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AS PRESENTED IN THE ROUNDS OF THE CARDIOVASCULAR DIVISION  
OF BRIGHAM AND WOMEN'S HOSPITAL, BOSTON, MASSACHUSETTS

## Dietary treatment to prevent cardiovascular disease Part I: Lowering blood pressure

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During my 18 years of clinical practice in hyperlipidemia at Brigham and Women's Hospital and my teaching in this field, I have heard various views from practicing physicians on dietary treatment. First, many of these physicians usually have an intense interest in, and sophisticated knowledge about, the latest dietary information to give their patients, or to use themselves. In fact, I have always marveled that when I give a continuing medical education lecture devoted solely to drug therapy for hyperlipidemia, questions often focus on diet. These physicians pass on the information to their patients, knowing that many will not adhere to the recommendations. While recognizing the potential effectiveness of diet to prevent CVD, a second nihilistic view is dominated by disappointment in how poorly many patients fare with nonpharmacological therapy; thus, many physicians virtually abandon any mention of diet or exercise in their practice. As discussed below, modest changes in several areas of lifestyle can result in important reductions in risk that are not always reflected in marked changes in the lipid profile or blood pressure. A third view can be described, sadly, as disinterest, often coupled with a resistance to data demonstrating that one's habits are at the root of most cardiovascular problems and the major cause of disease in our society.

This issue of *Cardiology Rounds* is the first of a two-part series concerning dietary treatment to prevent cardiovascular disease (CVD). This issue will focus on blood pressure control and the next issue on hyperlipidemia. Diet and other lifestyle choices are critical factors affecting heart disease. These articles are designed to offer physicians with any of the viewpoints mentioned above, and by extension their patients, constructive approaches to diet therapy.

There is no doubt that diet modification and exercise – in fact, any alteration of an individual's habits – is difficult, and most often, a change is more difficult to maintain than to initiate. In order to assist a patient in making lifestyle choices that could make a difference in disease prognosis, an informed, encouraging, optimistic, and compassionate approach by the physician is essential. Explicitly acknowledging the obstacles that many of



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us have encountered personally may help in establishing an empathetic relationship with the patient.

### Diet and hypertension

Approximately 25% of the US adult population, or an estimated 43 million Americans, have hypertension.<sup>1</sup> Moreover, about 80% of US adults above the age of 50 have above optimal blood pressure (BP) and could benefit from blood pressure lowering. A typical sustained diastolic BP reduction of 5 mm Hg, reduces the incidence of coronary heart disease events by 15% and cerebrovascular disease by 45%.<sup>2</sup> Lifestyle therapy reduces the need for antihypertensive medication, and also has benefits for hypercholesterolemia and diabetes. The Joint National Commission on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure has consistently recommended lifestyle therapy for prevention and treatment of hypertension.<sup>1</sup> Such therapies include weight loss, the DASH dietary pattern (described subsequently), reduction of dietary sodium, and moderation of alcohol intake (Table 1).

### Weight loss

Adiposity, particularly excess abdominal fat, is a strong, modifiable cause of hypertension. The overweight condition is increasing in prevalence throughout the world.<sup>3</sup> In the US, the combined prevalence of overweight and obesity (a body mass index (BMI) > 25 kg/m<sup>2</sup>) is nearly 60% in men and 50% in women.<sup>4</sup> Every kilogram of weight loss lowers blood pressure by 1.6/1.1 mm Hg.<sup>5</sup> This relationship shows how effective weight loss can be in controlling high blood

pressure. A 5 kg loss would lower blood pressure by 8/5.5 mm Hg, which is equivalent to drug monotherapy. Substantial weight loss should be sustained over the long-term (3 or more years).<sup>6-9</sup>

### The DASH Diet (Dietary Approaches to Stop Hypertension)

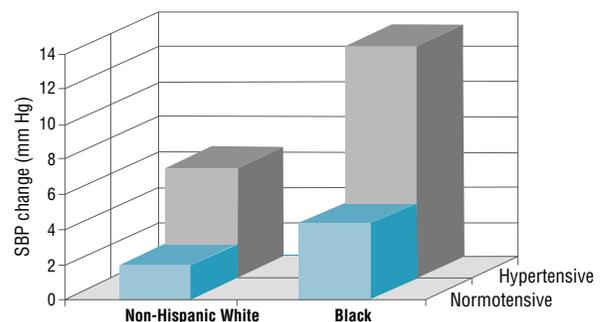
DASH was a randomized clinical trial testing a diet that emphasizes fruits, vegetables, and low-fat dairy foods; includes whole grains, poultry, fish, and nuts; and is reduced in fats, red meat, sweets, and sugar-containing beverages (Table 2).<sup>10</sup> The DASH trial diet had reduced amounts of total and saturated fat, cholesterol, and increased amounts of potassium, calcium, magnesium, dietary fiber, and protein.<sup>10</sup> It was compared to a control dietary pattern that resembled customary dietary intake in the US. All food for the experimental diets was provided for the participants and the amounts were titrated to keep body weight constant. It is important to emphasize that the DASH study did not intend to, and did not, reduce dietary sodium intake or body weight.

After just two weeks, the DASH diet lowered blood pressure substantially and significantly. It was highly effective in mild hypertensives, with a mean reduction of 11.6/5.3 mm Hg (Figure 1).<sup>11</sup> The DASH diet was also effective in patients with high normal blood pressure, although with less intensity, giving a mean reduction of 3.5/2.2 mm Hg. Among African Americans with hypertension, the DASH diet reduced blood pressure by 13.2/6.1 mm Hg. In addition, a “fruits and vegetables” diet was included to test the effect of fruits and

**Table 1: Lifestyle treatments for elevated blood pressure**

- Weight loss
- DASH dietary pattern
  - Emphasizing fruits, vegetable, and low-fat dairy products, includes whole grains, poultry, fish, and nuts, and that is reduced in red meats, sweets, sugar-containing beverages
- Dietary sodium reduction
- Moderation in drinking alcoholic beverages

**Figure 1: Systolic blood pressure reduction by the DASH diet<sup>11</sup>**



**Table 2: The DASH Diet**

The DASH eating plan shown below is based on 2,000 calories a day. The number of daily servings in a food group may vary from those listed depending on your caloric needs. Use this chart to help you plan your menus or take it with you when you go to the store.

<b>FOOD GROUP</b>	<b>DAILY SERVINGS</b> (except as noted)	<b>SERVING SIZES</b>	<b>EXAMPLES AND NOTES</b>	<b>SIGNIFICANCE OF EACH FOOD GROUP TO THE DASH EATING PLAN</b>
Grains & grain products	7-8	1 slice bread 1 oz dry cereal* ½ cup cooked rice, pasta, or cereal	whole wheat bread, English muffin, pita bread, bagel, cereals, grits, oatmeal, crackers, unsalted pretzels and popcorn	major sources of energy and fiber
Vegetables	4-5	1 cup raw leafy vegetable ½ cup cooked vegetable 6 oz vegetable juice	tomatoes, potatoes, carrots, green peas, squash, broccoli, turnip greens, collards, kale, spinach, artichokes, green beans, lima beans, sweet potatoes	rich sources of potassium, magnesium and fiber
Fruits	4-5	6 oz fruit juice 1 medium fruit ¼ cup dried fruit ½ cup fresh, frozen or canned fruit	apricots, bananas, dates, grapes, oranges, orange juice, grapefruit, grapefruit juice, mangoes, melons, peaches, pineapples, prunes, raisins, strawberries, tangerines	important sources of potassium, magnesium, and fiber
Low fat or fat-free dairy foods	2-3	8 oz milk 1 cup yogurt 1½ oz cheese	fat-free (skim) or low fat (1%) milk, fat-free or low fat buttermilk, fat-free or low fat regular or frozen yogurt, low fat and fat-free cheese	major sources of calcium and protein
Meats, poultry, and fish	2 or less	3 oz cooked meats, poultry, or fish	select only lean; trim away visible fats; broil, roast or boil, instead of frying; remove skin from poultry	rich sources of protein and magnesium
Nuts, seeds, and dry beans	4-5 per week	⅓ cup or 1½ oz nuts 2 Tbsp or ½ oz seeds ½ cup cooked dry beans	almonds, filberts, mixed nuts, peanuts, walnuts, sunflower seeds, kidney beans, lentils, peas	rich sources of energy, magnesium, potassium, protein, and fiber
Fats & oils**	2-3	1 tsp soft margarine 1 Tbsp low fat mayonnaise 2 Tbsp light salad dressing 1 tsp vegetable oil	soft margarine, low fat mayonnaise, light salad dressing, vegetable oil (such as olive, corn, canola, or safflower)	DASH has 27 percent of calories as fat, including that in or added to foods
Sweets	5 per week	1 Tbsp sugar 1 Tbsp jelly or jam ½ oz jelly beans 8 oz lemonade	maple syrup, sugar, jelly, jam, fruit-flavoured gelatin, jelly beans, hard candy, fruit punch, sorbet, ices	sweets should be low in fat

\* Equals 1/2 -1 1/4 cup, depending on cereal type. Check the product's nutrition label.

\*\* Fat content changes serving counts for fats and oils: For example, 1 Tbsp of regular salad dressing equals 1 serving; 1 Tbsp of a low fat dressing equals 1/2 serving; 1 Tbsp of a fat-free dressing equals 0 servings.

vegetables alone. This diet produced about half the blood pressure effect of the DASH diet, demonstrating at least one food group that can be held responsible for the DASH diet effect. The magnitude of the decrease in blood pressure caused by the DASH diet shows that it could replace pharmacological therapy as initial anti-hypertensive treatment, or could reduce the need for combination drug therapy. In the general population, the DASH diet could prevent the development of hypertension and presumably, associated cardiovascular disease.

The Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure endorsed the results of DASH and recommended the use of this diet for the general population and in clinical practice. The diet is to be used in combination with other nonpharmacological treatments such as weight loss and reduced sodium intake.<sup>1</sup> The DASH diet is reasonably low in cost with a retail price of about \$130 per week for a family of 4.

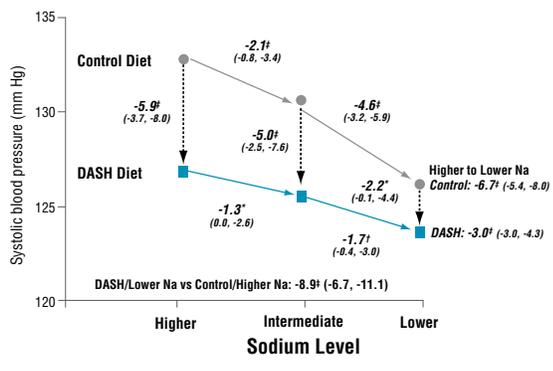
The National Heart, Lung, and Blood Institute publishes a practical guide to the DASH diet, “Facts About the DASH Diet”, which can be purchased or viewed on-line at: [http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/new\\_dash](http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/new_dash).

### Sodium reduction

A large body of evidence from epidemiological and clinical trials indicates that salt (sodium chloride) intake raises blood pressure. Guidelines recommend reducing daily dietary sodium intake to 100 mmol/d (2.3 g sodium, 5.8 g sodium chloride) or less. However, the actual magnitude of blood pressure lowering caused by sodium reduction has been debated because results have varied widely among individual clinical trials. Some skepticism had been justified, since, even after decades of research, the dose-response effect of dietary sodium on blood pressure remained unclear.

The DASH-Sodium Trial, like DASH, was a multicenter, randomized, feeding trial,<sup>12</sup> comparing the effects on blood pressure of reducing sodium

**Figure 2: Effect of the DASH diet and reduced sodium on blood pressure<sup>12</sup>**



intake from 142 mmol (an average intake in the US) to 107 mmol (near the current guideline of 100 mmol) and to 65 mmol. These 3 sodium levels were studied in the context of a typical US diet and with the DASH diet. All the food was provided for the participants. As in the DASH trial, the amount of food was titrated to assure that participants did not gain or lose weight. Those taking antihypertensive drugs were excluded.

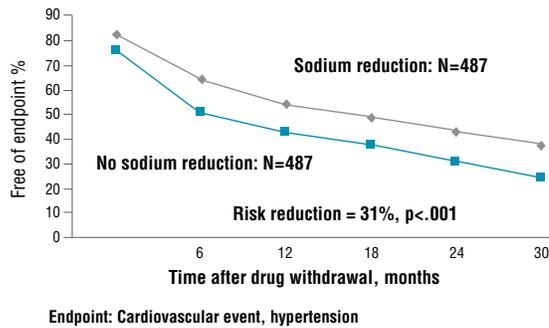
Reduced sodium intake significantly lowered blood pressure in a stepwise fashion, in both the control and the DASH diets (Figure 2). There was an enhanced blood pressure response to progressively lower sodium intakes. The effects of sodium reduction were substantial in hypertensives and similar to the effects of drug monotherapy (Figure 3). A recent study documented long-term benefits of sodium reduction in preventing hypertension in persons at risk for hypertension,<sup>8</sup> and in facilitating hypertension control in older-aged

**Figure 3: Effect of sodium reduction on systolic blood pressure in persons eating a typical US diet<sup>12</sup>**

	African American SBP	Non African American SBP
M vs H	-2.3*	-1.9
L vs M	-7.0***	-4.8**
L vs H	-9.4***	-6.8***

\* p < .1 \*\* p < .001 \*\*\* p < .00001  
H = Sodium intake averaging 142 mmol/d, M=107 mmol/d, L=65 mmol/d.

**Figure 4: Sodium reduction in the treatment of hypertension in older persons (TONE)<sup>9</sup>**



persons on medication (Figure 4).<sup>9</sup> Finally, two recent epidemiological studies in the general US population and in Finland, found that high sodium intake was a predictor of cardiovascular events, particularly in overweight individuals.<sup>13</sup>

In order to reduce salt intake, it is important that consumers limit supplemental salt intake, as well as choose foods low in salt content. However, even well-motivated individuals often find it difficult to reduce sodium intake to below the recommended levels because of the huge amount of salt generally added during food processing. Individuals add only 15% of the sodium in their diets when they prepare or eat food. Recent trials show that behavior-change interventions can reduce intake, but by only 30-50 mmol/day.<sup>6-9</sup> Hence, any meaningful strategy to reduce salt intake must rely on food manufacturers to reduce the amount of salt that they add during preparation.

### The combination of DASH diet and sodium reduction

The combined effects on blood pressure of lower sodium intake and the DASH diet were substantial and greater than either alone.<sup>12</sup> Therefore, in order to achieve the greatest effect on blood pressure, it is recommended that both interventions be used.

## Conclusion

Dietary strategies can have a major impact on hypertension prevention and treatment. The evidence has been established for the independent benefits of weight loss, sodium reduction, and the DASH dietary pattern. It is safe to say that the hypertension problem in developed countries is largely a result of adverse dietary habits, in both the quality and the quantity of food intake. Unfortunately, developing countries appear to be recapitulating these detrimental dietary patterns. To reverse this trend, physicians, patients, and society at large, all have important roles to play in utilizing the knowledge we now have regarding the ability of a proven dietary regimen to reduce and prevent hypertension.

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**Editor's note:**

At our request, Dr. Sacks has divided his Brigham and Women's Hospital Cardiovascular Grand Rounds on diet and cardiovascular disease into two publications. The second part entitled *Dietary Treatment to Prevent Cardiovascular Disease. Part II: Effects on Hyperlipidemia* will appear in the September issue of *Cardiology Rounds*.

In addition, the Cardiovascular Division of Brigham and Women's Hospital is preparing *Cardiology Scientific Updates* from key presentations at the European Society of Cardiology held in Stockholm, Sweden, September 1-5, 2001.



**Frank M. Sacks, M.D.**, is a Professor of Cardiovascular Disease Prevention, Harvard School of Public Health, and an attending physician at Brigham and Women's Hospital where he has a specialty clinic in hyperlipidemia. He is involved in research and public policy in nutrition, cholesterol disorders, hypertension, and cardiovascular disease.

His research program is a combination of laboratory research on human lipoprotein metabolism, clinical trials in nutrition, and drug therapy in cardiovascular disease. Dr. Sacks is the Chair of the Steering Committee for the recently completed DASH-Sodium trial. This multi-center NHLBI trial studied the effect of dietary patterns and salt intake on blood pressure in persons with mild hypertension or high-normal blood pressure. Dr. Sacks was the Principal Investigator of the Cholesterol and Recurrent Events trial (CARE) that found that pravastatin treatment reduced coronary events and stroke in patients with average cholesterol concentrations.

Dr. Sacks is active in national and international committees and conferences in nutrition and health guidelines. He is member of the American Heart Association Nutrition Committee, the policy making group for nutrition at the AHA. He recently chaired European-American consensus conferences on dietary fat and health. He was a member for 7 years of the Nutrition Study Section, the grant review committee on nutrition for the NIH.

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