Salt and Blood Pressure—A Need to Reduce Levels at Any Age

Studies on salt intake of Western countries—such as the recent one reported here from the Swiss—continue to document high sodium intake in adults. In the study of adults (aged 35–74 yr) from Geneva (n = 6,688 men and 6,647 women), the average dietary salt intake was calculated to be 10.6 g/d for men and 8.1 g/d for women (2). These averages were calculated using a validated, semiquantitative food frequency questionnaire with discretionary salt being estimated using extensive analysis on a subset of 100 volunteers from the cohort. During the 12 yr course of the study, the salt intake varied little and, unfortunately, remained well above recommended levels. In addition to actual intakes of salt, salt density—that is, salt per energy intake reported in g/MJ—was also calculated. Salt density was shown to increase both with age and with body mass index.

In the Swiss cohort, dietary sources of nondiscretionary salt accounted for 48% of the salt intake. (Note: This is lower than the nearly 75–80% found in some other Western countries.) Breads accounted for 17%, cheeses 10–11%, meat and meat products 7–8%, soups 6–9%, and ready-to-eat foods 5%. The authors concluded that salt intakes from all sources were too high for those in Geneva and probably most all Swiss adults.

The concern about high sodium intakes is due to the link between salt intake and increased blood pressure in the adult population. Elevated blood pressure is associated with metabolic syndrome and cardiovascular disease (CVD). Worldwide, more than 26% of adults have hypertension. Annually, nearly 8 million cardiovascular deaths are attributed to hypertension (systolic blood pressure [SBP] ≥140 mm Hg and/or diastolic blood pressure [DBP] ≥90 mm Hg). Many additional deaths are attributable to a condition labeled as prehypertension, where the blood pressure is above normal but below levels considered hypertensive (SBP 120–139 mm Hg and/or DBP 80–89 mm Hg).

In the United States, more than 27% of adults have hypertension and another 31% have prehypertension. Across populations, aging is associated with increased prevalence of hypertension. Data on the U.S. population suggest that the lifetime probability of developing hypertension is nearly 90%.

The effects of high salt intake in adults have raised concern that the development of hypertension is accelerated due to high intakes of salt in children. A recent UK study on adolescents and children showed that lowering salt intake in children reduces blood pressure. In the nationally representative sample of British young people (n = 1,658 children aged 4–18 yr) done as part of the 1997 National Diet and Nutrition Survey, higher levels of dietary salt, as determined by 7-day dietary records, were associated with higher blood pressures (7). Systolic blood pressure was shown to increase 0.4 mm Hg with every 1 g increment of salt ingested. The authors noted that those who had somewhat elevated blood pressure in the early years were more likely to develop high blood pressure later in life. The average salt intake, which did not include salt added in cooking or at the table, was 4.7 g/d at the age of 4 yr and 6.8 g/d by the age of 18 yr.

The British findings are consistent with the results of a meta-analysis of 10 trials on salt reduction in children and adolescents. The meta-analysis showed that decreasing salt intake by 42% for approximately 4 weeks lowered systolic blood pressure by 1.17 mm Hg and diastolic blood pressure by 1.29 mm Hg. While the actual drop in blood pressure may not seem great, both of the decreases were statistically significant. Similarly, analysis of the data on infants revealed that a reduction in salt intake of just over 50% was associated with a drop in systolic blood pressure of about 2.5 mm Hg. The authors proposed that the combined data from all the studies makes clear the need to call for measures to lower salt in the diets of children with the probability that this would not only have immediate impacts on blood pressure, but also would be likely to reduce the number of people developing high blood pressure later in life.

A British review (6) also published in 2007 suggests that elevated blood pressure is responsible for 62% of strokes and 49% of coronary heart disease in developed countries and that dietary salt is a major cause of raised blood pressure. In this review of ecological, population, and prospective cohort studies, as well as follow-up studies of individuals who participated in short-term salt reduction trials, a modest reduction in salt intake lowered blood pressure and would be associated with a reduction in CVD and mortality. The authors state that the evidence for universal salt reduction is strong, and reducing salt from the current intake of 10–12 g/day to the recommended level of 5–6 g/day will have a major effect on blood pressure and cardiovascular mortality. They also suggest that the reduction in salt intake could also result in considerable savings on health care expenditure.

The constancy of data across populations that links the level of blood pressure, the incremental rise in blood pressure with age, and the prevalence of hypertension directly to sodium intake resulted in a review paper by the Council on Science and Public Health (CSPH), American Medical Association, in a recent Journal of the American Medical Association titled “The Urgent Need to Reduce Sodium Consumption” (4). The review noted the following points:

- The majority of sodium consumed in the United States is derived from that added during food processing;
- Leading scientific organizations and governmental agencies advise limiting sodium intake to 2,400 mg or less daily (approximately 6,000 mg of salt); and

doi:10.1094/CFW-53-1-0043
• Substantial public health benefits accrue from small reductions in the population blood pressure distribution. A 1.3 g/d lower lifetime sodium intake translates into an approximately 5 mm Hg smaller rise in systolic blood pressure as individuals advance from 25 to 55 years of age, a reduction estimated to save 150,000 lives annually.

The CSPH requested that the food industry work voluntarily to lower sodium by developing technical solutions so that safe, lower-sodium foods would be available to the public without loss of convenience or food enjoyment. The CSPH suggested that if industry failed to do this voluntarily, then regulations would be needed. The CSPH also requested that there be consumer education programs on lowering sodium, which includes help for consumers with use of food labels.

This call to action is consistent with that of many health agencies worldwide. Both the World Action on Salt and Health (WASH) and Consensus Action on Salt and Health (CASH) are placing pressure on food companies to reduce dietary salt intake.

Other groups such as EuSalt dispute the need for salt intake restrictions. The detractors note that studies are associational and do not constitute a cause-effect relationship. One part of the debate focuses on whether reducing salt intake will significantly reduce cardiovascular risk. For instance, a recent prospective study in Japan with its high rates of hypertension looked at dietary patterns of 40,547 men and women over 40 and the risk of CVD (8). The study compared three dietary patterns: 1) a Japanese dietary pattern that was related to high salt intakes and hypertension that included soybean products, fish, seaweeds, vegetables, fruits, and green tea, 2) an “animal food” dietary pattern, and 3) a high-dairy, high-fruit-and-vegetable, low-alcohol (DFA) dietary pattern. Despite the relationship with hypertension and higher sodium intake, the Japanese dietary pattern score was associated with a lower risk of CVD mortality (hazard ratio of the highest quartile vs. the lowest, 0.73). The animal food dietary pattern was associated with an increased risk of CVD, but the DFA dietary pattern was not.

Data from a Rotterdam case-cohort study (5) of subjects over 55 years of age established no consistent association between urinary sodium, potassium, or sodium/potassium ratio with either CVD or all-cause mortality. The lack of association could be due to the already high intakes observed in this population. Dietary potassium estimated by food frequency questionnaire, however, was associated with a lower risk of all-cause mortality in subjects initially free of CVD and hypertension (RR = 0.71). The study also noted a significant positive association between urinary sodium/potassium ratio and all-cause mortality, but only in overweight subjects who were initially free of CVD and hypertension (RR = 1.19).

In the Second National Health and Nutrition Examination Survey (NHANES II), sodium intake was estimated by single 24-hour dietary recall and adjusted for calorie intake and the relationship of this to CVD was measured (3). The community sample (n = 7,154) represented 78.9 million noninstitutionalized U.S. adults (ages 30–74). Sodium (adjusted for calories) and sodium/calorie ratio as continuous variables had independent inverse associations with CVD. The adjusted Hazard Ratio (HR) of CVD mortality for sodium <2,300 mg was 1.37. If the sodium threshold was lowered to 1,900 mg or raised to 2,700 mg, the results varied little. While most subgroups showed the inverse association, this was not the case for those under 55 yrs old, for nonwhites, or the obese. The authors suggested that the inverse association between sodium and CVD mortality brings into question the need to lower dietary sodium and calls for more studies to delineate the relation of dietary sodium to overall mortality.

These three studies are examples of why larger analyses are unable to draw clear associations between dietary sodium and adverse cardiovascular events or mortality. Such is the case in a review using a structured protocol (10). The protocol researched 462 papers in order to select the 14 papers that represented the best evidence on the subject. Analysis of the protocol concluded that restricting sodium intake to levels below 6 g/d, as most international guidelines—the American Heart Association, the U.S. Dietary Guideline Committee, and the Scientific Advisory Committee on Nutrition—recommend, clearly reduces blood pressure and in turn may reduce the need for antihypertensives by as much as 30%. However, the link between dietary sodium restriction and the reduction in the incidence of cardiovascular events is not clear-cut. The authors noted that while some studies show a 20–30% reduction in CVD, there are insufficient large trials with adequate rigor to make strong conclusions.

So what is the food industry to do? It appears that the data linking salt and reduced hypertension are conclusive, even though those on other cardiovascular endpoints are not. Thus, the food and cereal industry should take notice and make efforts to reduce salt in foods.

In the United States, the average man consumes 3,100–4,700 mg/d of sodium and the average women 2,300–3,100 mg/d. Put another way, 95% of men and 75% of women regularly consume sodium in excess of the safe upper intake level (UL) of 2,300 mg/d (for those aged 31–50 yr) (1).

Since data from the UK, Ireland, and the United States show that around 80% of salt intake comes from processed food, with about 35% from cereal and cereal products, companies should employ strategies to include technical advances in the making of bread and other cereal-based products while allowing for salt reduction and maintaining taste and functionality. In addition, there needs to be an industry-wide strategy to gradually reduce salt wherever possible. Furthermore, consumers need to be encouraged to use herbs and other flavoring agents to replace the salt they might add at the table and in cooking. Herb and spice suppliers to the cereal and food industry could help with strategies to help maintain flavor while decreasing the sodium content.

Glycemic Index Values Vary Widely

Multiple glycemic index (GI) determinations, which compared 50 g of available carbohydrate from white bread versus 50 g of glucose in solution in 14 individuals on three different days, showed that the measure has a high level of interindividual and intra-individual variability (9). While the average value of the GI in this study for white bread was 71, which is nearly identical to the published value, individual values ranged from 44 to 132. The coefficient of variation (CV), a measure of how much the values vary, for a single individual varied by as much as 42.8% and between individuals varied as much as 17.8%. Causes of the observed variability seen with single foods are not known and need to be determined. Further, understanding how the GI of foods changes when foods are eaten in their usual manner, e.g., in meals and combinations, is needed to improve the usefulness of this measure. Despite the variability, the paper’s authors thought that the use of the glycemic index for groups can be used as a reasonable indicator to predict chronic disease risk.

Most of the conclusions of this paper, except for the latter one, are similar to those of the AACC International Glycemic Response Task Force. Both this paper and the Task Force urge the development of methodology that reduces variability and reflects accurately the amount of food eaten. Such improvements are important because a number of studies suggest that a diet with a
low glycemic load with slowly digestible carbohydrates may play a role in preventing obesity and diabetes.

References


Julie Miller Jones, a board-certified (CNS) and licensed nutritionist, is a professor in the Department of Family, Consumer and Nutritional Sciences at the College of St. Catherine in St. Paul, MN. She writes and speaks locally, nationally, and internationally on issues regarding nutrition and food safety, with special emphasis on whole grains and dietary fiber, carbohydrates and glycemic index, and dieting. She can be reached at juliemjones@comcast.net.