The Effects of Dietary Factors on Blood Pressure

Lawrence J. Appel, MD, MPH

KEYWORDS

• Blood pressure • Dietary factors • Hypertension • Cardiovascular disease • Renal disease

KEY POINTS

- A compelling body of evidence supports the concept that multiple dietary factors affect blood pressure (BP).
- Dietary changes that effectively lower BP are weight loss, reduced sodium intake, increased potassium intake, moderation of alcohol intake (among those who drink), and Dietary Approaches to Stop Hypertension (DASH)-style and vegetarian dietary patterns.
- In view of the increasing levels of BP in children and adults and the continuing epidemic of BP-related cardiovascular (CV) and renal diseases, efforts to reduce BP in both nonhypertensive and hypertensive individuals are warranted.
- The challenge to health care providers, researchers, government officials, and the general public is developing and implementing effective clinical and public health strategies that lead to sustained dietary changes among individuals and more broadly among whole populations.

INTRODUCTION

Elevated BP remains an extraordinarily common and important risk factor for CV and kidney diseases throughout the world.[1] According to the 2011 to 2012 National Health and Nutrition Examination Survey (NHANES), approximately 70 million adult Americans (29%) have hypertension (a systolic BP $\geq$140 mm Hg, a diastolic BP $\geq$90 mm Hg, or treatment with antihypertensive medication),[2] and at least as many Americans have prehypertension (systolic BP 120–139 mm Hg or diastolic BP 80–89 mm Hg, not on medication). Regrettably, the prevalence of hypertension has remained essentially unchanged for the past 2 decades, and control rates remain low, at approximately 53%.[3]

Systolic BP progressively rises with age, such that hypertension becomes almost ubiquitous among the elderly. As a result of the age-related rise in systolic BP, approximately 90% of adult Americans develop hypertension over their lifetime.[4] Elevated BP afflicts both men and women. African Americans, on average, have higher BP than non–African Americans as well as an increased risk of BP-related disease, in particular stroke and kidney disease.

BP is a strong, consistent, continuous, independent, and etiologically relevant risk factor for CV disease and renal disease.[5] Importantly, there is no evidence of a BP threshold, that is, the risk of CV disease increases progressively throughout the range of usual BP, including the prehypertensive range.[6] It has been estimated that approximately a third of BP-related deaths from coronary heart disease (CHD) occur in individuals with BP in the nonhypertensive range. Accordingly, prehypertensive individuals not only have a high probability of developing hypertension but also carry an excess risk of CV disease compared with those with a normal BP (systolic BP <120 mm Hg and diastolic BP <80 mm Hg).[7] Approximately 54% of strokes and 47% of ischemic heart disease events worldwide have been attributed to an elevated BP.[8]

Elevated BP results from environmental factors (including dietary factors), genetic factors, and

Text adapted from Appel LJ, Brands MW, Daniels SR, et al. Dietary approaches to prevent and treat hypertension: a scientific statement from the American Heart Association. Hypertension 2006;47(2):296–308.

Welch Center for Prevention, Epidemiology, and Clinical Research, Johns Hopkins University, 2024 East Monument Street, Suite 2-642, Baltimore, MD 21205-2223, USA
E-mail address: lappel@jhmi.edu

Cardiol Clin 35 (2017) 197–212
http://dx.doi.org/10.1016/j.ccl.2016.12.002

interactions among these factors. Of the environmental factors that affect BP (diet, physical inactivity, toxins, and psychosocial factors), diet likely has a predominant role in BP homeostasis. Well-established dietary modifications that lower BP are a reduced sodium intake, weight loss, moderation of alcohol consumption (among those who drink excessively), and healthy dietary patterns, specifically, Dietary Approaches to Stop Hypertension (DASH)-style diets, vegetarian diets, and, to a lesser extent, Mediterranean-style diets.

In nonhypertensive individuals, dietary changes that lower BP have the potential to prevent hypertension and reduce the risk of BP-related CV disease. Even an apparently small BP reduction, if applied broadly to an entire population, could have an enormous, beneficial impact. For example, it has been estimated that a 3 mm Hg average reduction in systolic BP could lead to an 8% reduction in stroke mortality and a 5% reduction in mortality from CHD (Fig. 1).[9] In uncomplicated stage I hypertension (systolic BP 140–159 mm Hg or diastolic BP 90–99 mm Hg), dietary changes can serve as first-line therapy, before antihypertensive medication. Among hypertensive individuals who are already on medication, dietary changes can further lower BP and make it possible to reduce the number and doses of medications. In general, the magnitude of BP reduction from dietary changes is greater in hypertensive individuals than in nonhypertensive individuals.

Although dietary changes lower BP, there is considerably less evidence on whether dietary changes blunt the age-related rise in systolic BP. On average, systolic BP rises by approximately 0.6 mm Hg per year. Efforts to prevent this age-associated rise in systolic BP hold the greatest promise as a means to prevent elevated BP and curb the epidemic of BP-related disease. Unfortunately, even the longest diet-BP intervention trials have lasted less than 5 years. Whether the BP reductions observed in these trials have merely shifted the age-associated rise in BP curve downward, without a change in slope (Fig. 2), or actually reduced its slope (see Fig. 2) cannot be determined. Still, evidence from migration studies, ecologic studies, and, most recently, observational analyses of trial data[10] suggest that dietary factors should reduce the rise in systolic BP with age.

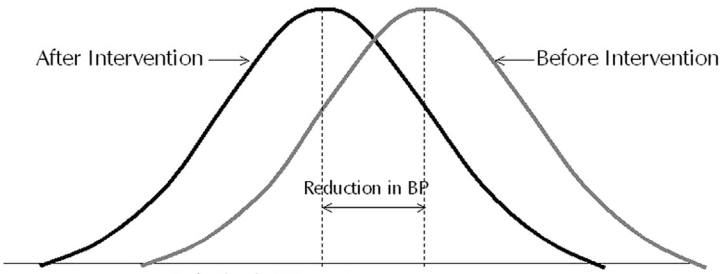
The objective of this article is to synthesize evidence on the relationship of diet and BP. The summary of evidence and corresponding recommendations largely reflect previous reviews.[11,12]

DIETARY FACTORS THAT REDUCE BLOOD PRESSURE

Weight Loss

Weight is directly associated with BP. The importance of this relationship is reinforced by the high and increasing prevalence of obesity throughout the world. In the United States, approximately 69% of adults have a body mass index (BMI) greater than or equal to 25 kg/m^2 and, therefore, are classified as either overweight or obese; approximately 35% of adults are obese (BMI $\geq$30 kg/m^2).[13] Likewise, among infants, toddlers, children, and adolescents, the prevalence of high weight persists, with scant evidence of any improvement.

Weight loss lowers BP. Reductions in BP occur before, and even without, attainment of a desirable body weight. In a meta-analysis of 25 trials, an average weight loss of 5.1 kg reduced systolic BP by a mean of 4.4 mm Hg and diastolic BP by a mean of 3.6 mm Hg.[14] In subgroup analyses, BP reductions were greater in those who lost more weight. Dose-response analyses[15] and observational studies also provide evidence that greater weight loss leads to greater BP reduction. Given the potential for huge reductions in weight, however, a linear dose-response relationship is unlikely.



Reduction in BP mm Hg	% Reduction in Mortality Stroke	CHD	Total
2	-6	-4	-3
3	-8	-5	-4
5	-14	-9	-7

Fig. 1. Estimated effects of population-wide shifts in systolic BP on mortality. CHD, coronary heart disease. (*Data from* Stamler R. Implications of the INTERSALT study. Hypertension 1991;17(1 Suppl):I16–20.)