Sodium Intake and Blood Pressure: New Controversies, New Labels . . . New Guidelines?

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ARTICLE INFORMATION

Article history:
Accepted 19 September 2014
Available online 20 November 2014

Keywords:
Sodium
Dietary intake
Hypertension
Health literacy
Nutrition label

http://dx.doi.org/10.1016/j.jand.2014.10.013

HYPERTENSION AND PREHYPERTENSION ARE highly prevalent; these conditions are present in 29% and 36% of US adults aged 18 and older, respectively.[1,2] Among adults aged 60 years and older, hypertension prevalence rises to about two-thirds of US adults (ie, 65%).[1] Of individuals with hypertension, only about half (ie, 52%) have their blood pressure adequately controlled to <140/90 mm Hg.[1] Mortality rates are higher among those with hypertension than among nonhypertensives (ie, 14.3 vs 9.1 per 1,000 person-years).[3] Given that hypertension is a leading cause of death and disability worldwide, the American Medical Association is focusing its efforts to improve cardiovascular disease outcomes by first addressing hypertension treatment.[4] It has been estimated that, on a national level, reducing sodium intake by 400 mg/day in those with uncontrolled hypertension would save $2.3 million in medical costs annually,[5] and that reducing the population's average sodium intake to 2,300 mg/day may reduce hypertension cases by 11 million and save $18 billion in health care costs.[6]

Recommended treatment approaches for blood pressure reduction include reducing daily sodium intake to <2,300 mg/day, or to 1,500 mg/day for those in high-risk subgroups (aged older than 51 years, African Americans, or those with hypertension, diabetes, or chronic kidney disease); the Dietary Approaches to Stop Hypertension (DASH) dietary pattern; weight control; and regular exercise.[7-9] The American College of Cardiology/American Heart Association Task Force on Practice Guidelines evaluated evidence of the influence of lifestyle factors on cardiovascular disease prevention and treatment.[8] In its 2013 report, the Task Force concluded that evidence graded as moderate supported the recommendation of specific sodium intake levels (eg, 2,400 mg/day, 1,500 mg/day) for blood pressure reduction, but that strong evidence supported the recommendation to reduce sodium intake for blood pressure reduction.[8] Yet 90% of US adults consume more sodium than is recommended, with major dietary sources being packaged foods and restaurant meals.[10] In addition, <20% of individuals with hypertension report consuming a diet consistent with the DASH guidelines.[11]

In 2013, the Institute of Medicine (IOM) released a report addressing sodium intake and health outcomes that created controversy and, perhaps, confusion.[12] This report concluded that existing evidence supported a positive relationship between sodium intake and cardiovascular disease risk and population-based efforts to lower excessive sodium intake, but that existing evidence does not support recommendations to reduce sodium intake to 1,500 mg/day in the general population or in high-risk subgroups, described previously.[12] The committee also did not find sufficient evidence of the benefits of a sodium intake between 1,500 and 2,300 mg/day. In addition, the committee did find some risk of adverse health outcomes with this level of sodium intake among high-risk subgroups (ie, individuals with congestive heart failure, diabetes, kidney disease, and cardiovascular disease). Methodological limitations, including inaccurate self-reported sodium intake and incomplete urine collections, and variations in study designs that made comparison across studies difficult, were cited by the IOM as issues that must be addressed in future research on this topic.[12]

Three recently published articles have added to the controversy surrounding sodium intake and health outcomes. Graudal and colleagues[13] conducted a meta-analysis of primarily observational studies, and compared all-cause mortality and cardiovascular events across three sodium intake levels: low (<2,645 mg/day), usual (2,645 to 4,945 mg/day), and high (>4,945 mg/day). The authors reported a U-shaped relation, meaning that the lowest risk of mortality and cardiovascular events was associated with the usual sodium intake level, which is above the US recommended intake of 2,300 mg/day. The American Heart Association issued a response, stating "Reduced salt intake critical,"[14] and called the review by Graudal and colleagues flawed, in that study populations were not representative of the general population, but rather those with poor health, and that unreliable measurements of sodium intake (eg, self-reported dietary intake, spot urine secretions) were used. Within weeks, He and colleagues[15] published results from the Health Survey for England, which attributed significant reductions in blood pressure, stroke, and ischemic heart disease mortality during an 8-year period to a 15% reduction in salt intake during this time period. Salt intake was assessed using an objective indicator (ie, biomarker) of sodium intake, 24-hour urinary sodium excretion, which was verified for completeness using para-aminobenzoic acid. Despite this strength, a limitation of

this investigation was the use of separate random samples (ie, different sets of participants) for assessment of sodium excretion vs blood pressure and mortality. The Trials of Hypertension Prevention (TOHP) Follow-Up Study used the average of several (ie, three to seven) 24-hour urine collections during an 18-month or 3- to 4-year period as the indicator of usual sodium intake. Recently reported results from this follow-up investigation demonstrated a linear association of sodium excretion with cardiovascular disease events; a reduction in risk was noted with descending levels of sodium excretion from 3,600 mg/day to 2,300 mg/day to 1,500 mg/day. However, the follow-up period was 5 to 10 years after trial completion and it is not known whether sodium intake levels were consistent at the initial and follow-up assessment periods.[16] Despite their limitations, when taken together, these recent articles do seem to support the report of the IOM and the American College of Cardiology/American Heart Association Task Force recommendation to reduce excessive sodium intake to lower cardiovascular disease risk and mortality.

The Nutrition Facts Label was developed to provide consumers, from both the general population and those at risk for cardiovascular disease, high blood pressure, or stroke,[17] with information that can be used to make healthier food choices. In this issue of the *Journal of the Academy of Nutrition and Dietetics*, Elfassy and colleagues describe the findings of a cross-sectional evaluation of New York City residents with and without hypertension, participating in the 2010 Community Health Survey Heart Follow-Up Study (n=1,656).[18] Self-reported use of sodium information from the Nutrition Facts Label was compared to 24-hour urinary sodium excretion, according to self-reported hypertension status. The authors reported that the odds of using the Nutrition Facts Label for sodium information was higher among individuals with hypertension than among those without hypertension (odds ratio=1.71). Among hypertensive individuals, sodium intake (assessed by sodium excretion) was not different among label users and nonusers, with intake levels being just above 3,000 mg/day.

There are several possible explanations for these findings. First, individuals with hypertension may be aware that sodium intake should be limited and are seeking out this information, but they may not comprehend the information on the label or understand how to apply this information to improve their dietary habits. Second, because label usage was self-reported, it is possible that hypertensive individuals in this sample reported using the label because they are aware this is something they should do (ie, social desirability). Lastly, as acknowledged by the authors, a single 24-hour urine collection reflects sodium consumption on a single day, and may not reflect habitual sodium intake.

One issue that was not addressed in this investigation was whether sodium excretion and label usage was different in hypertensive individuals with well-controlled compared with not optimally controlled blood pressure. Furthermore, it was not clear whether individuals taking medications that could alter sodium excretion were included (eg, diuretics), or whether those with hypertension had been prescribed a specific level of sodium intake by a health care provider. Future studies are needed to address these issues, although the findings of Elfassy and colleagues are relevant to registered dietitian nutritionists (RDNs), as they suggest that when providing medical nutrition therapy to individuals with hypertension that label-reading "nutrition literacy" should be addressed in order to effectively promote sodium intake reduction.[18]

In the US population, the use of the Nutrition Facts Label is increasing. From 2002 to 2008, the Food and Drug Administration reported that rates of frequent label use among consumers increased from 44% to 54%, and that in 2008, two-thirds of consumers reported using the label to determine sodium content.[19,20] However, consumers must have adequate health and nutrition literacy and numeracy skills for label usage to impact dietary behaviors. Health literacy refers to an individual's ability to obtain and comprehend health information.[21] More than one-third of US adults have limited health literacy, which reduces their ability to interpret labels and health messages.[21]

The associations of literacy and numeracy with Nutrition Facts Label comprehension was evaluated by Rothman and colleagues,[22] who reported correlations between food label comprehension and income, education, literacy, and numeracy skills. Most (89%) in this sample of primary care patients reported using the Nutrition Facts Label. However, those with a chronic illness (eg, hypertension, diabetes) scored significantly lower on the Nutrition Label Survey to assess label comprehension compared with those without a chronic illness (65% vs 72% correct). Some of the commonly encountered errors that occurred as a result included the inability to apply serving size/servings per container information, calculation errors, and incorrect use of the percent Daily Value column or the Recommended Daily Allowance footnote.

In February 2014, the Food and Drug Administration proposed label changes to the Nutrition Facts Label,[17] which were supported by the Academy of Nutrition and Dietetics.[23] The proposed changes (displayed in the Figure) included shifting %Daily Value to the left of the label, highlighting caloric content of foods and the servings per container (ie, using larger, bold font), changing "Amount per serving" to "Amount per ___" (eg, "Amount per $^1/_2$ cup"), and revising the footnote explaining the %Daily Value.[17] Serving sizes may also be revised to the amount of the food people typically consume at one sitting. For example, the serving size of ice cream would be revised from $^1/_2$ cup to 1 cup. In addition, as packaging size influences amounts of food and beverage consumed, both a 20-fl oz and a 12-fl oz bottle of soda would be described on the label as one serving, because people typically consume a bottle during an eating occasion. For packages that could be consumed over several eating occasions (eg, a pint of ice cream or 24-fl oz bottle of soda), a dual-column food label (see Figure) providing nutrition information both per serving and per package would be required. Changes are also being considered to the dietary sodium information provided on the Nutrition Facts Label; specifically, reducing the sodium Daily Value from 2,400 mg to 2,300 mg. A greater reduction, to 1,500 mg, is also being considered.

Clear nutrition labeling is an indispensable part of helping consumers make informed food choices about the amount of sodium in foods they purchase. However, the proposed labeling changes and improving nutrition and health literacy and numeracy is only part of the solution to reduce population sodium intake. Several countries, including