 2 diabetes mellitus). In summary, inclusion of physical activity in the management of BP in adults with HTN is strongly encouraged.

SUMMARY

The purpose of this guideline is to provide an evidence-based summary of effective practice in the dietary management and treatment of HTN in adults. HTN management by RDNs is effective: Research has shown that even 4 years following initial contact, BP reductions were sustained.[23] Further, our review of the literature clearly indicates that MNT provided by an RDN has a substantial influence on BP reduction. Indeed, a report from 2013 indicated that suboptimal dietary habits were the leading cause of both mortality and disability-adjusted life-years lost, surpassing even tobacco.[79] More specifically, high dietary salt consumption has been shown to be responsible for 102,000 deaths annually.[80] Globally, 1.65 million deaths from cardiovascular causes were attributed to sodium intake above 2,000 mg/day.[81] The Strong rating received by the recommendation on sodium reduction supports the importance of working with patients and clients on achieving the recommended sodium intake in their daily consumption.

Fifteen recommendation statements are provided in the guideline and eight received a Strong rating.[6] These include effectiveness of MNT by an RDN and frequency of encounters with an RDN, reducing sodium intake, use of calcium supplementation, following the DASH diet alone or in combination with weight reduction when appropriate, reduced alcohol consumption in heavy drinkers, and inclusion of physical activity. Four recommendations (on dietary and supplemental potassium, dietary calcium, and supplemental magnesium) received a Fair rating and three recommendations (on dietary or supplemental vitamin D, dietary magnesium, and moderate consumption of alcohol) received a Weak rating.[6]

These recommendations are consistent with guidelines made by health organizations such as ACC/AHA.[7] Specifically, sodium reduction is beneficial to maintaining a normal BP and can lower BP in those with HTN. Adoption of the DASH dietary pattern, which focuses on nutrients such as potassium, calcium, and magnesium, is effective in lowering BP. Also, it was found that overweight or obese individuals who adhere to the DASH dietary pattern experience weight reduction. Finally, abstinence from alcohol in heavy drinkers, as well as inclusion of regular physical activity in all individuals, reduces BP. Taken together, the current EAL evidence-based guideline is aligned with evidence summaries by the ACC/AHA.[7]

Strengths and Limitations

A defining strength of this work is the rigorous and transparent methodology used to conduct the systematic review[9] and develop the guideline.[6] Although this guideline is an excellent tool to guide practitioners in working with an individual with HTN, for more specific information on BP goals, special populations, and anti-HTN medications, practitioners are referred to the Eighth Joint National Committee Report.[82] This guideline only focuses on intervention recommendations and does not include assessment or monitoring and evaluation steps of the NCP.[5]

A limitation of the evidence supporting the current guideline is the lack of RCTs in several topics that were reviewed. Specifically, additional research is needed in pre-HTN and HTN populations to determine the relationship between vitamin D status or intake in adults with HTN, the effect of dietary magnesium and calcium, the effect of magnesium supplementation, and the optimal range of intake for dietary and supplemental potassium and calcium to achieve BP control. More research is needed to investigate the effect of plant-based diets (eg, DASH or Mediterranean-style diet[83]) for BP lowering. Further, short- and long-term effect of moderate alcohol consumption on BP remains underinvestigated. Studies addressing these highlighted topics would strengthen current recommendations. In addition to a lack of studies in this area, we chose to use the definitions of moderate and heavy alcohol consumption as defined by the study authors. Finally, in our systematic review process, we only used PubMed as a database for our search and therefore we could have inadvertently missed relevant studies found in other databases.

IMPLICATIONS FOR PRACTICE

Effective practice in the dietary management and treatment of HTN in adults includes MNT provided by an RDN. RDNs in inpatient settings should provide MNT before discharge or referral to an outpatient RDN. Outpatient RDNs should provide monthly MNT encounters for the first year, with at least two to three encounters the following year taking into consideration the extent to which the patient's insurance covers MNT for the appropriate International Classification of Diseases, 10th revision, diagnostic codes.[84] MNT provided by an RDN centers around the DASH dietary pattern with individualized, evidenced-based nutrition recommendations (eg, tailored energy recommendations, servings of food groups, and other nutrition care factors). The DASH dietary pattern emphasizes limiting dietary sodium intake while achieving adequate dietary potassium, calcium, and magnesium to facilitate the reduction and management of SBP and DBP. A sodium restriction of 1,500 to 2,400 mg/day is recommended based on stage of HTN, concomitant conditions or disease states, medications, and estimated calorie needs. When suboptimal dietary intake of potassium, calcium, and magnesium is anticipated, an RDN should recommend dietary supplements to achieve the appropriate sex- and age-based DRI for each of those micronutrients. In overweight and obese individuals, the DASH dietary pattern (combined with an energy deficit for weight loss) is indicated for even greater reductions in SBP and DBP. Abstinence from alcohol is recommended in heavy drinkers (>200 g/day) following assessment of nutritional status, including possible suboptimal micronutrient intake and absorption. Finally, in addition to these nutrition recommendations, physical activity, which normalizes BP, should be encouraged pending physician approval.

Supportive resources to educate individuals in the management and treatment of HTN:

- DASH dietary pattern https://www.nhlbi.nih.gov/health/health-topics/topics/dash
- Managing BP with a heart-healthy diet http://www.heart.org/HEARTORG/Conditions/HighBloodPressure/PreventionTreatmentofHighBloodPressure/Managing-Blood-Pressure-with-a-Heart-Healthy-Diet_UCM_301879_Article.jsp#.V6yMsk0m7cs

- HTN nutrition therapy, low sodium nutrition therapy, sodium-free flavoring tips, and the sodium (salt) content of foods https://www.nutritioncaremanual.org/

HTN is a highly prevalent form of cardiovascular disease that negatively influences the health of every one in three US adults.[1] The recommendations found in this guideline serve as an essential foundation for nutrition and dietetics practitioners in the area of nutrition and HTN in adults. This EAL guideline outlines the most current information on HTN in the context of the NCP[5] and provides evidence-based practice guidance for RDNs and DTRs and other health professionals.

References

1. Mozaffarian D, Benjamin EJ, Go AS, et al. Heart disease and stroke statistics-2016 update: A report from the American Heart Association. *Circulation*. 2016;133(4):e38-e360.
2. Chobanian AV, Bakris GL, Black HR, et al. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension*. 2003;42(6):1206-1252.
3. Crim MT, Yoon SS, Ortiz E, et al. National surveillance definitions for hypertension prevalence and control among adults. *Circ Cardiovasc Qual Outcomes*. 2012;5(3):343-351.
4. James PA, Oparil S, Carter BL, et al. 2014 evidence-based guideline for the management of high blood pressure in adults: Report from the panel members appointed to the Eighth Joint National Committee (JNC 8). *JAMA*. 2014;311(5):507-520.
5. Nutrition care process and model part I: The 2008 update. *J Am Diet Assoc*. 2008;108(7):1113-1117.
6. Papoutsakis C, Moloney L, Sinley RC, Acosta A, Handu D, Steiber AL. Academy of Nutrition and Dietetics Methodology for Developing Evidence-Based Nutrition Practice Guidelines. *J Acad Nutr Diet*. 2017;117(5):794-804.
7. Eckel RH, Jakicic JM, Ard JD, et al. 2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014;129(25 suppl 2):S76-S99.
8. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA Statement. *PLoS Med*. 2009;3(3):e123-e130.
9. Handu D, Moloney L, Wolfram T, Ziegler P, Acosta A, Steiber A. Academy of Nutrition and Dietetics methodology for conducting systematic reviews for the Evidence Analysis Library. *J Acad Nutr Diet*. 2016;116(2):311-318.
10. Appel LJ, Champagne CM, Harsha DW, et al. Effects of comprehensive lifestyle modification on blood pressure control: Main results of the PREMIER clinical trial. *JAMA*. 2003;289(16):2083-2093.
11. Appel LJ, Espeland MA, Easter L, Wilson AC, Folmar S, Lacy CR. Effects of reduced sodium intake on hypertension control in older individuals: Results from the Trial of Nonpharmacologic Interventions in the Elderly (TONE). *Arch Intern Med*. 2001;161(5):685-693.
12. Applegate WB, Miller ST, Elam JT, et al. Nonpharmacologic intervention to reduce blood pressure in older patients with mild hypertension. *Arch Intern Med*. 1992;152(6):1162-1166.
13. Darne B, Nivarong M, Tugaye A, et al. Hypocaloric diet and antihypertensive drug treatment. A randomized controlled clinical trial. *Blood Press*. 1993;2(2):130-135.
14. Eriksson KM, Westborg CJ, Eliasson MC. A randomized trial of lifestyle intervention in primary healthcare for the modification of cardiovascular risk factors. *Scand J Public Health*. 2006;34(5):453-461.
15. Ferrara AL, Pacioni D, Di Fronzo V, et al. Lifestyle educational program strongly increases compliance to non-pharmacologic intervention in hypertensive patients: A 2-year follow-up study. *J Clin Hypertens*. 2012;14(11):767-772.
16. Goertz CH, Grimm RH, Svendsen K, Grandits G. Treatment of Hypertension with Alternative Therapies (THAT) Study: A randomized clinical trial. *J Hypertens*. 2002;20(10):2063-2068.
17. Huggins CE, Margerison C, Worsley A, Nowson CA. Influence of dietary modifications on the blood pressure response to antihypertensive medication. *Br J Nutr*. 2011;105(2):248-255.
18. Koopman H, Spreeuwenberg C, Westerman RF, Donker AJ. Dietary treatment of patients with mild to moderate hypertension in a general practice: A pilot intervention study (2). Beyond three months. *J Hum Hypertens*. 1990;4(4):372-374.
19. Koopman H, Spreeuwenberg C, Westerman RF, Donker AJ. Dietary treatment of patients with mild to moderate hypertension in a general practice: A pilot intervention study (1). The first three months. *J Hum Hypertens*. 1990;4(4):368-371.
20. Kumanyika SK, Cook NR, Cutler JA, et al. Sodium reduction for hypertension prevention in overweight adults: Further results from the Trials of Hypertension Prevention Phase II. *J Hum Hypertens*. 2005;19(1):33-45.
21. Noda K, Zhang B, Iwata A, et al. Lifestyle changes through the use of delivered meals and dietary counseling in a single-blind study. The STYLIST study. *Circ J*. 2012;76(6):1335-1344.
22. Rankins J, Sampson W, Brown B, Jenkins-Salley T. Dietary Approaches to Stop Hypertension (DASH) intervention reduces blood pressure among hypertensive African American patients in a neighborhood health care center. *J Nutr Educ Behav*. 2005;37(5):259-264.
23. Torres MR, Ferreira Tda S, Nogueira Lde P, do Nascimento DC, Sanjuliani AF. Dietary counseling on long-term weight loss in overweight hypertensive patients. *Clinics (Sao Paulo)*. 2011;66(10):1779-1785.
24. Weinberger MH, Cohen SJ, Miller JZ, Luft FC, Grim CE, Fineberg NS. Dietary sodium restriction as adjunctive treatment of hypertension. *JAMA*. 1988;259(17):2561-2565.
25. Welty FK, Nasca MM, Lew NS, Gregoire S, Ruan Y. Effect of onsite dietitian counseling on weight loss and lipid levels in an outpatient physician office. *Am J Cardiol*. 2007;100(1):73-75.
26. Whelton PK, Appel LJ, Espeland MA, et al. Sodium reduction and weight loss in the treatment of hypertension in older persons: A randomized controlled trial of nonpharmacologic interventions in the elderly (TONE). TONE Collaborative Research Group. *JAMA*. 1998;279(11):839-846.
27. Fiscella K, Winters P, Tancredi D, Franks P. Racial disparity in blood pressure: is vitamin D a factor? *J Gen Intern Med*. 2011;26(10):1105-1111.
28. Mateus-Hamdan L, Beauchet O, Bouvard B, Legrand E, Fantino B, Annweiler C. High parathyroid hormone, but not low vitamin D concentrations, expose elderly inpatients to hypertension. *Geriatr Gerontol Int*. 2013;13(3):783-791.
29. Vacek JL, Vanga SR, Good M, Lai SM, Lakkireddy D, Howard PA. Vitamin D deficiency and supplementation and relation to cardiovascular health. *Am J Cardiol*. 2012;109(3):359-363.
30. Larsen T, Mose FH, Bech JN, Hansen AB, Pedersen EB. Effect of cholecalciferol supplementation during winter months in patients with hypertension: A randomized, placebo-controlled trial. *Am J Hypertens*. 2012;25(11):1215-1222.
31. Wamberg L, Kampmann U, Stodkilde-Jorgensen H, Rejnmark L, Pedersen SB, Richelsen B. Effects of vitamin D supplementation on body fat accumulation, inflammation, and metabolic risk factors in obese adults with low vitamin D levels - results from a randomized trial. *Eur J Intern Med*. 2013;24(7):644-649.
32. Witham MD, Price RJ, Struthers AD, et al. Cholecalciferol treatment to reduce blood pressure in older patients with isolated systolic hypertension: The VitDISH randomized controlled trial. *JAMA Intern Med*. 2013;173(18):1672-1679.
33. Bernini G, Carrara D, Bacca A, et al. Effect of acute and chronic vitamin D administration on systemic renin angiotensin system in essential hypertensives and controls. *J Endocrinol Invest*. 2013;36(4):216-220.
34. Hedayati SS, Minhajuddin AT, Ijaz A, et al. Association of urinary sodium/potassium ratio with blood pressure: Sex and racial differences. *Clin J Am Soc Nephrol*. 2012;7(2):315-322.
35. Hu G, Tian H. A comparison of dietary and non-dietary factors of hypertension and normal blood pressure in a Chinese population. *J Hum Hypertens*. 2001;15(7):487-493.
36. Kwok TC, Chan TY, Woo J. Relationship of urinary sodium/potassium excretion and

calcium intake to blood pressure and prevalence of hypertension among older Chinese vegetarians. *Eur J Clin Nutr*. 2003;57(2):299-304.

37. Lancaster KJ, Smiciklas-Wright H, Weitzel LB, Mitchell DC, Friedmann JM, Jensen GL. Hypertension-related dietary patterns of rural older adults. *Prev Med*. 2004;38(6):812-818.
38. Schroder H, Schmelz E, Marrugat J. Relationship between diet and blood pressure in a representative Mediterranean population. *Eur J Nutr*. 2002;41(4):161-167.
39. Cheung BM, Ho SP, Cheung AH, Lau CP. Diastolic blood pressure is related to urinary sodium excretion in hypertensive Chinese patients. *QJM*. 2000;93(3):163-168.
40. Berry SE, Mulla UZ, Chowienczyk PJ, Sanders TA. Increased potassium intake from fruit and vegetables or supplements does not lower blood pressure or improve vascular function in UK men and women with early hypertension: A randomised controlled trial. *Br J Nutr*. 2010;104(12):1839-1847.
41. Espeland MA, Kumanyika S, Yunis C, et al. Electrolyte intake and nonpharmacologic blood pressure control. *Ann Epidemiol*. 2002;12(8):587-595.
42. He J, Gu D, Chen J, et al. Gender difference in blood pressure responses to dietary sodium intervention in the GenSalt study. *J Hypertens*. 2009;27(1):48-54.
43. Kelly TN, Gu D, Rao DC, et al. Maternal history of hypertension and blood pressure response to potassium intake: The GenSalt Study. *Am J Epidemiol*. 2012;176(suppl 7):S55-S63.
44. Franzoni F, Santoro G, Carpi A, et al. Antihypertensive effect of oral potassium aspartate supplementation in mild to moderate arterial hypertension. *Biomed Pharmacother*. 2005;59(1-2):25-29.
45. China Salt Substitute Study Collaborative Group. Salt substitution: A low-cost strategy for blood pressure control among rural Chinese. A randomized, controlled trial. *J Hypertens*. 2007;25(10):2011-2018.
46. He FJ, Marciniak M, Carney C, et al. Effects of potassium chloride and potassium bicarbonate on endothelial function, cardiovascular risk factors, and bone turnover in mild hypertensives. *Hypertension*. 2010;55(3):681-688.
47. He FJ, Markandu ND, Coltart R, Barron J, MacGregor GA. Effect of short-term supplementation of potassium chloride and potassium citrate on blood pressure in hypertensives. *Hypertension*. 2005;45(4):571-574.
48. Dickinson HO, Nicolson DJ, Campbell F, Beyer FR, Mason J. Potassium supplementation for the management of primary hypertension in adults. *Cochrane Database Syst Rev*. 2006;3:Cd004641.
49. Varenna M, Manara M, Galli L, Binelli L, Zucchi F, Sinigaglia L. The association between osteoporosis and hypertension: The role of a low dairy intake. *Calcif Tissue Int*. 2013;93(1):86-92.
50. Toledo E, Delgado-Rodriguez M, Estruch R, et al. Low-fat dairy products and blood pressure: Follow-up of 2290 older persons at high cardiovascular risk participating in the PREDIMED study. *Br J Nutr*. 2009;101(1):59-67.
51. Hilpert KF, West SG, Bagshaw DM, et al. Effects of dairy products on intracellular calcium and blood pressure in adults with essential hypertension. *J Am Coll Nutr*. 2009;28(2):142-149.
52. van Mierlo LA, Arends LR, Streppel MT, et al. Blood pressure response to calcium supplementation: A meta-analysis of randomized controlled trials. *J Hum Hypertens*. 2006;20(8):571-580.
53. Dickinson HO, Nicolson DJ, Cook JV, et al. Calcium supplementation for the management of primary hypertension in adults. *Cochrane Database Syst Rev*. 2006;2:Cd004639.
54. Pikilidou MI, Befani CD, Sarafidis PA, et al. Oral calcium supplementation ambulatory blood pressure and relation to changes in intracellular ions and sodium-hydrogen exchange. *Am J Hypertens*. 2009;22(12):1263-1269.
55. Kesteloot† H, Tzoulaki I, Brown IJ, et al. Relation of urinary calcium and magnesium excretion to blood pressure. *Am J Epidemiol*. 2011;174(1):44-51.
56. Hatzistavri LS, Sarafidis PA, Georgianos PI, et al. Oral magnesium supplementation reduces ambulatory blood pressure in patients with mild hypertension. *Am J Hypertens*. 2009;22(10):1070-1075.
57. Bayir A, Kara H, Ak A, Cander B, Kara F. Magnesium sulfate in emergency department patients with hypertension. *Biol Trace Elem Res*. 2009;128(1):38-44.
58. Dickinson HO, Nicolson DJ, Campbell F, et al. Magnesium supplementation for the management of essential hypertension in adults. *Cochrane Database Syst Rev*. 2006;3:Cd004640.
59. Kojuri J, Rahimi R. Effect of "no added salt diet" on blood pressure control and 24 hour urinary sodium excretion in mild to moderate hypertension. *BMC Cardiovasc Disord*. 2007;7:34.
60. Jablonski KL, Fedorova OV, Racine ML, et al. Dietary sodium restriction and association with urinary marinobufagenin, blood pressure, and aortic stiffness. *Clin J Am Soc Nephrol*. 2013;8(11):1952-1959.
61. Graudal N, Hubeck-Graudal T, Jurgens G, McCarron DA. The significance of duration and amount of sodium reduction intervention in normotensive and hypertensive individuals: A meta-analysis. *Adv Nutr*. 2015;6(2):169-177.
62. Graudal NA, Hubeck-Graudal T, Jurgens G. Effects of low sodium diet versus high sodium diet on blood pressure, renin, aldosterone, catecholamines, cholesterol, and triglyceride. *Cochrane Database Syst Rev*. 2011;4:Cd004022.
63. He FJ, Li J, Macgregor GA. Effect of longer-term modest salt reduction on blood pressure. *Cochrane Database Syst Rev*. 2013;4. Cd004937.
64. Khaw KT, Bingham S, Welch A, et al. Blood pressure and urinary sodium in men and women: The Norfolk Cohort of the European Prospective Investigation into Cancer (EPIC-Norfolk). *Am J Clin Nutr*. 2004;80(5):1397-1403.
65. Mente A, O'Donnell MJ, Rangarajan S, et al. Association of urinary sodium and potassium excretion with blood pressure. *N Engl J Med*. 2014;371(7):601-611.
66. Al-Solaiman Y, Jesri A, Mountford WK, Lackland DT, Zhao Y, Egan BM. DASH lowers blood pressure in obese hypertensives beyond potassium, magnesium and fibre. *J Hum Hypertens*. 2010;24(4):237-246.
67. Azadbakht L, Mirmiran P, Esmaillzadeh A, Azizi T, Azizi F. Beneficial effects of a Dietary Approaches to Stop Hypertension eating plan on features of the metabolic syndrome. *Diabetes Care*. 2005;28(12):2823-2831.
68. Blumenthal JA, Babyak MA, Sherwood A, et al. Effects of the Dietary Approaches to Stop Hypertension diet alone and in combination with exercise and caloric restriction on insulin sensitivity and lipids. *Hypertension*. 2010;55(5):1199-1205.
69. Elmer PJ, Obarzanek E, Vollmer WM, et al. Effects of comprehensive lifestyle modification on diet, weight, physical fitness, and blood pressure control: 18-month results of a randomized trial. *Ann Intern Med*. 2006;144(7):485-495.
70. Kirpizidis H, Stavrati A, Geleris P. Assessment of quality of life in a randomized clinical trial of candesartan only or in combination with DASH diet for hypertensive patients. *J Cardiol*. 2005;46(5):177-182.
71. Nowson CA, Wattanapenpaiboon N, Pachett A. Low-sodium Dietary Approaches to Stop Hypertension-type diet including lean red meat lowers blood pressure in postmenopausal women. *Nutr Res*. 2009;29(1):8-18.
72. Nowson CA, Worsley A, Margerison C, Jorna MK, Godfrey SJ, Booth A. Blood pressure change with weight loss is affected by diet type in men. *Am J Clin Nutr*. 2005;81(5):983-989.
73. Epstein DE, Sherwood A, Smith PJ, et al. Determinants and consequences of adherence to the dietary approaches to stop hypertension diet in African-American and white adults with high blood pressure: Results from the ENCORE trial. *J Acad Nutr Diet*. 2012;112(11):1763-1773.
74. Hering D, Kucharska W, Kara T, Somers VK, Narkiewicz K. Potentiated sympathetic and hemodynamic responses to alcohol in hypertensive vs. normotensive individuals. *J Hypertens*. 2011;29(3):537-541.
75. Kawano Y, Abe H, Kojima S, Takishita S, Matsuoka H. Effects of repeated alcohol intake on blood pressure and sodium balance in Japanese males with hypertension. *Hypertens Res*. 2004;27(3):167-172.
76. Baros AM, Wright TM, Latham PK, Miller PM, Anton RF. Alcohol consumption, %CDT, GGT and blood pressure change during alcohol treatment. *Alcohol Alcohol*. 2008;43(2):192-197.
77. Soardo G, Donnini D, Varutti R, et al. Effects of alcohol withdrawal on blood pressure in hypertensive heavy drinkers. *J Hypertens*. 2006;24(8):1493-1498.

78. Stewart SH, Latham PK, Miller PM, Randall P, Anton RF. Blood pressure reduction during treatment for alcohol dependence: Results from the Combining Medications and Behavioral Interventions for Alcoholism (COMBINE) study. *Addiction*. 2008;103(10):1622-1628.

79. Murray CJ, Atkinson C, Bhalla K, et al. The state of US health, 1990-2010: Burden of diseases, injuries, and risk factors. *JAMA*. 2013;310(6):591-608.

80. Danaei G, Ding EL, Mozaffarian D, et al. The preventable causes of death in the United States: Comparative risk assessment of dietary, lifestyle, and metabolic risk factors. *PLOS Med*. 2009;6(4):e1000058. Erratum in: 2011;8:10.1371/annotation/1370ef1347acd-1379dcc-4296-a1897-1872d1182cde1357.

81. Mozaffarian D, Fahimi S, Singh GM, et al. Global sodium consumption and death from cardiovascular causes. *N Engl J Med*. 2014;371(7):624-634.

82. Mahajan R. Joint National Committee 8 report: How it differ from JNC 7. *Int J Appl Basic Med Res*. 2014;4(2):61-62.

83. Toledo E, Hu FB, Estruch R, et al. Effect of the Mediterranean diet on blood pressure in the PREDIMED trial: Results from a randomized controlled trial. *BMC Med*. 2013;11:207.

84. World Health Organization. International Classification of Diseases (ICD). 2016. http://www.who.int/classifications/icd/en/. Accessed December 19, 2016.

AUTHOR INFORMATION

S. L. Lennon is a workgroup member of the 2015 Hypertension EAL project, and an associate professor, Department of Kinesiology and Applied Physiology, University of Delaware, Newark. D. M. DellaValle is chair of the 2015 Hypertension EAL project Workgroup, and associate professor and research dietitian, Department of Nutrition and Dietetics, Marywood University, Scranton, PA. S. G. Rodder is a workgroup member of the 2015 Hypertension EAL project, an assistant professor, Department of Clinical Nutrition, and a medical nutrition therapy provider, Program in Preventive Cardiology, University of Texas Southwestern Medical Center, Dallas. M. Prest is a workgroup member of the 2015 Hypertension EAL project, and lead dietitian, Lakeview Dialysis, Fresenius Kidney Care, Chicago, IL. R. C. Sinley is an assistant professor, Nutrition Department, College of Professional Studies, Metropolitan State University of Denver, Denver, CO; at the time of the study, she was a nutrition researcher, level I, Academy of Nutrition and Dietetics, Chicago, IL. M. K. Hoy is lead analyst of the 2015 Hypertension EAL project Workgroup, and a nutritionist, Food Surveys Research Group, Agricultural Research Service, US Department of Agriculture, Beltsville, MD. C. Papoutsakis is director, Nutrition Care Process, Academy of Nutrition and Dietetics, Chicago, IL; at the time of the study, she was a nutrition researcher, level II, Academy of Nutrition and Dietetics, Chicago, IL.

Address correspondence to: Constantina Papoutsakis, PhD, RD, Academy of Nutrition and Dietetics, 120 S Riverside Plaza, Suite 2190, Chicago, IL 60606. E-mail: cpapoutsakis@eatright.org

STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

FUNDING/SUPPORT

The Academy is the primary source of funding for evidence-based nutrition practice guidelines. Guidelines do not receive industry funding. The expert workgroup had complete autonomy of the systematic review and guideline during all stages of development.

ACKNOWLEDGEMENTS

The authors thank those who assisted in completing the Academy Evidence Analysis Library (EAL) 2015
Hypertension Project. The EAL Hypertension Project systematic review was conducted to develop the 2015 EAL Evidence-Based Nutrition Practice Guideline for the Management of Hypertension in Adults. The authors also thank the Academy of Nutrition and Dietetics for providing financial support for the project.
S. L. Lennon, D. M. DellaValle, S. G. Rodder, M. Prest, and M. K. Hoy collected the data. S. L. Lennon wrote the first draft with contributions from D. M. DellaValle, S. G. Rodder, M. Prest, R. C. Sinley, M. K. Hoy, and C. Papoutsakis. All authors reviewed and commented on subsequent drafts of the manuscript.

Search strategy for:
In persons with hypertension, how effective is **medical nutrition therapy** provided by a registered dietitian nutritionist compared to no or other interventions on blood pressure?
Studies were initially identified in PubMed and published in English between July 2004 and July 2013.
The following syntax was used to identify relevant studies:

1. Hypertension or blood pressure
2. Medical nutrition therapy or nutrition counseling and individualized care
3. Frequency and duration
4. Dietitian or nutritionist
5. #2 and #3 or #4
6. #1 and #5

Filters: adult, human, comparative study, controlled clinical trial, randomized controlled trial, systematic review, meta-analysis

Search strategy for:
What is the relationship of **vitamin D status or intake (from supplements or food sources)** and hypertension in adults with hypertension?
Studies were initially identified in PubMed and published in English between January 2004 and June 2014.
The following syntax was used to identify relevant studies:

1. Hypertension or blood pressure
2. Vitamin D or dietary vitamin D or intake
3. Serum or plasma vitamin D or status
4. Vitamin D supplementation
5. #2 or #3 or #4
6. #1 or #5

Filters: adult, human, comparative study, controlled clinical trial, randomized controlled trial, systematic review, meta-analysis

Search strategy for:
What is the relationship between **potassium intake from food sources** and blood pressure in adults with hypertension? What is the relationship between potassium intake from supplements and blood pressure in adults with hypertension?
Studies were initially identified in PubMed and published in English between January 2004 and April 2014.

1. Hypertension or blood pressure
2. Potassium intake or dietary potassium
3. Potassium supplementation
4. #2 or #3
5. #1 or #4

Filters: adult, human, comparative study, controlled clinical trial, randomized controlled trial, systematic review, meta-analysis

Search strategy for:
What is the relationship between **magnesium intake from food sources** and blood pressure in adults with hypertension? What is the relationship between magnesium intake from supplements and blood pressure in adults with hypertension?
Studies were initially in PubMed and published in English between January 2004 and June 2014.

1. Hypertension or blood pressure
2. Magnesium intake or dietary magnesium
3. Magnesium supplementation
4. #2 or #3
5. #1 and #4

Filters: adult, human, comparative study, controlled clinical trial, randomized controlled trial, systematic review, meta-analysis

(continued on next page)

Figure 1. Search Strategies for the Academy of Nutrition and Dietetics Evidence Analysis Library evidence-based systematic review for the management of hypertension in adults.

Search strategy for:
What is the relationship between **calcium intake from food sources** and blood pressure in adults with hypertension? What is the relationship between calcium intake from supplements and blood pressure in adults with hypertension?
Studies were initially identified in PubMed and published in English between January 2004 and June 2014.

1. Hypertension or blood pressure
2. Calcium intake or dietary calcium
3. Calcium supplementation
4. #2 or #3
5. #1 and #4

Filters: adult, human, comparative study, controlled clinical trial, randomized controlled trial, systematic review, meta-analysis

Search strategy for: What is the effect of reduced **sodium intake** on blood pressure in adults with hypertension?
Studies were initially identified in PubMed and published in English between January 2007 and March 2015.

1. Hypertension or blood pressure
2. Sodium intake or dietary or reduced sodium intake
3. #1 and #2

Search strategy for:
How does **alcohol intake** affect blood pressure in heavy drinkers with hypertension? How does alcohol intake affect blood pressure in moderate drinkers with hypertension?
Studies were initially identified in PubMed and published in English between January 2004 and February 2014.

1. Hypertension or prehypertension or blood pressure
2. Alcohol intake
3. Hypertension risk
4. #2 or #3
5. #1 and #5

Filters: adult, human, comparative study, controlled clinical trial, randomized controlled trial, systematic review, meta-analysis

Search strategy for:
What is the effect of the **DASH diet pattern** on blood pressure in adults with hypertension?
Studies were initially identified in PubMed and published in English between January 2004 and July 2014.

1. Hypertension or blood pressure
2. DASH or DASH diet
3. #1 and #2

Filters: adult, human, comparative study, controlled clinical trial, randomized controlled trial, systematic review, meta-analysis

Search strategy for:
What is the effect of the **Mediterranean diet pattern** on blood pressure in adults with hypertension?
Studies were initially identified in PubMed and published in English between January 2004 and June 2014.

1. Hypertension or blood pressure
2. Mediterranean diet
3. #1 and #2

Filters: adult, human, comparative study, controlled clinical trial, randomized controlled trial, systematic review, meta-analysis

Figure 1. *(continued)* Search Strategies for the Academy of Nutrition and Dietetics Evidence Analysis Library evidence-based systematic review for the management of hypertension in adults.

Question	Conclusion statement	Grade	Nutrition Care Process step
Question 1: MNT[a]			
In persons with HTN, how effective is MNT provided by an RDN[b] compared with no or other interventions on BP[c]?	MNT provided by an RDN is recommended to reduce BP in adults with HTN. A strong body of research[10-18,20-25] indicates that MNT provided by an RDN using individual or group sessions reduces BP in persons with HTN or pre-HTN	Grade I	Intervention
Question 2 Vitamin D			
What is the relationship of vitamin D status or intake (from supplements or food sources) and HTN in adults with HTN	Data from observational[27-29] and intervention[30-33] studies are inconclusive regarding the association between vitamin D status or intake and BP in individuals with HTN	Grade III	Intervention
Question 3 Potassium			
Question 3.1 Dietary potassium			
What is the relationship between potassium intake from food sources and blood pressure in adults with HTN?	Results from 6[34-36,39,41] of 8[34-41] studies showed a significant inverse relationship between potassium intake from food sources and BP in adults with HTN. Potassium excretion as a marker of dietary intake was inversely associated with BP in 4[34-36,39] of 5[34-36,38,39] studies. In 1[41] of 2[40,41] dietary intervention studies, increasing potassium intake up to 2,000 mg above baseline increased the likelihood of DBP[d] control	Grade II	Intervention
Question 3.2 Potassium supplementation			
What is the relationship between potassium intake from supplements and blood pressure in adults with HTN?	In 4[42,44,45,47] of 7[40,42-48] studies of adults with HTN, potassium supplementation of up to approximately 3,700 mg reduced SBP[e] and DBP by 3-13 mm Hg and 0-8 mm Hg, respectively	Grade II	Intervention

(continued on next page)

Figure 3. Conclusion statements for the Academy of Nutrition and Dietetics Evidence Analysis Library (EAL) evidence-based systematic review for the management of hypertension (HTN) in adults.

Question	Conclusion statement	Grade	Nutrition Care Process step
Question 4 Calcium			
Question 4.1 Dietary calcium			
What is the relationship between calcium intake from food sources and blood pressure in adults with HTN?	In 4[38,49,50,52] of 6[37,38,49-52] studies of adults with HTN, total dietary calcium intake of 800 mg or more per day (primarily from dairy products) reduced SBP up to 4.0 mm Hg and DBP up to 2.0 mm Hg	Grade II	Intervention
Question 4.2 Calcium supplementation			
What is the relationship between calcium intake from supplements and blood pressure in adults with HTN?	In 2 meta-analyses[52,53] of adults with HTN, calcium supplementation of 1,000-1,500 mg/d reduced SBP up to 3.0 mm Hg and DBP up to 2.5 mm Hg. One randomized controlled trial[54] did not find significant effects on BP with calcium supplementation	Grade I	Intervention
Question 5 Magnesium			
Question 5.1 Dietary magnesium			
What is the relationship between magnesium intake from food sources and BP in adults with HTN?	Results from 3 studies[37,38,55] suggest that the relationship between magnesium intake from food sources and BP in adults with HTN is unclear	Grade III	Intervention
Question 5.2 Magnesium supplementation			
What is the relationship between magnesium intake from supplements and BP in adults with HTN?	In 3 studies,[56-58] including 1 meta-analysis[58] of adults with HTN, magnesium supplementation of 240-1,000 mg/d reduced SBP by 1.0-5.6 mm Hg and DBP by 1.0-2.8 mm Hg	Grade II	Intervention

(continued on next page)

Figure 3. *(continued)* Conclusion statements for the Academy of Nutrition and Dietetics Evidence Analysis Library (EAL) evidence-based systematic review for the management of hypertension (HTN) in adults.

Question	Conclusion statement	Grade	Nutrition Care Process step
Question 6 **Sodium**			
What is the effect of reduced sodium intake on BP in adults with HTN?	Results from 13 studies,[35-39,42,59-65] including 3 meta-analyses,[61-63] demonstrate a relationship between sodium intake and BP in adults with HTN. In 4 studies,[35,36,64,65] BP increased with higher levels of sodium intake. In 5 studies,[42,59,60,62,63] including 2 meta-analyses,[62,63] a decrease in dietary sodium intake to 1,500-2,000 mg/d reduced SBP and DBP up to 12 mm Hg and 6 mm Hg, respectively	Grade I	Intervention
Question 7 **Diet patterns**			
Question 7.1 **DASH[f] diet**			
What is the effect of the DASH diet pattern on BP in adults with HTN?	The DASH diet with a sodium range of 1,500-2,400 mg, reduced SBP by 2.0-11 mm Hg and DBP by 0.0-9.0 mm Hg in overweight or obese adults with HTN regardless of anti-HTN medications.[17,67-71,73] DASH plus weight loss resulted in reductions in SBP of 11-16 mm Hg and DBP of 6.0-10 mm Hg.[67-69,72] There were no studies that met the search inclusion criteria for normal weight adults with HTN	Grade I	Intervention
Question 7.2 **Mediterranean diet**			
What is the effect of the Mediterranean diet pattern on BP in adults with HTN?	Limited evidence from 1 randomized controlled trial[83] reports that adults with HTN who followed a Mediterranean diet, supplemented with either extra virgin olive oil (up to 1 L/wk) or nuts (30 g/d) had reductions in DBP up 1.5 mm Hg greater than those following a low-fat diet	Grade III	Intervention

(continued on next page)

Figure 3. *(continued)* Conclusion statements for the Academy of Nutrition and Dietetics Evidence Analysis Library (EAL) evidence-based systematic review for the management of hypertension (HTN) in adults.

Question	Conclusion statement	Grade	Nutrition Care Process step
Question 8 **Alcohol**			
Question 8.1 **Alcohol intake in heavy drinkers** How does alcohol intake affect BP in heavy drinkers with HTN?	There were no studies directly examining the effect of alcohol intake on BP in heavy drinkers with HTN. However, 3 studies in chronic heavy drinkers with HTN found that abstinence from alcohol resulted in a decrease in SBP of 10-28 mm Hg and a decrease in DBP of 7-18 mm Hg[76-78]	Grade I	Intervention
Question 8.2 **Alcohol intake in moderate drinkers**			
How does alcohol intake influence BP in moderate drinkers with HTN?	In moderate drinkers with HTN, the influence of alcohol on BP is unclear. Two studies[74,75] measuring the effect of a relatively high dose of alcohol (1 g or 1 mL/kg body weight) on BP yielded contradictory results. Confounders such as ethnic origin, use of sodium restriction, and differences in measurement times do not allow for direct comparison of the 2 studies. More research is needed to discern the shorter- and longer-term effect of alcohol intake alone, in moderate drinkers with HTN	Grade III	Intervention

[a]MNT=medical nutrition therapy.

[b]RDN=registered dietitian nutritionist.

[c]BP=blood pressure.

[d]DBP=diastolic blood pressure.

[e]SBP=systolic blood pressure.

[f]DASH=Dietary Approaches to Stop Hypertension.

Figure 3. *(continued)* Conclusion statements for the Academy of Nutrition and Dietetics Evidence Analysis Library (EAL) evidence-based systematic review for the management of hypertension (HTN) in adults.

Evidence summary	NCP[a] Step
Question 1 **MNT[b]:** In persons with HTN[c], how effective is MNT provided by an RDN[d] compared with no or other interventions on BP[e]?	Intervention
Evidence summary for question 1 (MNT) The effectiveness of MNT for HTN was evaluated using 15 studies in 17 publications (9 positive; 6 neutral quality). These included 11 randomized controlled/crossover trials (Appel and colleagues[10] [positive quality], Appel and colleagues[11] [positive quality], Applegate and colleagues[12] [neutral quality], Darne and colleagues[13] [neutral quality], Eriksson and colleagues[14] [neutral quality], Ferrara and colleagues[15] [positive quality], Goertz and colleagues[16] [positive quality], Huggins and colleagues[17] [neutral quality], Koopman and colleagues[18] [neutral quality], Koopman and colleagues[19] [neutral quality], Kumanyika and colleagues[20] [positive quality], and Noda and colleagues[21] [positive quality], Whelton and colleagues[26] [positive quality]), 1 prospective cohort study (Torres and colleagues[23] [positive quality]), 2 nonrandomized trials (Rankins and colleagues[22] [positive quality] and Weinberger and colleagues[24] [positive quality]) and 1 time study (Welty and colleagues[25] [neutral quality]). Patients received individual or group counseling on DASH[f] diets,[10,17,22,23,25] low-sodium diets,[11,12,16-21,23,24,26] weight control,[12,13,21,23,25,26] national dietary recommendations,[14] and the Mediterranean diet.[15] Six studies reported on the short-term effectiveness of MNT (shorter than 6 mo), with 3 studies reporting changes in BP after 1 mo of MNT. Goertz and colleagues[16] reported an average decrease in SBP[g] of −4.9 mm Hg and in DBP[h] of −5.6 mm Hg for the RDN group after 4 wk. Huggins and colleagues[17] reported that after 4 wk, the low-sodium, high-potassium diet reduced SBP by −6.2 mm Hg for those on anti-HTN therapy, compared with −2.8 mm Hg for those not on anti-HTN therapy (this was greatest for those on renin-angiotensin system blocker therapy (−9.5 mm Hg); on the DASH-type diet, SBP was reduced by −1.1 mm Hg overall and by −4.2 mm Hg for those on renin therapy). In addition, Weinberger and colleagues[24] reported that SBP was reduced by 10 mm Hg and DBP was reduced by 6 mm Hg at Week 4, after receiving 3 visits of individualized dietary counseling with an RDN. After 8 wk of MNT, Noda and colleagues[21] reported that only participants in Group D, in which participants received 4 counseling sessions, showed significant reductions from baseline in SBP (−6 mm Hg) and DBP (−4 mm Hg). Rankins and colleagues[22] reported that changes in BP were significant only for those in Group 1 who missed 2 or fewer sessions (SBP: −8.4 mm Hg and DBP: −4.3 mm Hg). After 3 mo in the dietary advice group, Koopman and colleagues[18] reported that there was NS[i] difference in SBP (−3.2 mm Hg); however, there was a significant decrease in DBP (−3.1 mm Hg). Five studies (6 publications) reported on the effectiveness of MNT between 6 mo and 1 y. In the PREMIER (PREMIER: Lifestyle Interventions for Blood Pressure Control) trial, Appel and colleagues[10] reported mean net reductions in SBP of 3.7 mm Hg in the Established group and 4.3 mm Hg in the Established Plus DASH group and in DBP of 1.7 mm Hg in the Established group and 2.6 mm Hg in the Established Plus DASH group; these participants received 18 face-to-face intervention contacts (14 group meetings and 4 individual counseling sessions) during the initial 6 mo. Regarding TONE (Trial of Nonpharmacologic Intervention in the Elderly), Appel and colleagues[11] reported differences between the low-sodium group and usual care group of −4.3 mm Hg for SBP and −2.0 mm Hg for DBP, whereas Whelton and colleagues[26] reported that changes in SBP (−3.4±0.8 mm Hg in sodium reduction, −4.0±1.3 mm Hg in weight loss, −5.3±1.2 mm Hg in combined intervention vs −0.8±0.8 mm Hg in usual care) and DBP (−1.9±0.5 mm Hg in sodium reduction, −1.1±0.8 mm Hg in weight loss, −3.4±0.8 mm Hg in combined intervention vs −0.8±0.5 mm Hg in usual care) were significantly different in all intervention groups than in the usual care group. Applegate and colleagues[12] reported that the intervention group experienced a greater reduction in SBP and DBP than did the control group (mean differences between groups at 6 mo were 4.2 mm Hg and 4.9 mm Hg, respectively). Darne and colleagues[13] reported reductions in BP after hypocaloric diet (SBP: −18±7 mm Hg and DBP: +6±8 mm Hg). At 1 y, Eriksson and colleagues[14] reported significant changes in BP in the intervention group (SBP: −4.7±10.5 mm Hg and DBP: −3.8±5.0 mm Hg).	

(continued on next page)

Figure 5. Evidence summaries of the Evidence Analysis Library evidence-based systematic review for the management of hypertension in adults.

Evidence summary	NCP[a] Step
Four studies (5 publications) reported on the effectiveness of MNT beyond 1 y. Koopman and colleagues[18] reported that 18 mo after dietary intervention, participants still had significant decreases in SBP (−3.7 mm Hg) and DBP (−4.0 mm Hg). Ferrara and colleagues[15] reported that after 2 y, patients in the lifestyle education program still had lower SBP and DBP than those in usual care. Welty and colleagues[25] reported that over a mean follow-up period of 2.6 y, SBP was lowered by 3 mm Hg and DBP by 4 mm Hg. Kumanyika and colleagues[20] reported that changes in BP were still significant for the sodium reduction group at 18 mo (SBP: −3.8±8.1 mm Hg and DBP: −4.4±6.5 mm Hg) and 36 mo (SBP: −0.7±9.0 mm Hg), with goal achievement at 18 mo and 36 mo being associated with attendance (<9 vs ≥9 total in-person contacts; $P<0.05$). After 4 y, Torres and colleagues[23] reported that subjects in the dietary counseling group had decreases in SBP (−2.36±2.85 mm Hg) and DBP (−2.81±1.67 mm Hg).	
Question 2 **Vitamin D:** What is the relationship of vitamin D status or intake (from supplements or food sources) and HTN in adults with HTN?	Intervention
Evidence summary for question 2 (vitamin D) Eight studies evaluated the relationship between vitamin D intake and status and HTN in adults with HTN. Three observational studies evaluated vitamin D status and HTN, including 2 cross-sectional studies (Fiscella[27] [positive quality] and Mateus-Hamdan[28] [positive quality]) and 1 retrospective cohort study (Vacek[29] [neutral quality]). Three RCTs[j] (Larsen and colleagues[30] [neutral quality], Wamberg and colleagues[31] [neutral quality], and Witham and colleagues[32] [neutral quality]), and 1 nonrandomized and 1 noncontrolled trial (Bernini and colleagues[33] [neutral quality]) investigated the effect of vitamin D supplementation on blood levels and concomitant change in BP in individuals with HTN. Two of 3 observational studies observed a relationship between vitamin D deficiency and HTN. Results from analysis of more than 7,000 individuals in the National Health and Nutrition Examination Survey 2001-2006[27] (n=1,984 non-Hispanic blacks and n=5,156 non-Hispanic whites) showed that participants in the lowest quintile of serum vitamin D (2-15 ng/mL[k]) had mean SBP levels 2.64 mm Hg (2.58-2.70 mm Hg) higher than those in the highest quintile (31-80 ng/mL[k]). In individuals with HTN (24% of the sample), those in the lowest quintile had a statistically significant 6 mm Hg higher SBP than those in the highest quintile (significance level not reported). In the retrospective cohort analysis of 10,889 individuals seen over a 5.5-y period,[29] there was a significantly higher percentage of individuals with HTN (36% vs 29%; $P<0.0001$) who were vitamin D deficient at baseline (<30 ng/mL[k]). Vitamin D deficiency was associated with HTN (OR[l] 1.4, 95% CI 1.285-1.536). Bernini and colleagues[33] also observed significant differences in plasma vitamin D levels at baseline between individuals with and without HTN (12.6±1.6 ng/mL[k] vs 20.1±2.5 ng/mL[k], respectively; $P<0.02$). In contrast, a small (N=284) cross-sectional analysis of elderly inpatients[28] did not observe a difference in serum vitamin D levels between individuals without HTN (33.54±19.94 nmol/L[k]) and those with HTN (35.65±22.8 nmol/L[k]). After adjustment for covariables, there was no association between serum vitamin D and SBP or DBP. Serum vitamin D was not associated with HTN in univariate and multivariate analyses. Five intervention trials investigated the effect of vitamin D supplementation on serum or plasma levels, and the associated change in BP. Trials ranged in duration from 7 d[33]) to 1 y[32] with moderate durations of 8 wk[33] and 20-26 wk.[30,31] Studies included 18[33]-142[32] subjects who ranged in age from 18-85 y. Studies included 60%-70% women, with the exception of Bernini and colleagues.[33] Baseline vitamin D levels ranged from ∼14[31]-23 ng/mL[k].[30] Four of 5 intervention trials observed significant increases in serum or plasma vitamin D (25[OH]D) levels that ranged from 12-21 ng/mL[k].[30-33] Amounts of vitamin D were 75-175 μg[30] (3,000-7,000 IU) and taken in divided doses throughout the day, or 2,500-7,500 μg (100,000-300,000 IU) given in 1 administration,[32,33] 1 of which was every 3 mo for 1 y.[32] Taking trial duration into consideration, these amounts would correspond to daily intakes of 18 g/d[32] to 134 μg/d.[33] In 1 noncontrolled trial, 0.5 μg calcitriol (1,25[OH]D2) was taken for 7 d, and there was no change in plasma levels.[33]	

(continued on next page)

Figure 5. *(continued)* Evidence summaries of the Evidence Analysis Library evidence-based systematic review for the management of hypertension in adults.

Evidence summary	NCP[a] Step
Treatment dose did not appear to influence change in vitamin D levels. Treatment with 75 μg for 20 wk resulted in a change in serum vitamin D of 21 ng/mL[k] from a baseline of 23±12 ng/mL[k]. A dose of 175 μg provided to obese individuals aged 18-50 y resulted in a change in serum levels of 33 nmol/L[k] to 110 nmol/L[k] from a baseline of 34.5±10 nmol/L[k]. Administration of 100,000 IU vitamin D once every 3 mo for 1 y resulted in a change of 18 ng/mL[k] to 28 ng/mL[k] from a baseline level of 18 ng/mL[k] in individuals older than age 80 y, whereas a 1-time administration of 300,000 IU resulted in a 12-ng/mL[k] increase from a baseline level of 14.9 ng/mL[k]. In 4 of 5 intervention trials, there were NS changes in SBP of 1-6 mm Hg[30-33] and in DBP of 1 mm Hg[30] and 8 mm Hg.[33] In 1 trial,[30] there were significant changes in SBP and DBP of 4 mm Hg (P=0.05) and 3 mm Hg (P=0.01), respectively, in individuals with baseline vitamin D levels <32 ng/mL[k].	
Question 3 **Potassium**	
Question 3.1 **Dietary potassium:** What is the relationship between potassium intake from food sources and BP in adults with HTN?	Intervention
Evidence summary for question 3.1 (dietary potassium) The relationship between potassium intake from dietary sources and BP in adults with HTN was investigated in 8 studies, including 5 cross-sectional analyses (Hedayati and colleagues[34] [neutral quality], Hu and Tian[35] [neutral quality], Kwok and colleagues[36] [positive quality], Lancaster and colleagues[37] [neutral quality], and Schroder and colleagues[38] [positive quality]), 1 case-control study (Cheung and colleagues[39] [positive quality]),1 randomized crossover trial (Berry and colleagues[40] [positive quality]), and 1 secondary analysis of an RCT (Espeland and colleagues[41]). Five trials assessed 24-h urinary potassium excretion and in 2 of these,[39,40] it was used as a marker of compliance. Five trials[34-36,38,39] evaluated BP in relation to the urinary sodium:potassium. **Associations between potassium intake, BP, and HTN** The associations of dietary intake of potassium with HTN or with BP control were investigated in 4 cross-sectional studies.[35,37-39] Three studies with dietary intake data[35,37,38] showed NS differences in dietary intake of potassium between individuals without and with HTN. Dietary intakes ranged from approximately 1,900-3,700 mg potassium. In 2 studies, logistic regression analyses did not show a relationship between dietary potassium intake and HTN.[35,38] There was no difference in potassium intake among individuals taking medication for HTN whose BP was controlled vs not controlled.[38] Two studies used urinary potassium excretion as a marker of intake. In 1 study,[39] it was significantly correlated with DBP (R=−0.24; P=0.05). There were significant differences in potassium excretion between those with HTN (40±16 mmol/d) and controls without HTN (551±16 mmol/d), indicating that individuals without HTN consumed more potassium. **Dietary potassium intake and BP in HTN** With dietary intervention, 1 of 2 studies observed beneficial effects of increasing dietary potassium intake on BP. In a secondary analysis of individuals who were randomized to a sodium or energy restriction intervention,[41] a 50-mmol (1,950-mg) increase in potassium intake was associated with increased odds for DBP control, depending on baseline level: baseline DBP <75 mm Hg (NS), baseline DBP 75-79 mm Hg (OR 2.97, 95% CI 1.04-8.51), or baseline DBP 80-84 mm Hg (OR 9.41, 95% CI 1.9-46.69). However, in 1 randomized crossover trial,[40] an increase in potassium intake of 780 mg and 1,560 mg from fruit and vegetables did not result in significant changes in BP. **Urinary sodium:potassium and BP** The relationship between urinary sodium:potassium excretion and BP was evaluated in 5 studies that showed positive relationships in 4 cross-sectional studies[34,36,38,39] and 1 case-control study.[35]	

(continued on next page)

Figure 5. *(continued)* Evidence summaries of the Evidence Analysis Library evidence-based systematic review for the management of hypertension in adults.

Evidence summary	NCP[a] Step
In 1 cross-sectional study,[38] sodium:potassium was directly associated with DBP (P=0.006) in individuals without HTN and individuals with HTN not taking medication. In individuals with HTN taking medication, it was associated with both SBP (P<0.02) and DBP (P<0.05). However, there were also significant associations of sodium, but not potassium, with BP.[38] In another cross-sectional analysis, urinary sodium:potassium correlated with DBP in patients with HTN (R=0.45; P=0.002).[39] Significant differences in urinary sodium:potassium were observed in older individuals with HTN compared with individuals without HTN (4.7±2.8 vs 3.4±2.3; P=0.02), and the ratio was significantly correlated (R=0.30) with SBP, but not DBP.[36] One analysis found that SBP and DBP increased by 1.16 mm Hg and 8.4 mm Hg, respectively, for each 3-unit increase in the urinary sodium:potassium.[34] In a case-control study,[35] men with HTN had borderline significantly higher urinary sodium:potassium than men without HTN (3.13 vs 2.99; P<0.06) and women with HTN had significantly higher ratios compared with women without HTN (3.34 vs 3.08; P<0.01).The OR for dietary sodium:potassium and HTN was 1.12 (P=0.061) in men and 1.18 (P<0.01) in women.	
Question 3.2 **Potassium supplementation:** What is the relationship between potassium intake from supplements and BP in adults with HTN?	Intervention
Evidence summary for question 3.2 (potassium supplementation) The relationship between potassium intake from supplements and BP in adults with HTN was investigated in 7 studies, including 1meta-analysis (Dickinson and colleagues[48] [positive quality]),[48] 1 RCT (China Salt Substitute Study Collaborative group[45] [positive quality]), 1 nonrandomized trial (Franzoni and colleagues[44] [positive quality]), 1 noncontrolled trial (He and colleagues[42] [positive quality] and Kelly and colleagues[43] [positive quality]), and 3 randomized crossover trials (Berry and colleagues[40] [positive quality], He and colleagues[46] [positive quality], and He and colleagues[47] [positive quality]). Potassium intake was increased by supplementation of 20-40 mmol (780-1,560 mg),[40,44] 60 mmol (2,340 mg),[35,43,46] and 96 mmol (3,744 mg)[47] per day for 1-6 wk or by diet alone.[40] One meta-analysis included randomized potassium supplementation trials of individuals with HTN of at least 8-wk duration. One trial[44] evaluated BP in relation to urinary sodium:potassium. **Potassium supplementation and BP and HTN** With potassium supplementation, 4 of 6 studies observed decreases in SBP and DBP ranging from 3-13 mm Hg and 0-5 mm Hg, respectively. In 1 randomized crossover trial, potassium supplementation of 96 mmol for 1 wk (approximately 3,750 mg) resulted in decreases in SBP of up to 13 mm Hg, and in DBP of 5 mm Hg.[47] Another RCT[45] observed a significant mean difference in SBP between an intervention group receiving a salt substitute (65% sodium chloride, 25% potassium chloride, and 10% magnesium sulfate) and a control group (100% sodium chloride) of −3.7 mm Hg (P<0.001). There was also evidence that the reduction increased over time (P=0.001) with a net reduction of 5.4 mm Hg observed at 12 mo. In a nonrandomized trial, there were decreases in SBP and DBP, respectively, of up to 12 mm Hg and 7 mm Hg with potassium supplementation of 30 mmol (1,170 mg) for 4 wk.[44] In 1 study,[43] reductions in SBP and DBP with potassium supplementation of 60 mmol for 1 wk (2,340 mg) were higher in those with a maternal history of HTN vs those with no parental HTN; reductions in SBP and DBP, respectively, were 4.31 mm Hg vs 3.35 mm Hg and 1.8 mm Hg vs 1.35 mm Hg. Another analysis of GenSalt[42] found that changes in SBP and DBP with potassium supplementation were significantly higher for women vs men for DBP (−2.1 vs −1.52 mm Hg; P=0.007), but not SBP (−4.43 vs −4.45 mm Hg; NS). As age increased, reductions were greater for SBP (<35 y: −3.88 mm Hg; 35-44 y: −4.01 mm Hg; >44 y: −5.44 mm Hg, P<0.0001), but not DBP. Reductions with potassium supplementation were greater as BP increased for SBP (P<0.0001) and DBP (P=0.0002), respectively (BP <120/80: −2.89 and −1.14 mm Hg; BP 120/80-139/89: −4.04 and −0.160; BP >140/90: −6.5 and −2.69 mm Hg).	

(continued on next page)

Figure 5. *(continued)* Evidence summaries of the Evidence Analysis Library evidence-based systematic review for the management of hypertension in adults.

Evidence summary	NCP[a] Step
However, in 2 randomized crossover trials,[40,46] significant changes in SBP or DBP were not observed with potassium supplementation of 40 mmol for 6 wk (1,560 mg)[40] or 64 mmol for 4 wk (approximately 2,500 mg).[46] In a meta-analysis of 6 RCTs of potassium supplementation (range=48-120 mmol/d; ~1,900-4,700 mg), there were NS decreases in SBP of 3.9-11.2 mm Hg and in DBP of 1.5-5.5 mm Hg. Inconclusive effects of potassium supplementation on BP from this analysis were attributed to small sample sizes in high-quality trials and short duration of follow-up (8-16 wk). **Urinary sodium:potassium and BP** The relationship between urinary sodium:potassium excretion and BP was evaluated in 1 study,[44] which showed a positive relationship in 1 nonrandomized intervention trial. Potassium supplementation of 30 mmol (1,170 mg) for 4 wk in a nonrandomized trial[44] resulted in decreases in office and 24-h SBP of 12 mm Hg and 8 mm Hg, respectively, which were positively related (R=0.58 and R=0.51; both P values <0.001, respectively) to decreases in urinary sodium:potassium.	
Question 4 **Calcium**	
Question 4.1 **Dietary calcium:** What is the relationship between calcium intake from food sources and BP in adults with HTN?	Intervention
Evidence summary for question 4.1 (dietary calcium) The relationship between calcium intake from food sources and BP in individuals with HTN was investigated in 6 studies, including 3 cross-sectional studies (Lancaster and colleagues[37] [neutral quality], Schroder and colleagues[38] [positive quality], and Varenna and colleagues[49] [positive quality]), 1 prospective cohort study (Toledo and colleagues, 2009[50] [positive quality]), 1 randomized crossover trial (Hilpert and colleagues[51] [neutral quality]), and 1 meta-analysis (van Mierlo and colleagues[52] [neutral quality]). The studies investigated relationships between dietary intake of calcium and BP,[37,38,49-52] 2 of which evaluated low-fat dairy vs whole-fat dairy intake.[50,51] One serving of dairy was considered to provide approximately 300 mg calcium. **Dietary calcium intake and BP in HTN** Four of 6 studies suggest that consuming approximately 2-3 servings/d low-fat dairy products may decrease SBP and DBP by 2.5-4.2 mm Hg and 0.5-1.8 mm Hg, respectively. These included 2 cross-sectional analyses, 1 cross-sectional/longitudinal analysis, and 1meta-analysis. Two studies, including 1cross-sectional study and 1 RCT, did not find relationships between calcium intake and BP in HTN. In 1 cross-sectional[38] there were no significant differences in calcium intake between individuals without HTN (987.2 mg), individuals with HTN not taking medication (953.8 mg), and individuals with HTN taking medication (963.8 mg). However, there was a significant inverse correlation between calcium intake and SBP (P=0.01), and DBP (P<0.05). Analysis of the medicated HTN group showed that among those whose BP was controlled, calcium intake was significantly higher (approximately 90 mg; P<0.05) than those whose BP was not controlled (975.6 mg vs 884.5 mg). The relative risk of inadequate BP control for these subjects was reduced by 52% with a calcium intake of more than 800 mg/d in combination with sodium intake <2,400 mg/d (OR 0.48, 95% CI 0.24-0.95), but not for either calcium or sodium intake alone. In a cross-sectional analysis of postmenopausal women,[49] those with dairy intake of ≤7 servings/wk (approximately ≤300 mg/d) had a higher risk for HTN (OR 1.46; P=0.00) compared with those who consumed ≥16 servings/wk (approximately ≥675 mg/d). In a cross-sectional analysis after 12 mo of follow-up,[50] there was a significant linear trend of lower BP values across quintiles of low-fat dairy intake for SBP (P=0.001) and DBP (P=0.01). In longitudinal analysis, those in the highest quintile of low-fat dairy intake (631 g/d, approximately 2.5 c; 35 g whole-fat dairy) had significantly lower SBP (−4.2 mm Hg) and DBP (−1.8 mm Hg) at 12 mo compared with those in the lowest quintile of low-fat dairy intake (<10 g/d; 260 g whole-fat dairy, approximately 1 c). There were no associations between whole-fat dairy consumption and changes in BP.	

(continued on next page)

Figure 5. *(continued)* Evidence summaries of the Evidence Analysis Library evidence-based systematic review for the management of hypertension in adults.

Evidence summary	NCP[a] Step
In contrast, a cross-sectional study[37] found NS differences when a similar average level of calcium intake over 1 y was consumed by both individuals without HTN (629±298 mg) and with HTN (664±298 mg). Meta-analysis of 5 RCTs with HNT effects on BP of increased dietary calcium intake[52] found decreases in SBP and DBP of −2.56 mm Hg and 1.7 mm Hg, respectively with increased intakes of approximately 355-1,150 mg/d. However, in a randomized crossover trial, increased consumption of fruit and vegetables with either 3.4 servings low-fat dairy or 0.4 servings of low-fat dairy resulted in similar decreases in SBP and DBP of −12.0 to −12.3 mm Hg and −7.0 to −7.2 mm Hg, respectively.	
Question 4.2 **Calcium supplementation:** What is the relationship between potassium intake from supplements and BP in adults with HTN?	Intervention
Evidence summary for question 4.2 (calcium supplementation) The relationship between calcium intake from supplements and BP in adults with HTN was investigated in 3 studies, including 1 RCT[54] and 2 meta-analyses representing 38 RCTs.[52,53] **Calcium supplementation and BP in HTN** Two of 3 studies investigating the effect of calcium supplementation on BP in individuals with HTN suggest that calcium supplementation of 1 g/d will decrease SBP and DBP by 2.5 to 3.2 mm Hg and 0.0 to 2.4 mm Hg, respectively. Both were meta-analysis RCTs. One RCT did not find significant effects of calcium supplementation on BP. One meta-analysis of RCTs[52] that provided a mean dose of 1,200 mg/d found an overall effect on SBP and DBP of −1.86 mm Hg and −0.99 mm Hg, respectively, which was not different when those with an initial BP <140/90 mm Hg vs at least 140/90 mm Hg were analyzed separately. Changes were greater (2.6/1.3 mm Hg) for those with intake of no more than 800 mg/d, compared with those whose intake exceeded 800 mg/d (0.9/0.63 mm Hg), although baseline calcium intake was generally unknown. In a meta-analysis of trials that included only studies of adults with HTN,[53] supplementation with a mean dose of 1.1 g/d resulted in overall changes in SBP and DBP of −2.5 mm Hg and −0.8 mm Hg (NS). Analysis of parallel trials only showed significant reductions in SBP and DBP of −3.2 mm Hg and −2.4 mm Hg, respectively, with 8 wk or more of calcium supplementation, whereas crossover trials showed NS reductions of 2.3 mm Hg and 0.28 mm Hg, respectively. In a 5-wk RCT, supplementation of 1,500 mg/d calcium, with a constant dietary intake of 500 mg did not result in significant changes in SBP or DBP between the intervention and control group.[54]	
Question 5 **Magnesium**	
Question 5.1 **Dietary magnesium:** What is the relationship between magnesium intake from food sources and BP in adults with HTN?	Intervention
Evidence summary for question 5.1 (dietary magnesium) The effect of magnesium intake from food sources on BP in adults with HTN was evaluated in 3 cross-sectional analyses (Kesteloot and colleagues[37] [positive quality], Lancaster and colleagues[38] [neutral quality], and Schroder and colleagues[55] [positive quality]).	

(continued on next page)

Figure 5. *(continued)* Evidence summaries of the Evidence Analysis Library evidence-based systematic review for the management of hypertension in adults.

Evidence summary	NCP[a] Step
The studies showed conflicting results for the relationship between dietary intake of magnesium and BP in adults with HTN. In a cross-sectional analysis of INTERMAP (the International Study of Macro-/Micronutrients and Blood Pressure) study participants (N=4,679),[55] urinary magnesium excretion of 65 mg (2.69 mmol) above the mean of the sample was associated with a decrease in SBP of 0.98 mm Hg ($P<0.05$) and in DBP of 1.04 mm Hg ($P<0.001$). Analysis of INTERSALT (International Study of Sodium, Potassium, and Blood Pressure) results showed a significant reduction in DBP of 0.63 mm Hg ($P<0.001$), but not SBP. Dietary magnesium intake was 134.4-154.6 mg/1,000 kcal and the correlation between magnesium intake and urinary magnesium excretion was $R=0.21$. A cross-sectional analysis[37] that included individuals with and without HTN showed no statistical differences in daily magnesium intake between those with HTN (241±82 mg) and controls (258±85 mg). Similarly, dietary intakes of magnesium above the Recommended Dietary Allowances (>350 mg/d for men and >280 mg/d for women) were not significantly related to HTN.[38]	
Question 5.2 **Magnesium supplementation:** What is the relationship between magnesium intake from supplements and BP in adults with HTN?	Intervention
Evidence summary for question 5.2 (magnesium supplementation) The effect of magnesium intake from supplements on BP in adults with HTN was evaluated in 2 trials, including 1 nonrandomized controlled trial (Hatzistavri and colleagues[56] [positive quality]), 1 randomized trial (Bayir and colleagues[57] [neutral quality]) and 1 meta-analysis of 12 RCTs through 2004 (Dickinson and colleagues[58] [positive quality]). In these 3 studies, the effect of magnesium supplementation was evaluated: 1 study[57] provided 1,500 mg as a 1-time treatment compared with anti-HTN medication or both, 1 study[56] provided 1,200 mg magnesium or no supplementation for 12 wk, and the last study[58] evaluated 12 RCTs providing an average of 400 mg (range=240-980 mg) over a period of 8-26 wk (median=11 wk). In supplementation trials, significant decreases in SBP and DBP have been observed. One-time intravenous supplementation of 1,500 mg magnesium to patients with HTN (N=127, SBP >135 mm Hg and DBP >85 mm Hg) resulted in significant decreases in SBP and DBP of approximately 30-50 mm Hg and 20-30 mm Hg, respectively, within 60 min of administration, and decreases were NS difference from those seen with anti-HTN medication or combined treatment.[57] Magnesium supplementation of 400-1,200 mg/d over periods of 8-26 wk resulted in smaller, but significant decreases in SBP and DBP. In 1 nonrandomized controlled trial,[56] supplementation with 1,200 mg magnesium for 12 wk in combination with lifestyle recommendations resulted in significant decreases in SBP of 5.6±0.7 mm Hg ($P<0.001$) and in DBP of 2.8±1.8 mm Hg ($P=0.02$). These decreases were significantly different from those who received lifestyle recommendations only (−1.3 mm Hg SBP and −1.0 mm Hg DBP). A meta-analysis of 12 RCTs[58] that included 545 individuals provided a mean dose of magnesium supplement of approximately 400 mg (range=240-1,000 mg) for 8-26 wk (median=11 wk), For all trials, there was a NS mean difference in SBP of 1.3 mm Hg and a significant decrease in DBP of 2.2 mm Hg at follow-up compared with control. Nine parallel trials showed NS mean differences in SBP and DBP of 0.3 mm Hg and 2.0 mm Hg at follow-up compared with control, respectively, whereas results of 3 crossover trials showed significant mean differences of 3.5 mm Hg and 2.0 mm Hg, respectively.	
Question 6 **Sodium:** What is the effect of reduced sodium intake on BP in adults with HTN?	Intervention
Evidence summary for question 6 (sodium) The effect of sodium intake on BP in individuals with HTN was investigated in 13 studies, including 6 cross-sectional studies (Hu and Tian[35] [neutral quality], Khaw and colleagues[36] [neutral quality], Kwok and colleagues[37] [positive quality], Lancaster and colleagues[38] [neutral quality], Mente and colleagues[64] [positive quality], and Schroder and colleagues[65] [positive quality]), 1 case-control study (Cheung and colleagues[39] [positive quality]), 1 nonrandomized controlled trial (Kojuri and colleagues[59] [positive quality]), 2 randomized crossover trials (He and colleagues[42] [positive quality] and Jablonski and colleagues[60] [positive quality]), and 3 meta-analyses (Graudal and colleagues[61] [positive quality], Graudal and colleagues[62] [positive quality], and He and colleagues[63] [positive quality]).	

(continued on next page)

Figure 5. *(continued)* Evidence summaries of the Evidence Analysis Library evidence-based systematic review for the management of hypertension in adults.

Evidence summary	NCP[a] Step
Associations between sodium intake, BP, and HTN risk in individuals with HTN Positive relationships between sodium intake, BP, and HTN risk were observed in 5 of 6 cross-sectional studies and the case-control study. Individuals with HTN had significantly higher sodium:potassium than those without HTN (4.7±2.8 vs 3.4±2.3; P=0.02).[36] Individuals with HTN also had significantly higher sodium intake than those without HTN, and risk for HTN was associated with sodium intake (OR 1.07; P<0.05) and sodium:potassium (OR men=1.12; P=0.061 and women=1.18; P<0.01).[35] Sodium intake <2,400 mg/d (104 mmol) decreased risk for HTN by 52% in nonmedicated individuals with HTN).[38] Compared with sodium intake of 220 mmol/d (5,060 mg/d), intake of 80 mmol/d (1,840 mg/d) was associated with differences in SBP and DBP of −7.2 mm Hg and −3.0 mm Hg, respectively. Further, for those with sodium intake of 220 mmol/d, the OR for having an SBP >150 mm Hg was 2.48 for men and 2.67 for women compared with sodium intake of 80 mmol/d.[64] Each 1-g increment in estimated sodium excretion was associated with an increase in SBP of 2.48 mm Hg.[65] In a case-control study[39] of untreated individuations with and without HTN, DBP but not SBP was significantly correlated with 24-h urinary sodium in individuals with but not without HTN (R=0.34; P<0.001). Each 10-mmol (230 mg) increase in sodium intake was associated with a 6-mm Hg increase in DBP and sodium intake accounted for 17% of the variance in DBP. In 1 study,[37] dietary intake of sodium by individuals without HTN was significantly higher than diagnosed individuals with HTN (2,962±969 mg vs 2,540±938 mg; P=0.003). **Effect of reduced sodium intake on BP in individuals with HTN** Significant decreases in BP were observed with reduced sodium intake in 1 nonrandomized controlled trial,[59] 2 randomized crossover trials,[60,66] and 3 meta-analyses of RCTs conducted since 1948.[61-63] In a nonrandomized controlled trial,[59] decreases in daytime SBP of 12 mm Hg and in DBP of 6 mm Hg were observed in patients with HTN who followed a no-added-salt diet compared with increases of 5 mm Hg and 2.5 mm Hg in controls. There was a reduction in urinary sodium of 37 mmol/dL (850 mg/dL) the intervention group (P<0.001) from a median baseline of 132 mmol/dL (approximately 3,000 mg/dL) to a median of 110 mmol/dL (approximately 2,500 mg/dL), whereas there was an increase in sodium excretion for controls. In 2 randomized crossover trials, there were decreases of 12 mm Hg for SBP (P<0.05), and 4-6 mm Hg (NS)[60] to 7 mm Hg (P<0.05).[42] for DBP during the low-sodium diet compared with the high-sodium diet. Low-sodium and high-sodium intakes were 1,150 mg and 7,000 mg (50 mmol and 304 mmol)[42] and 1,700 mg and 3,300 mg (74 mmol and 143 mmol),[60] respectively. There was a greater effect of sodium reduction as BP increased; a baseline BP <120/80 mm Hg was associated with a decrease of 3.28/1.46 mm Hg (P<0.01); a baseline BP 120/80-139/89 mm Hg, was associated with a decrease of 7.57/4.02 mm Hg (P<0.01); and a baseline BP higher than 140/90 mm Hg, was associated with a decrease from 11.8 mm Hg to 6.4 mm Hg (P<0.01).[42] Results from 2 meta-analyses of RCTs found significant decreases in BP with sodium reduction. Graudal and colleagues[62] analyzed RCTs that randomized to low (mean=71 mmol [1,633 mg]) or high-sodium diets (mean=196 mmol [4,508 mg]), with median sodium reductions of 94 mmol (2,162 mg) per 24 h and median duration of 28 d. In individuals with HTN, reductions in SBP and DBP were from 5.48 mm Hg to 2.75 mm Hg for whites, from 6.44 to 2.4 mm Hg for blacks, and from 10.21 to 2.60 mm Hg for Asians. In a subanalysis of trials >4 wk in duration, decreases in SBP and DBP were 4.18 mm Hg and 2.59 mm Hg, respectively. Another analysis of 7 trials with weekly BP measurements did not show significant differences after initiation of sodium reduction.[61] He and colleagues,[63] analyzed 34 RCTs, of which 22 included individuals with HTN. Trials were a median duration of 5 wk, with random allocation to either usual sodium intake or a modest reduction ranging from 40-120 mmol (920-2,760 mg) for at least 4 wk. Median sodium reduction was 75 mmol (1,725 mg) from baseline of 162 mmol (3,726 mg) and median reductions in SBP and DBP were 5.39 mm Hg and 2.82 mm Hg, respectively. A 100-mmol (2,300 mg) decrease in urinary sodium excretion was associated with a 10.8 mm Hg decrease in SBP.	

(continued on next page)

Figure 5. *(continued)* Evidence summaries of the Evidence Analysis Library evidence-based systematic review for the management of hypertension in adults.

Evidence summary	NCP[a] Step
Sodium dose and BP response A meta-analysis of 4 studies[61] in individuals with HTN showed that compared with a low-sodium intake (<90 mmol [2,070 mg]), there was a significant increase in BP with increasing levels of intake: intake of 90-159 mmol (2,071-3,656 mg) was associated with BP increase of 4.65 mm Hg/2.44 mm Hg ($P<0.01$); intake of 159-248 mmol (3,657-5,700 mg) was associated with an increase in BP of 6.87/3.61 mm Hg ($P<0.01$); and intake >248 mmol (5,700 mg) was associated with an increased in BP of 10.03/5.55 mm Hg ($P<0.01$).	
Question 7 **Diet patterns**	Intervention
Question 7.1 **DASH diet:** What is the effect of the DASH diet pattern on BP in adults with HTN?	
Evidence summary for question 7.1 (DASH diet) The effect of the DASH diet on BP in adults with HTN was evaluated in 2 RCTs (Al-Solaiman[17] [positive quality] and Huggins and colleagues[66] [neutral quality]), and 6 RCTs (Azadbakht and colleagues[67] [positive quality], Blumenthal and colleagues[68] [positive quality], Elmer and colleagues[69] [positive quality], Kirpizidis and colleagues[70] [positive quality], Nowson and colleagues[71] [neutral quality], and Nowson and colleagues[72] [positive quality]). One study (Epstein and colleagues[73] [positive quality]) conducted a subanalysis of data reported by Blumenthal and colleagues[68] on the ENCORE (Exercise and Nutritional Interventions for Cardiovascular Health) trial. In 2 studies, DASH was compared with interventions that increased potassium and magnesium intake through supplementation[66] or by diet.[17] Four studies included a weight-reduction component.[67-69,72] Three trials included sodium reduction to 1,500 mg,[17,70,71] 2 kept intake at 3,000-3,600 mg/d,[66,72] and the remaining trials limited intake to 2,300-2,800 mg/d. Two RCTs[70,71] evaluated DASH compared with controls who received no dietary advice[70] or advice on a healthy diet including sodium reduction.[71] Reductions observed in SBP ranged from 5-25 mm Hg and those observed in DBP ranged from 4-17 mm Hg. NS differences were observed between those receiving or not receiving anti-HTN therapy. In 2 crossover trials, the DASH diet resulted in significant reductions in SBP and DBP of 2.5-7.5 mm Hg and 0-4 mm Hg, respectively. Relative to potassium, magnesium, and fiber supplementation, the DASH diet resulted in a 6- and 4-mm Hg greater reduction in SBP and DBP, respectively.[66] Intake of potassium, magnesium, and fiber during the supplementation and the DASH diet phases showed some statistical differences but were relatively similar to each other vs the control intakes; intakes during the control period were significantly lower than both intervention periods. Sodium intake was around 3,600 mg/d during all phases. In contrast, dietary advice to increase intake of foods high in potassium and magnesium and decrease sodium intake to approximately 1,500 mg[17] vs the DASH diet with approximately 2,600 mg sodium resulted in similar significant reductions of 2.4-2.8 mm Hg SBP and NS changes in DBP. Urinary potassium and magnesium excretion were similar during each diet intervention period and were significantly different from the control period. Four trials evaluated the effect on BP of a DASH diet in combination with weight-reduction diet. Three trials[67,69,72] compared DASH plus weight reduction to weight reduction alone, of which 2[67,69] also included a usual care or advice-only control group. One trial compared DASH plus weight reduction with DASH alone.[68] DASH plus weight reduction led to decreases in BP that ranged from around 8-16 mm Hg for SBP and 5-10 mm Hg for DBP, all of which were significant compared with baseline[72] or to controls.[67-69] DASH plus weight reduction resulted in significantly greater differences in BP reductions,	

(continued on next page)

Figure 5. *(continued)* Evidence summaries of the Evidence Analysis Library evidence-based systematic review for the management of hypertension in adults.

Evidence summary	NCP[a] Step
compared with controls, than weight reduction alone in 2 studies[67,72] and were 8-12 mm Hg for SBP and 2-6 mm Hg for DBP. In 1 study,[69] DASH plus established recommendations (weight reduction and sodium reduction) was compared with established recommendations only.[69] There were NS differences in BP changes between the 2 groups: reductions ranged from 10-11 mm Hg for SBP and 6.5-7.5 mm Hg for DBP. In the ENCORE trial,[68] DASH plus weight reduction resulted in significantly greater reductions in SBP and DBP of 5.0 mm Hg and 2.5 mm Hg compared with DASH alone. In this trial, greater adherence to the DASH diet was associated with larger BP reductions independent of weight loss.[73] In 1 trial,[71] weight loss explained 7% and 6%, respectively, of the variance in SBP and DBP reduction with a DASH diet compared with a reference healthy diet, although weight loss was not a component of the intervention.	
Question 7.2 **Mediterranean diet:** What is the effect of the Mediterranean diet pattern on BP in adults with HTN?	Intervention
Evidence summary for question 7.2 (Mediterranean diet) The effect of a Mediterranean diet on BP in adults with HTN was evaluated in 1 RCT (Toledo and colleagues[83] [positive quality]). The trial included individuals with metabolic syndrome, of whom 83% had HTN, who were followed for 4 y. BP was a secondary outcome of the trial. Participants consumed a traditional Mediterranean diet supplemented with EVOO[m] 1 L/wk or with 30 g nuts per day, or a low-fat control diet. There were significant reductions in SBP of approximately 4 mm Hg and in DBP of approximately 2-3 mm Hg. There were NS differences for changes in SBP between either intervention group vs the control group. Changes in DBP were −1.51 mm Hg ($P<0.001$) and −0.65 mm Hg ($P<0.01$) for Mediterranean + EVOO and Mediterranean + nuts, respectively, vs control.	
Question 8 **Alcohol**	Intervention
Question 8.1 **Alcohol intake in heavy drinkers:** How does alcohol intake affect BP in heavy drinkers with HTN?	
Evidence summary for question 8.1 (alcohol intake in heavy drinkers) Three studies evaluated effects of alcohol withdrawal in chronic heavy drinkers with HTN, including 1 before−after study (Baros and colleagues[76] [positive quality]), 1 nonrandomized trial (Soardo and colleagues[77] [positive quality]), and 1 time-course study (Stewart and colleagues[78] [neutral quality]). In patients with HTN consuming 200+ g alcohol per day on average, abstinence resulted in BP decreases ranging from 10-28 mm Hg for SBP, and 7-18 mm Hg for DBP. In 1 study, individuals who abstained from drinking saw decreases in SBP and DBP of 28 mm Hg and 18 mm Hg after 30 days, respectively, whereas individuals who did not stop drinking saw no changes.[77] In another study, individuals who reported any drinking over a 12-wk period[76] saw only a NS 1 mm Hg decrease in both SBP and DBP compared with decreases of 10 mm Hg and 7 mm Hg, respectively, in those who abstained completely. One study[78] observed significant decreases in SBP and DBP of 12 mm Hg and 8 mm Hg after 4 wk, respectively, only in those whose SBP and DBP were above the study median (132 mm Hg and 84 mm Hg, respectively).	

(continued on next page)

Figure 5. *(continued)* Evidence summaries of the Evidence Analysis Library evidence-based systematic review for the management of hypertension in adults.

Evidence summary	NCP[a] Step
Question 8.2 **Alcohol intake in moderate drinkers:** How does alcohol intake affect BP in moderate drinkers with HTN?	Intervention
Evidence summary for question 8.2 (alcohol intake in moderate drinkers) Two studies evaluated the effects of moderate alcohol intake on BP in adults with HTN, including 1randomized crossover trial (Hering and colleagues[74] [neutral quality]), and 1 time study (Kawano and colleagues[75] [neutral quality]). One study evaluated acute effects of alcohol consumption in patients with HTN compared with individuals without HTN,[74] and 1 short-term time study[75] evaluated effects in individuals with HTN of repeated alcohol consumption for 1 wk compared with a 1-wk period of abstinence before the alcohol consumption phase, with sodium intake of 120 mmol (2,760 mg) during all phases. In the study of acute effects of alcohol consumption, intake of 1.0 g/kg resulted in a significant increase in SBP of 25 mm Hg and in DBP of 15 mm Hg 10 min after consumption compared with no change with placebo in 13 individuals with HTN. There was no increase in BP after alcohol consumption or placebo in 11 individuals without HTN.[74] In the time study, a 3-d control phase of no alcohol consumption preceded a 7-d observation of repeated effects of alcohol intake of 1 mL/kg at dinner, followed by a 3-d recovery of no alcohol; energy and sodium intake of 1,600 kcal and 120 mmol (2,760 mg) respectively, were constant throughout the study. There were no changes in 24-h average BP. However, after alcohol consumption at dinner, SBP decreased significantly by 15 mm Hg each evening compared with the abstinence control period, returning to normal during 3 d when alcohol intake was discontinued. There tended to be no statistical increases in SBP of 5 mm Hg each afternoon during the alcohol intake phase.	

[a]NCP=Nutrition Care Process.

[b]MNT=medical nutrition therapy.

[c]HTN=hypertension.

[d]RDN=registered dietitian nutritionist.

[e]BP=blood pressure.

[f]DASH=Dietary Approaches Against Hypertension.

[g]SBP=systolic blood pressure.

[h]DBP=diastolic blood pressure.

[i]NS=nonsignificant.

[j]RCT=randomized controlled trial.

[k]To convert ng/mL vitamin D to nmol/L, multiply ng/mL by 2.496. To convert nmol/L vitamin D to ng/mL, multiply nmol/L by 0.401.

[l]OR=odds ratio.

[m]EVOO=extra-virgin olive oil.

Figure 5. *(continued)* Evidence summaries of the Evidence Analysis Library evidence-based systematic review for the management of hypertension in adults.