Dietary sodium intake in young Korean adults and its relationship with eating frequency and taste preference

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Abstract

Dietary sodium intake is considered one of the major causal factors for hypertension. Thus, to control the increase of blood pressure and reduce the risk of hypertension-related clinical complications, a reduction in sodium intake is recommended. The present study aimed at determining the association of dietary sodium intake with meal and snack frequency, snacking time, and taste preference in Korean young adults aged 20-26 years, using a 125-item dish-frequency questionnaire. The mean dietary sodium intakes of men and women were 270.6 mmol/day and 213.1 mmol/day, which were approximately 310% and 245% of the daily sodium intake goal for Korean men and women, respectively. Dietary sodium intake was positively correlated with systolic blood pressure in the total group, and BMI in the total and men-only groups. In the total and men-only groups, those who consumed meals more times per day consumed more dietary sodium, but the number of times they consumed snacks was negatively correlated with dietary sodium intake in the total, men-only, and women-only groups. In addition, those who consumed snacks in the evening consumed more sodium than those who did so in the morning in the men-only group. The sodium intake was also positively associated with preference for salty and sweet taste in the total and women-only groups. Such a high intake of sodium in these young subjects shows that a reduction in sodium intake is important for the prevention of hypertension and related diseases in the future.

Key Words: Dietary sodium intake, eating frequency, taste preference, hypertension

Introduction

A number of causal factors for hypertension have been identified to date, including excess body weight, reduced physical activity, inadequate intake of fruits and vegetables, excess alcohol intake, and excess dietary sodium intake [1]. Among these factors, sodium intake has been shown to have a strong association with blood pressure in population-based studies [2] and randomized clinical trials [3].

In 2010, 26.9% of Korean adults aged 30 years or more had hypertension [4]. As blood pressure continues to increase throughout life, the prevalence of hypertension is expected to increase further owing to the increasing longevity of the Korean population [5,6].

Koreans normally consume seasoned soups and stews and pickled vegetables with a high sodium content. Thus, the average sodium intake of Korean adults was more than 260% of the daily sodium intake goal (87 mmol/day), which was 226 mmol (equivalent to 5,202 mg of sodium or 13.2 g of sodium chloride) per day in 2011 [4]. Additionally, Korean young adults in their 20s prefer instant foods such as ramen, which have a very high sodium content, resulting in higher sodium consumption of 217 mmol (equivalent to 4,990 mg of sodium or 12.7 g of sodium chloride) per day; this amounts to approximately 250% of the daily sodium intake goal [4]. Therefore, in order to effectively control the increase in blood pressure in the future and reduce the risk of hypertension-related clinical complications in Korea, changes in the diet, including sodium intake reduction in young people, should be implemented [3].

Salt preference is a liking for salt even in a sodium-replete state [7], whereas salt appetite reflects a desire for salt to maintain sodium homeostasis in a sodium-deprived state [8,9]. Therefore, salt preference is often assessed for the qualitative evaluation of salt intake and an individual’s attitude and response to salty foods [10-12]. Hypertensive patients have increased preference for salt without any alteration from normal sodium chloride taste thresholds [9], although some studies suggested that there was no relationship between salt preference and blood pressure [13,14]. Several studies showed that salt preference might be associated with the frequency or the amount of salty food...
consumption [11,12,15-17]. Some researchers have also attempted to elucidate the relationship between dietary sodium intake and frequency of meals and snacks [18-20]; nonetheless, some contradiction on this relationship still exists.

The present study aimed at determining the association between dietary sodium intake and certain factors related to dietary habits, including meal and snack frequency and taste preference, in young Korean adults in their 20s.

Subjects and Methods

Subjects

Two hundred and seventy-eight students in a university in Gyeonggi Province in the Republic of Korea participated in the survey. Among them, 50 students who provided incomplete information on the survey questionnaires or who were diagnosed with hypertension were excluded from the analyses. Of the remaining 228 students selected, 71 (31.1%) were men and 157 (68.9%) were women; their ages ranged from 20 to 26 years. Written informed consent was obtained from the participants.

Measurements

The survey was conducted in November 2008, using the self-administered questionnaire on sex, age, weight, height, frequency of meals and snacks, taste preference, alcohol drinking, and smoking. Snacks were defined as foods consumed between meals. To measure preference for salty, sweet, sour, and pungent tastes, a 5-point hedonic scale (1 = extreme dislike, 5 = extreme preference) was used. On the basis of this response, taste preference was classified into 3 categories: “low” (1 or 2 points), “moderate” (3 points), and “high” (4 or 5 points) because of the small proportion of subjects that chose 1 or 5 points. To investigate dietary sodium intake, a 125-item dish-frequency questionnaire (DFQ) [21] was used instead of a food-frequency questionnaire (FFQ), which was developed to estimate the habitual sodium intake suitable for Koreans, who usually enjoy soups, stews, and pickled vegetables such as kimchi. The DFQ questionnaire (DFQ) [21] was used instead of a food-frequency questionnaire (FFQ), which was developed to estimate the habitual sodium intake suitable for Koreans, who usually enjoy soups, stews, and pickled vegetables such as kimchi. The DFQ results significantly correlated with the 24-h urinary sodium estimates, and this questionnaire can be used quantitatively to estimate the sodium intake of adults [21].

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Blood pressure was measured twice between 10 a.m. and 12 a.m. while the subjects were seated, with a 5-minute rest period and using automatic sphygmomanometers (HEM 780, Omron automatic blood pressure monitor; Japan). The mean of the 2 measurements was used in the analyses. We defined hypertension as systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg, and prehypertension as 120 mmHg ≤ SBP ≤ 140 mmHg and/or 80 mmHg ≤ DBP < 90 mmHg by the Joint National Committee 7 criteria [23].

Statistical analysis

All values except for the number of subjects (%) and correlation coefficients are presented as mean (SEM). An analysis of variance (ANOVA) was performed to determine differences between the 3 groups and was followed by the Student-Newman-Keuls test, which was used for comparisons after the performed analysis was found to be significant. Student’s t-test or chi-square tests were performed to determine differences between 2 groups. The correlation of dietary sodium intake with blood pressure was examined using a partial correlation analysis, adjusting for age, body mass index (BMI), alcohol drinking, and smoking status. Correlations of dietary sodium intake with BMI and with snack frequency were analyzed using Pearson’s and Spearman’s rank correlation tests, which measured the correlations between 2 continuous variables and between 1 continuous variable and 1 ordinal numeric variable, respectively. SAS 9.2 statistical software (SAS Institute Inc., Cary, NC) was used for all analyses. Statistical significance was considered at P < 0.05.

Results

A total of 228 subjects (71 men and 157 women) were included in this study to assess the associations of sodium intake with blood pressure, taste preference, and dietary habits, including meal and snack frequency and snacking time. Characteristics of the study subjects are shown in Table 1.

Blood pressure

The mean values (SEM) of SBP and DBP of men were 127.5 (1.41) and 74.2 (1.49) mmHg, and the mean values of women

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Men (n = 71)</th>
<th>Women (n = 157)</th>
<th>Total (n = 228)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>20.9 (0.31)</td>
<td>19.6 (0.11)</td>
<td>20.0 (0.13)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>69.4 (1.38)</td>
<td>54.6 (0.58)</td>
<td>59.2 (0.74)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>175.3 (0.60)</td>
<td>161.6 (0.38)</td>
<td>165.9 (0.53)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>22.5 (0.42)</td>
<td>20.9 (0.18)</td>
<td>22.5 (0.19)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Systolic blood pressure (mmHg)</td>
<td>127.5 (1.41)</td>
<td>113.5 (0.95)</td>
<td>117.9 (0.90)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Diastolic blood pressure (mmHg)</td>
<td>74.2 (1.49)</td>
<td>71.4 (0.65)</td>
<td>72.3 (0.65)</td>
<td>0.089</td>
</tr>
<tr>
<td>Dietary sodium intake (mmol/day)</td>
<td>270.6 (18.6)</td>
<td>231.3 (13.3)</td>
<td>231.0 (11.0)</td>
<td>0.015</td>
</tr>
</tbody>
</table>

Student’s t-test between men and women.