5. Recommendations on dietary salt

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Abstract

Objective: To provide updated, evidence-based recommendations concerning the effects of dietary salt intake on the prevention and control of hypertension in adults (except pregnant women). The guidelines are intended for use in clinical practice and public education campaigns.

Options: Restriction of dietary salt intake may be an alternative to antihypertensive medications or may supplement such medications. Other options include other nonpharmacologic treatments for hypertension and no treatment.

Outcomes: The health outcomes considered were changes in blood pressure and in morbidity and mortality rates. Because of insufficient evidence, no economic outcomes were considered.

Evidence: A MEDLINE search was conducted for the period 1966–1996 using the terms hypertension, blood pressure, vascular resistance, sodium chloride, sodium, diet, sodium or sodium chloride dietary, sodium restricted/reducing diet, clinical trials, controlled clinical trial, randomized controlled trial and random allocation. Both trials and review articles were obtained, and other relevant evidence was obtained from the reference lists of the articles identified, from the personal files of the authors and through contacts with experts. The articles were reviewed, classified according to study design and graded according to level of evidence. In addition, a systematic review of all published randomized controlled trials relating to dietary salt intake and hypertension was conducted.

Values: A high value was placed on the avoidance of cardiovascular morbidity and premature death caused by untreated hypertension.

Benefits, harms and costs: For normotensive people, a marked change in sodium intake is required to achieve a modest reduction in blood pressure (there is a decrease of 1 mm Hg in systolic blood pressure for every 100 mmol decrease in daily sodium intake). For hypertensive patients, the effects of dietary salt restriction are most pronounced if age is greater than 44 years. A decrease of 6.3 mm Hg in systolic blood pressure and 2.2 mm Hg in diastolic blood pressure per 100 mmol decrease in daily sodium intake was observed in people of this age group. For hypertensive patients 44 years of age and younger, the decreases were 2.4 mm Hg for systolic blood pressure and negligible for diastolic blood pressure. A diet in which salt is moderately restricted appears not to be associated with health risks.

Recommendations: (1) Restriction of salt intake for the normotensive population is not recommended at present, because of insufficient evidence demonstrating that this would lead to a reduced incidence of hypertension. (2) To avoid excessive intake of salt, people should be counselled to choose foods low in salt (e.g., fresh fruits and vegetables), to avoid foods high in salt (e.g., pre-prepared foods), to refrain from adding salt at the table and minimize the amount of salt used in cooking, and to increase awareness of the salt content of food choices in restaurants. (3) For hypertensive patients, particularly those over the age of 44 years, it is recommended that the intake of dietary sodium be moderately restricted, to a target range of 90–130 mmol per day (which corresponds to 3–7 g of salt per day). (4) The salt consumption of hypertensive patients should be determined by interview.

Validation: These recommendations were reviewed by all of the sponsoring organizations and by participants in a satellite symposium of the fourth International Conference on Preventive Cardiology. They have not been clinically tested.

Sponsors: The Canadian Hypertension Society, the Canadian Coalition for High Blood Pressure Prevention and Control, the Laboratory Centre for Disease Control at Health Canada, and the Heart and Stroke Foundation of Canada.

Hypertension is an important part of the etiology and pathogenesis of myocardial infarction, cerebrovascular accidents, congestive heart failure and renal failure.[1,2] In Canada approximately one-fifth of the adult population has high blood pressure.[3] Epidemiologic, clinical and experimental studies suggest that ingestion of a diet habitually high in salt plays a role in the etiology and pathogenesis of hypertension.[4]

Sodium chloride is the most abundant salt occurring naturally in food. However,

Special supplement

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the largest quantities of salt now consumed in North America originate from industrially processed food.[5] Only 20% to 30% of total dietary sodium consumption is discretionary — or consumer-controlled — through the addition of salt to food after its preparation. The rest is derived from naturally occurring sources or commercial processes.

The question of whether restriction of dietary salt can prevent primary hypertension and whether a low-salt diet is an efficacious intervention in the treatment of hypertension is still controversial.[6] The most recent Canadian consensus statement on the role of salt in controlling hypertension was published in 1990.[7] That document recommended moderate salt reduction in normotensive people and salt restriction in those with high blood pressure.

Over the past 20 years, more than 60 randomized controlled trials have been published studying the effects of salt intake in normotensive and hypertensive subjects. Despite the vast literature on this issue, there is still little agreement as to the efficacy, safety and acceptability of this dietary intervention.[8–11]

The purpose of this report is to review the current evidence concerning the effect of dietary salt intake on blood pressure. On the basis of a critical assessment of these data, recommendations for health care professionals are offered as guidelines for patient counselling and for the formulation of relevant nutritional policies.

Methods

A complete description of the methods used in developing these guidelines is given in part 1 of this supplement.[12]

A panel of 5 health care professionals with expertise in the area of hypertension and diet was selected by the Organizing Committee for the lifestyle modification recommendations to address the issue of interaction between salt intake and hypertension. The panel established definitions of modestly restricted salt intake, normal salt intake and excessive salt intake (Table 1).

A published well-conducted meta-analysis[6] formed the foundation of the evidence. Each article cited in the meta-analysis was reviewed by the panel. In addition, a MEDLINE search was conducted for the period January 1966 to September 1996 using the following terms in combination: hypertension, blood pressure, vascular resistance, sodium chloride, sodium, diet, sodium or sodium chloride dietary, sodium restricted/reducing diet, clinical trials, controlled clinical trial, randomized controlled trial and random allocation. In addition, each member of the panel searched his or her own reprint files for any additional articles that might have been missed in the literature search. To ensure consistency, the inclusion criteria used were identical with those of the published meta-analysis.[6] Specifically, to assess the effect of sodium restriction on blood pressure, all randomized trials that included an intervention involving dietary salt and that measured diastolic and systolic blood pressure as main outcomes were used. Abstracts and unpublished studies were excluded. Other studies that investigated the effect of salt restriction on left ventricular hypertrophy and papers dealing with the interaction of salt restriction and pharmacologic treatment were used. Review articles and papers reporting on trials dealing with the interaction effects of salt intake, drugs and weight loss were also reviewed by members of the panel. The articles were classified according to study design and subjects (hypertensive or normotensive people). The principles for grading the evidence and the recommendations were based on those previously used by the Canadian Hypertension Society[13] and are summarized in part 1 of this supplement.[12]

A statistical analysis was performed to determine the effect of dietary interventions by correlating changes in urinary excretion of sodium with changes in blood pressure. The methods used to calculate this effect are described in the previously published meta-analysis.[6]

An attempt was made to reach consensus on all recommendations. The evidence and the recommendations were presented to the other expert panels for this guidelines series, submitted for review to major Canadian organizations and presented at an international conference on preventive cardiology, to allow for further national and international input. All revisions were reviewed and assessed by the panel before incorporation into the final document.

Results

Twenty-nine studies of normotensive subjects[14–42] and 30 studies of hypertensive subjects[14,24,32,43–69] were identified and reviewed. Studies of normotensive subjects tended to be short-term studies with less than 1 month of intervention. Only 3 long-term studies of normotensive subjects (lasting more than 1 year) were identified.[23,24,42] The subjects in the studies of normotensive people were generally younger (mean age 26 years) than those in the studies of hypertensive people (mean age 47 years). Trials with hypertensive subjects had longer intervention periods, and 5 long-term studies were identified.[44,53,58,64,69] Apart from the studies identified from the meta-analysis,[6] 19 additional studies were evaluated.[4,5,22,40,41,42,49,67,70–80]

Salt and normotensive adults

Only a few studies have investigated the feasibility of preventing hypertension by nonpharmacologic interventions.[22,42,71,81] In a recent trial of more than 2000 subjects,[42] restricting salt intake was much less effective than weight loss in preventing hypertension.

Recommendation

- Restriction of salt intake for normotensive people is not recommended at present because of insufficient evidence to indicate that this would lead to reduced incidence of hypertension (grade B recommendation).

Table 1: Daily intake of sodium for moderately restricted, normal and excessive sodium diets

Moderately restricted sodium intake	Normal sodium intake	Excessive sodium intake
90–130 mmol Na+	131–175 mmol Na+	> 175 mmol Na+
1.0–1.5 tsp NaCl	1.6–3 tsp NaCl	> 3 tsp NaCl
5.0–7.5 g NaCl	7.6–10 g NaCl	> 10 g NaCl
2.0–3.0 g Na+	3.1–6.0 g Na+	> 6 g Na+

The meta-analysis[6] revealed that the effect of restricting salt in free-living normotensive subjects (people who had been counselled about salt intake but who were not enrolled in tightly controlled trials) was not statistically significant. After adjustment for error in the measurement of urinary excretion of sodium, the decrease in blood pressure for normotensive subjects after a reduction in sodium intake of 100 mmol/day was 1.0 mm Hg for systolic blood pressure and 0.1 mm Hg for diastolic blood pressure.[6]

Although these results suggest that salt restriction yields only modest effects in terms of reducing blood pressure, this panel recognizes that excessive intake of salt in the North American diet should be avoided. A downward shift in the entire distribution of systolic blood pressure by 1 mm Hg is likely to reduce the annual mortality rate from stroke by 3%, the mortality rate from coronary artery disease by 2% and the annual all-cause mortality rate by 1.5%.[70]

Recommendation

- To avoid excessive intake of salt people should be counselled to choose foods low in salt (e.g., fresh fruits and vegetables), to avoid foods high in salt (e.g., pre-prepared foods), to refrain from adding salt at the table and minimize the amount of salt used in cooking, and to increase their awareness of the salt content of food choices in restaurants (grade D recommendation).

Salt and hypertensive adults

For people with high blood pressure, salt restriction seems to have significant value in reducing blood pressure. Midgley and colleagues[6] found that in trials with hypertensive subjects, the adjusted decrease in blood pressure associated with a reduction in daily sodium intake of 100 mmol was 3.7 mm Hg for systolic blood pressure and 0.9 mm Hg for diastolic blood pressure. This effect was more pronounced in people older than 44 years of age.

In a subgroup analysis using only trials in which the mean age was 44 years or older, the decrease was much greater: for a reduction in daily sodium intake of 100 mmol the reduction in systolic blood pressure was 6.3 mm Hg and the reduction in diastolic blood pressure was 2.2 mm Hg. For younger hypertensive patients, the decrease was 2.4 mm Hg for systolic blood pressure and negligible for diastolic blood pressure.[6]

Although reducing salt intake may have beneficial effects on blood pressure in hypertensive patients, a cohort study of 3000 people with mild or moderate hypertension reported that those with a daily sodium consumption of less than 89 mmol had a 4-fold greater likelihood of myocardial infarction than did those with higher sodium intake.[82] Thus, the safety of restricting dietary sodium to less than 89 mmol/day in hypertensive patients has not been established.

Recommendation

- In hypertensive patients, particularly those over the age of 44 years, it is recommended that the intake of dietary sodium be moderately restricted to a target range of 90–130 mmol per day (grade B recommendation).

To determine whether salt consumption plays a role in a patient's elevated blood pressure, an estimate of daily salt consumption must be obtained. Although 24-hour urine collection yields a good estimate of daily salt consumption, accurate collection of such a specimen takes considerable effort on the part of several people, including the physician requesting the test; this makes the test less appealing to medical personnel. In addition, it has been found that repeated 24-hour urine collections are needed to obtain an accurate estimate.

In contrast, an interview assessment of diet can, with a little encouragement, be easily incorporated into a physician's interview with the patient. The mere fact that the physician wants to discuss salt consumption flags it as an important issue for the patient. Several studies have indicated the effectiveness and accuracy of self-reporting and interview assessments in determining a patient's diet. A simple questionnaire suitable for determining the probable level of salt intake is shown in Appendix 1.

Recommendation

- It is recommended that the salt consumption of hypertensive patients be determined by interview (grade D recommendation).

Salt reduction has been suggested as a possible adjunct to pharmacologic treatment to enhance blood pressure control. Several studies have investigated this issue and found that, for hypertensive patients who are receiving antihypertensive medication, salt restriction provides additional benefits in terms of blood pressure control.

One of the larger studies of this type was conducted by Erwteman and associates,[49] who found that an additional 3 mm Hg decrease in diastolic blood pressure could be achieved through salt restriction among patients taking diuretics and β-blockers. Similar results were reported in another study involving 356 patients, in which a low-salt diet provided an additional 4 mm Hg decrease in systolic blood pressure and an additional 2 mm Hg decrease in diastolic blood pressure.[72] Carney and collaborators[73] reported a similar trend for patients using diuretic drugs.

Hypertensive patients receiving angiotensin-converting enzyme inhibitors also appear to benefit from salt restriction. Both MacGregor and colleagues[74] and Hollenberg and coworkers[75] reported that patients receiving captopril had a further decrease in blood pressure when salt intake was moderately reduced. Kristinsson and associates[76] stud-

ied 27 patients and reported an additional reduction of 4 mm Hg in systolic blood pressure and 3 mm Hg in diastolic blood pressure when a low-salt diet was used in conjunction with captopril treatment.

The effect of calcium channel blockers in reducing blood pressure does not appear to be enhanced by restriction of dietary salt. In fact, most studies found that the reduction in blood pressure caused by calcium channel blockers was greater when patients were on a high-salt diet than when they were on a low-salt diet.[77–79]

Salt restriction appears to provide additional benefits for hypertensive patients taking medication, except those taking calcium channel blockers. The additive effect of salt restriction leads to a further decrease of 3–4 mm Hg in blood pressure.[80]

Although this report focuses on the relation between salt intake and blood pressure, the effects of sodium restriction on left ventricular hypertrophy should not be neglected. A positive correlation between sodium intake and changes in left ventricle geometry has been confirmed in normotensive and hypertensive subjects.[83-85] Schmieder and collaborators[86] and Liebson and coworkers[87] found that urinary excretion of sodium was the strongest predictor of left ventricular mass in patients with primary hypertension. Given that hypertrophy is an important independent risk factor for future cardiovascular events, this issue requires further research.

Interpretation

The role of sodium in the etiology and pathogenesis of hypertension remains controversial. Since the 1989 Canadian Consensus Conference on Non-pharmacologic Approaches to the Management of High Blood Pressure,[7] many new studies have addressed the effects of a reduction in dietary sodium on blood pressure. Our panel had at its disposal a recent meta-analysis of 56 randomized trials[6] and assessed additional evidence. The panel ascertained that there is still no evidence that salt restriction prevents hypertension in the general population. It reconfirmed that this manoeuvre is an efficacious strategy for treating hypertension, particularly in patients over 44 years of age. The previous Canadian recommendations did not specify the desirable level of sodium intake per day for normotensive or hypertensive people.[13] We have now established levels for both of these groups.

We recognize that, in addition to individual counselling, the strategies for sodium reduction must involve appropriate food labelling, the availability of alternatives to replace the taste of salt and the availability of low-salt products for consumers.

Another independent meta-anlaysis, published by Graudal and associates in 1998,[88] has confirmed the conclusions of this panel.

Future research

There is a need for further research in several areas.

Studies of normotensive people 40 years of age and over are needed to further assess the influence of sodium on blood pressure. This research should help in formulating nutritional policies for the Canadian population.

Strategies must be developed for educating patients about successful implementation of a salt-restricted diet. Such strategies might include innovative approaches to counselling, development of better teaching aids and development of alternative diets.

In cooperation with the food industry, researchers must find palatable solutions to achieve a gradual reduction of the salt content in food products and to increase the availability of low-salt alternatives. In addition, research on public health policy should include identifying a consumer-friendly way to highlight salt content on food labels and formulating public education campaigns about healthy food choices.

Conclusion

The Canadian population should recognize the benefits of reducing excessive salt intake as a move toward a healthier lifestyle. Health care professionals should be aware that reducing excess salt intake is an efficacious measure in hypertensive patients, particularly those over 44 years of age. Thus, in these patients, counselling and assistance in embarking on a low-salt diet should be an integral part of the overall therapeutic regimen. The panel has recommended a desirable daily target range for salt intake for hypertensive people.

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Appendix 1: Interview to evaluate sodium consumption in hypertensive people

Statement to assess sodium consumption*
I use prepared foods such as frozen dinners, packaged or canned goods, or processed meats or cheeses
I eat salty snack foods such as potato chips, salted nuts, cheese snacks or pretzels
I eat restaurant meals
I salt my food at the table

*Possible responses are "usually" (more than once per week), "sometimes" (approximately once per week) or "rarely or never." The physician should advise the patient who chooses "usually" for any of the items that moderating sodium intake may help control blood pressure. For the patient who chooses "usually" more than twice, the physicians should offer educational material or referral to a dietitian because of the high possibility that the patient's sodium intake is excessive.

Appendix 2: Guidelines for a low-sodium diet (90–130 mmol sodium)

Eat fresh foods such as fruits and vegetables as often as possible (frozen vegetables without sauces are acceptable).

Use processed foods sparingly (e.g., canned vegetables; processed meats such as bologna, bacon, corned beef, ham, smoked meat and sausage; processed cheese food; salted snack foods such as potato chips and popcorn; pickles; sauerkraut; and prepared sauces such as ketchup and soy sauce).

Many meals are high in sodium. The type of meal chosen and the number of meals eaten outside the home will affect sodium intake. People may be able to determine the sodium content of the meal by taste; thirst after a meal may be an indicator of a high-salt meal. Chinese food, pizza and battered deep-fried chicken are particularly high in sodium.