

Reducing the Public Health Burden From Elevated Blood Pressure Levels in the United States by Lowering Intake of Dietary Sodium

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Elevated blood pressure levels are a major cause of heart disease and stroke. *Healthy People 2010* established objectives to reduce mortality from these diseases by 20% and to reduce the major causal factors associated with these elevated levels, such as excess sodium intake. The American public consumes far more sodium than is needed, most of which is added by food manufacturers and restaurants.

In November 2002, the American Public Health Association adopted a policy resolution calling for a 50% reduction in sodium in the nation's food supply over the next 10 years. Such a reduction would greatly enhance the chances of attaining the *Healthy People 2010* objectives and would save at least 150 000 lives annually. This issue warrants public health intervention. (*Am J Public Health*. 2004;94:19–22)

CARDIOVASCULAR DISEASES

are responsible for 40% of all deaths in the United States. Each year more than 725 000 Americans die of heart disease, the leading cause of death in the United States; most of these deaths are due to coronary heart disease (CHD).¹ More than 160 000 people die each year of stroke, the third leading cause of death.¹ Of special concern, age-adjusted death rates for CHD and stroke among Blacks are approximately 50% and 80% higher, respectively, than among Whites.

Healthy People 2010 set two important goals: (1) increasing quality of life and years of life and (2) eliminating health disparities.² In line with these goals, *Healthy People 2010* established objectives to reduce age-adjusted CHD and stroke mortality rates by 20% among individuals of all races by 2010.²

High blood pressure levels—systolic levels above 120 mm Hg and diastolic levels above 80 mm Hg—are one of the major causes of cardiovascular disease. The relationship between blood pressure level and risk of developing cardiovascular disease is strong, continuous, graded, consistent, independent, and etiologically significant. The risks of heart attack, congestive heart failure, stroke, and end-stage renal disease increase progressively as blood pressure rises above optimal levels.^{3–6}

Hypertension, defined as a systolic blood pressure of 140 mm Hg or higher and a di-

astolic blood pressure of 90 mm Hg or higher (or taking medication to control the condition), affects about 50 million US adults.^{7,8} The prevalence of hypertension rises dramatically with age. By the age of 80 years, more than 70% of the population is hypertensive, as compared with fewer than 10% of individuals aged 30 to 39 years.⁷ Blacks have about a 40% higher prevalence rate of hypertension than Whites⁷; this increased prevalence represents one of the major reasons for their higher cardiovascular disease incidence and mortality rates.⁷

Most hypertension is uncontrolled, and nearly half of patients with hypertension do not receive treatment.⁹ The *Healthy People 2000* goal of 50% of people with hypertension having their blood pressure controlled to a level less than 140/90 mm Hg was not met^{9,10}; instead, only about 25% of adults with hypertension have their blood pressure controlled to this extent.⁹ A similar goal for improving hypertension control by the year 2010 was established in *Healthy People 2010*.²

In addition, roughly 20 million adults have systolic blood pressure levels between 130 and 139 mm Hg or diastolic levels of between 85 and 89 mm Hg, placing them at significantly increased risk for developing heart disease and stroke. Recent data from the Framingham Heart Study show that individuals at such blood pressure levels have a 1.5 to 2.5 times greater risk of

experiencing a heart attack, a stroke, or heart failure in 10 years than those whose blood pressure level is below 120/80 mm Hg.¹¹ The adverse effects of such levels are found among men and women of all ages, and especially among those aged 65 years or older.

NEED FOR PUBLIC HEALTH INTERVENTIONS

Effective public health interventions that will lead to population-wide reductions in blood pressure are necessary if the *Healthy People 2010* goals and objectives noted earlier are to be met. Moreover, as a result of elevated blood pressure levels, arterial disease and target organ (e.g., kidneys, eyes, heart) damage often occur before the onset of hypertension. Antihypertensive medications can be costly, and many patients fail to take medications as prescribed. Moreover, almost all antihypertensive medications carry the potential for adverse effects. Primary prevention of hypertension provides an attractive opportunity to interrupt and prevent the continuing costly cycle of managing hypertension and its complications.^{12,13}

National guidelines recommend 5 approaches to preventing hypertension: (1) reduction of sodium intake; (2) an eating plan that is rich in fruits, vegetables, and low-fat dairy products and reduced in saturated fat, total fat, and cholesterol; (3) prevention and reduction of excess body

weight; (4) regular physical activity; and (5) moderation of alcohol intake.¹³ These approaches also are effective in treating hypertension and reduce the need for medications. Efforts by public health practitioners to address weight control, dietary composition, physical activity, and alcohol consumption have been ongoing for a number of years, and these difficult but important issues must continue to be addressed.

IMPORTANCE OF REDUCING CONSUMPTION OF SODIUM

The goal of decreasing sodium consumption has received somewhat less attention. Yet, because it can be accomplished by changing the population's exposure to sodium in the food supply, it represents the challenge most amenable to a public health solution.

There is a clear relationship between habitual sodium intake and blood pressure levels. In their meta-analysis of 32 randomized clinical trials, Cutler et al.¹⁴ concluded that a daily decrease in sodium intake corresponding to 100 mmol (about 2300 mg) lowers (systolic/diastolic) blood pressure by 5.8/2.5 mm Hg among individuals with hypertension and by 2.3/1.4 mm Hg among those without hypertension. In addition, within-population studies have shown that lowering sodium intake by 100 mmol a day—from 170 mmol (about 3800 mg) to 70 mmol (about 1500 mg)—is associated with a reduction of 3 to 6 mm Hg in systolic blood pressure.¹⁵

Randomized clinical trials have demonstrated that reducing sodium intake decreases blood pressure among people both with

and without high blood pressure. One such trial, the Dietary Approaches to Stop Hypertension (DASH) Sodium Study, reported decreases in blood pressure associated with reduced sodium intake, with the greatest reductions being seen with the lowest sodium intakes.^{16,17} Participants were randomized either to the DASH eating plan or to the usual American diet. Individuals consumed their respective diets at 3 random-order sodium levels: (1) high level (142 mmol per day, about 3300 mg), (2) intermediate level (107 mmol per day, about 2400 mg), or (3) low level (65 mmol per day, about 1500 mg).

Sodium reduction alone from a high level to a low level reduced blood pressure by 8.3/4.4 mm Hg among individuals with hypertension and by 5.6/2.8 mm Hg among those without hypertension; the greatest reductions in blood pressure were seen in 2 groups at high levels of risk for developing hypertension, Blacks and older persons. The combination of this amount of salt reduction and the DASH diet lowered blood pressure levels by 11.5/5.7 mm Hg and 7.1/3.7 mm Hg, respectively, among those with and without hypertension. These findings reaffirm the benefit of recommending that sodium be limited to 2400 mg or less per day; they suggest that limiting sodium intake further to 1500 mg per day is feasible and would result in additional reductions in blood pressure levels without adverse effects.

Blood pressure reductions such as those just described would have major effects on mortality and morbidity. For example, a 5 mm Hg decrease in mean population systolic blood pressure levels would result in

14% fewer deaths from stroke, 9% fewer deaths from CHD, and 7% fewer deaths overall.¹⁸

Higher sodium intakes have negative effects in addition to that of increasing blood pressure levels. The National Health and Nutrition Examination Survey Epidemiologic Follow-up Study showed that, among participants aged 25 to 74 years who were overweight, a 100-mmol increase in intake of sodium was associated with an increase in relative risk of coronary heart disease mortality of 61%, an increase in stroke mortality of 89%, and an increase in all-cause mortality of 39%. Moreover, these effects were found *after* adjustment for blood pressure, age, body mass index, and other important variables.¹⁹ Given that more than 50% of adults are now considered to be overweight,²⁰ this study has major implications in regard to the importance of reducing sodium intake above and beyond concerns about blood pressure.

SOURCES OF SODIUM IN THE AMERICAN DIET

Data from the 1994 through 1996 Continuing Survey of Food Intakes by Individuals indicated an estimated average dietary sodium intake among US adults aged 20 years or older of approximately 142 mmol per day (3300 mg) per 2000 calories.²¹ This estimate does not include discretionary sodium use, such as salt added at the table. Adding in discretionary sodium use results in an average increase in daily intake of about 15%.²² Thus, the average American adult ingests nearly 170 mmol per day (4000 mg) of sodium, far exceeding the current recommendation of no more than 2400 mg

per day (approximately 6 g of sodium chloride).⁷

Approximately 75% of the daily sodium intake of the US population comes from salt added by food manufacturers and restaurants; only 10% comes from foods' natural content.^{22,23} High dietary salt intakes thus normally result from a large portion of daily calories consisting of processed foods. This makes it extremely difficult for consumers to follow a low-sodium diet. Many canned and frozen foods contain 1000 mg or more of sodium in an 8-oz (224-g) serving. Consumers must read food labels very carefully to select lower sodium products, especially breads, cereals, canned foods, frozen meals, cheese, and processed meats; often such products are difficult to find or cost more. Restaurant meals, which are not labeled, may contain 4000 mg or more of sodium, added without the consumer's knowledge.²⁴

Conversely, the DASH eating plan, which is rich in fruits, vegetables, and low-fat dairy products and reduced in sodium, saturated fat, total fat, and cholesterol, is associated with lower blood pressure levels.^{16,25} This eating plan is also consistent with current public health recommendations, including the 2000 US federal government dietary guidelines for Americans.

In the United Kingdom, organizations have been successful in working with food manufacturers to reduce the overall sodium content of processed foods. For example, a UK supermarket chain (Sainsbury's) has reduced salt content in its store brand products. The company's aim is to reduce salt content by 10% to 15% without affecting quality or safety.²⁶ To date, it has removed the equiv-

alent of more than 400 tons of salt per year across a broad range of its products, including ready-made meals, sausages, and bread. The company did not advertise this salt reduction, and judging from the lack of customer comments, the salt seems not to have been missed.

Evidence of the efficacy and safety of a dietary sodium intake of no more than 2400 mg per day was reviewed and affirmed in 1989 by the National Academy of Sciences and in 1993 by the National High Blood Pressure Education Program Working Group on Primary Prevention. The 2400-mg recommendation has also been carefully reviewed and approved by the National Heart, Lung, and Blood Institute's National High Blood Pressure Education Program Coordinating Committee, which includes representatives from 45 professional health-related agencies. The evidence was reaffirmed in the *Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC VI)*⁹ and by a 1999 workshop on sodium and blood pressure sponsored by the National Heart, Lung, and Blood Institute.²⁷

These reviews support the assertion that lowering Americans' daily dietary sodium intake to no more than 2400 mg would reduce the mean blood pressure of the US population. Healthy adults living in a temperate climate can maintain a normal sodium balance with as little as 115 mg of dietary sodium per day. Given the wide variation in Americans' physical activity and climatic exposure, a level of 500 mg of sodium intake per day is considered safe.²⁸ Data derived from animal experiments, observational studies, and randomized clinical trials have

shown no long-term adverse effects associated with substantial reductions in habitual daily sodium intakes.¹²

A CALL FOR ACTION

Attainment of lower sodium levels in the general population represents an important public health opportunity and challenge. *Healthy People 2010* has established an objective to increase the percentage of the population that meets the standard of 2400 mg or less of daily sodium intake from 21% to 65% by the year 2010.² Gradually reducing the amount of sodium added in the manufacturing and commercial preparation of food is a prudent and safe public health intervention and the single most effective means of attaining this objective.

This reduction will also make a substantial contribution to meeting the *Healthy People 2010* objective of 50% of individuals with hypertension having their blood pressure under control, as well as the objective of a 20% reduction in mortality rates from heart disease and stroke. Meeting these objectives can play a major role in making progress toward the 2 overarching goals of *Healthy People 2010*.

Furthermore, such an action will meet the growing consumer demand for products lower in sodium. Consumer education and product availability must go hand in hand. If they do, the benefits reaped will be substantial.

Recognizing the importance of action on this issue, the American Public Health Association adopted a policy resolution at its November 2002 annual meeting calling for a 50% reduction in sodium in processed and restaurant foods over the next 10

years.²⁹ New *JNC VII* guidelines have endorsed this resolution.³⁰ We estimate that, when fully implemented, this reduction will result in at least a 5 mm Hg decrease in systolic blood pressure levels, a 20% reduction in the prevalence of hypertension, and 150 000 fewer deaths.

Follow-up activities will be necessary to ensure that the food industry follows through with the recommendations included in the American Public Health Association's policy resolution. The public health of Americans will be significantly improved by this critical means of preventing and controlling hypertension. ■

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Each of the 3 authors contributed to the writing and revision of the article. S. Havas took the lead in writing the article.

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