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Short Communication

# Early adulthood: an overlooked age group in national sodium reduction initiatives in South Korea

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**BACKGROUND/OBJECTIVES:** South Korean's sodium consumption level is more than twice the upper limit level suggested by the WHO. Steep increases in the prevalence of hypertension and cardiovascular disease in Korea necessitate more effective sodium reduction programs. This study was conducted in order to compare sodium intake-related eating behaviors and key psychosocial factors according to age group and gender.
**SUBJECTS/METHODS:** Using an online survey, a total of 1,564 adults (20-59 years old) considered to be geographically representative of South Korea were recruited and surveyed. The major outcomes were perceived behaviors, knowledge, intentions, and self-efficacy related to sodium intake.
**RESULTS:** The results show that perceived behavior and level of self-efficacy related to low sodium consumption differed by age and gender. Female participants showed better behavior and intention towards low sodium intake than male counterparts. Young participants in their 20s showed the lowest intention to change their current sodium intake as well as lowest self-efficacy measures.
**CONCLUSIONS:** Future sodium reduction interventions should be developed with tailored messages targeting different age and gender groups. Specifically, interventions can be planned and implemented at the college level or for workers in their early career to increase their intention and self-efficacy as a means of preventing future health complications associated with high sodium intake.

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## INTRODUCTION

High sodium intake has been proven to be a risk factor for many chronic diseases, including hypertension and cardiovascular diseases [1]. South Koreans consumed approximately 4,800 mg of sodium (12.2 g as salt) per day in 2012 [2]. Due in part to Korea's traditional food culture centering around various vegetables and seafood preserved with salt and soy sauce, Korean's sodium consumption level is more than twice the upper limit level recommended by the World Health Organization (WHO) (2,000 mg/day) [3]. Steep increases in the prevalence of hypertension and cardiovascular disease in Korea necessitate more effective sodium reduction programs [4].

In an attempt to control chronic diseases that can be prevented by reduced sodium intake, many countries and cities have initiated sodium reduction programs [5,6]. South Korean government agencies also instituted sodium reduction initiatives at the district, province, and national levels beginning in early 2009 [7,8]. The goal of these government initiatives is to deliver nutritional messages to the adult public in order to increase awareness of the harmful effects of high sodium intake. However, most of these messages are relatively untargeted, such as "reduce size of soup bowl and eat less soup liquid" and "reduce *kimchi (fermented cabbage)* consumption" [9]. To effectively reach populations with properly targeted messages, it is necessary to explore nutritional issues in greater detail along with related psychosocial and environmental factors specific to the population of interest.

Prior national nutrition surveys and studies in South Korea have shown that different age groups and genders have specific dietary habits [10]. Frequencies of eating home-cooked meals, meals served at school or work cafeterias, and meals served at restaurants differ among age and gender groups, and this factor certainly affects sodium intake levels [11]. In addition,

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food intake habits and the environments in which people make food choices on a daily basis differ according to their age, gender, and occupation [11]. Hence, it is crucial to understand food habits, intentions, and self-efficacy related to sodium-related eating behaviors among different age and gender groups for planning successful interventions.

However, to our knowledge, there is still no comprehensive understanding of the various aspects of designing nutrition programs, especially sodium reduction programs, for different gender and age groups. One previous study focused mostly on knowledge and eating behaviors and did not include other important psychosocial factors, such as intention and self-efficacy [12]. Therefore, this study examined South Koreans' knowledge, intentions, and self-efficacy toward sodium consumption among different age groups in the adult population. Guided by social cognitive and social marketing theory, we attempted to develop targeted messages tied to specific behavioral and psychosocial factors among different age and gender groups.

## SUBJECTS AND METHODS

*Subjects and study design*

Based on 2010 census data [13], a nationally representative sample, 20-59 years of age, was selected from a sampling pool. This sampling pool was provided by a survey research firm in Seoul, South Korea that has been conducting marketing and social surveys since 1989. The sampling pool consisted of approximately 800,000 people who are representative of South Korea. The initial recruitment of survey participants started with invitations for periodical participation in social surveys with small compensation. Using the participants' socio-demographic factors, the survey research firm continuously updates the pool of samples to be nationally representative.

For this study, we selected 4,500 people from the sampling pool using cluster random sampling methods with age and region of residence as clusters. Self-administered questionnaires were distributed to these randomly selected people via email, and the completed survey questionnaires were collected online. Initially, we sent questionnaires to 4,500 people due to the low participation rate of online surveys and targeted more than 1,500 complete surveys. The final number of participants was 1,564, and we checked that the returned questionnaires were representative of various regions of the country. This survey had a 95% confidence level and a sampling error of 2.84%.

*Survey questionnaire and statistical analysis*

The developed survey questionnaires included various psychosocial and behavioral aspects of sodium intake, including knowledge, intentions, self-efficacy, and eating habits. A five-point Likert scale was used in the questionnaire. For perceived behavior, we created a composite index based on five statements: 1) I eat salty food more than others (1-5 points), 2) I prefer salty food (1-5 points), 3) I eat more soup and side dishes than others (1-5 points), 4) I often eat liquid-based dishes (stew, soup, noodle soup) (1-5 points), and 5) I usually do not leave liquid when eating soup and stew (1-4 points). Consumption of salty side dishes and the liquid part of soup or stew are the biggest contributors to sodium intake in Korean food culture [14]. All other measures were expressed as the mean values of a five-point Likert scale for each question. The calculation of descriptive statistics, chi-squared tests, and comparisons of means among groups were performed using Stata 10.1 (Texas, USA). For comparing continuous variables, multiple linear regressions were used to adjust for a covariate such as age when comparing men and women as well as gender when comparing different age groups. When comparing the three different age groups in men and women separately, analysis of variance (ANOVA) and chi-square test were used. For continuous variables, post-hoc analysis was conducted using bonferroni adjustment to understand statistically significant group differences.

## RESULTS

*Perceived behavior, knowledge, and intention by age and gender*

To employ social marketing approaches in future interventions, the data were analyzed based on three different age groups in men and women: 20-29, 30-49, and 50-59 years old. The participants' mean age was 38.8 years (standard deviation: 10.8 years), and female participants represented approximately half of the total participants (49.0%). Participants were proportionately recruited from all regions (Table 1).

Perceived behavior, knowledge, and intention regarding sodium intake are summarized in Table 2. The composite index score for high sodium intake behaviors differed by gender and

**Table 1.** Characteristics of participants

| | All (n = 1,564) | Men (n = 797) | Women (n = 767) |
|---|---|---|---|
| Mean age (yrs, SD) | 38.8 (10.8) | 38.9 (10.7) | 38.7 (10.9) |
| 19-29 yrs (n, %) | 366 (23.4) | 189 (23.7) | 177 (12.1) |
| 20-49 yrs (n, %) | 832 (53.2) | 424 (53.2) | 408 (53.2) |
| 50-59 yrs (n, %) | 366 (23.4) | 184 (23.1) | 182 (23.7) |
| Occupation (n, %) | | | |
| Students (college and graduate) | 163 (10.4) | 92 (11.5) | 71 (9.2) |
| Employed workers | 878 (56.1) | 558 (70.0) | 320 (41.7) |
| Homemakers | 282 (18.0) | 0 (0.0) | 282 (36.8) |
| Others (including self-employed) | 241 (15.4) | 147 (18.5) | 94 (12.3) |
| Region of residence (n, %) | | | |
| Seoul | 322 (20.6) | 160 (20.1) | 162 (21.1) |
| Gyeonggi | 322 (20.6) | 161 (20.2) | 161 (21.0) |
| Incheon | 121 (7.7) | 63 (7.9) | 58 (7.6) |
| Busan | 143 (9.1) | 68 (8.5) | 75 (9.8) |
| Daegu | 90 (5.8) | 51 (6.4) | 39 (5.1) |
| Gwangju | 73 (4.7) | 38 (4.8) | 35 (4.6) |
| Daejeon | 67 (4.3) | 30 (3.8) | 37 (4.8) |
| Ulsan | 35 (2.2) | 20 (2.5) | 15 (2.0) |
| Choongnam | 40 (2.6) | 21 (2.6) | 19 (2.5) |
| Choongbuk | 40 (2.6) | 26 (3.3) | 14 (1.8) |
| Ganwon | 42 (2.7) | 25 (3.1) | 17 (2.2) |
| Gyeongnam | 77 (4.9) | 39 (4.9) | 38 (5.0) |
| Gyeongbuk | 43 (2.8) | 20 (2.5) | 23 (3.0) |
| Jeonnam | 33 (2.1) | 20 (2.5) | 13 (1.7) |
| Jeonbuk | 36 (2.3) | 15 (1.9) | 21 (2.7) |
| Jeju | 80 (5.1) | 40 (5.0) | 40 (5.2) |

**Table 2.** Perceived behavior, knowledge, and intention regarding sodium intake for different age groups among participants

| Age groups (n) | All | | | | Men | | | | Women | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All | 20-29 | 30-49 | 50-59 | All | 20-29 | 30-49 | 50-59 | All | 20-29 | 30-49 | 50-59 |
| Behavior | | | | | | | | | | | | |
| Composite index score for having eating behaviors that lead to high sodium intake[+] | | | | | | | | | | | | |
| mean (SD)[1)2)] | 15.7 (3.5) | 15.9 (3.9) | 15.8 (3.4) | 15.4 (3.3) | 16.2 (3.5) | 16.4 (3.8) | 16.1 (3.4) | 16.0 (3.3) | 15.2 (3.5) | 15.3 (3.9) | 15.4 (3.4) | 14.7 (3.1) |
| Have higher scores (eating salty) (18-24) (%)[1)4)] | 55.0 | 56.3 | 56.4 | 50.6 | 61.2 | 62.7 | 60.6 | 60.9 | 48.5 | 49.2 | 52.0 | 40.1 |
| Knowledge | | | | | | | | | | | | |
| Know world health Organization recommended sodium intake level (%)[2)4)] | 21.7 | 27.1 | 20.1 | 20.0 | 22.2 | 26.5 | 21.5 | 19.6 | 21.1 | 27.7 | 18.6 | 20.3 |
| Intention | | | | | | | | | | | | |
| Considering reducing sodium intake (%)[1)2)3)4)] | 86.9 | 79.2 | 88.5 | 91.3 | 83.8 | 74.6 | 85.1 | 90.2 | 90.2 | 84.2 | 91.9 | 92.3 |
| Trying to reduce sodium intake when eating out (%)[2)3)4)] | 28.8 | 20.2 | 27.0 | 41.5 | 29.0 | 20.6 | 28.1 | 39.7 | 28.8 | 19.8 | 26.0 | 43.4 |

[+] Based on five statements designed to assess eating behaviors related to salt intake in Korean food culture: 1) I eat salty food more than others (1-5 points), 2) I prefer salty food (1-5 points), 3) I eat more soup and side dishes than others (1-5 points), 4) I often eat liquid-based dishes (stew, soup, noodle soup) (1-5 points), and 5) Usually do not leave the liquid when eating soup and stew (1-4 points). The total possible score ranges from 5 to 24. Cronbach' s alpha for the internal consistency of these five items was 0.790.

[1)] Statistically significantly different between men and women using multiple linear regression adjusting for age groups for continuous variables and chi-square test for categorical variables ($P < 0.05$).

[2)] Statistically significantly different among three age groups in all participants using multiple linear regression adjusting for gender for continuous variables and chi-square test for categorical variables ($P < 0.05$).

[3)] Statistically significantly different among three age groups in men using ANOVA and chi-square test ($P < 0.05$).

[4)] Statistically significantly different among three age groups in women using ANOVA and chi-square test ($P < 0.05$).

**Table 3.** Sodium intake-related eating behaviors and self-efficacy when eating out at restaurants or food service facilities among participants

| Age group (n) | All | | | | Men | | | | Women | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All | 20-29 | 30-49 | 50-59 | All | 20-29 | 30-49 | 50-59 | All | 20-29 | 30-49 | 50-59 |
| Eating Behaviors | | | | | | | | | | | | |
| When eating out, I enjoy salty food.[1)2)3)4)] | 2.82 | 3.02 | 2.83 | 2.59 | 2.99 | $3.17^{a}$ | $2.98^{ab}$ | $2.84^{b}$ | 2.63 | $2.86^{a}$ | $2.66^{a}$ | $2.34^{b}$ |
| When eating out, I enjoy eating soups.[1)4)] | 3.20 | 3.21 | 3.22 | 3.13 | 3.36 | 3.43 | 3.32 | 3.39 | 3.02 | $2.98^{ab}$ | $3.12^{a}$ | $2.86^{b}$ |
| When eating out, I intentionally for go salty dishes (sauces, side dishes, dressings).[1)2)3)4)] | 3.27 | 2.99 | 3.30 | 3.51 | 3.15 | $2.88^{a}$ | $3.20^{b}$ | $3.33^{b}$ | 3.27 | $2.99^{a}$ | $3.30^{b}$ | $3.51^{c}$ |
| Self-efficacy | | | | | | | | | | | | |
| When eating out, I am able to use minimal amounts of additional seasonings on the table.[1)2)3)4)] | 3.84 | 3.68 | 3.87 | 3.95 | 3.72 | $3.53^{a}$ | $3.74^{b}$ | $3.86^{b}$ | 3.97 | $3.84^{a}$ | $4.00^{b}$ | $4.03^{b}$ |
| When eating out, I am able to choose low-sodium dishes according to nutrition labeling.[1)2)3)4)] | 3.63 | 3.45 | 3.65 | 3.78 | 3.52 | $3.31^{a}$ | $3.56^{b}$ | $3.67^{b}$ | 3.75 | $3.60^{a}$ | $3.75^{a}$ | $3.90^{b}$ |
| When eating out, I am able to select restaurants (food service facilities) that serve low-sodium dishes.[1)2)3)4)] | 3.28 | 3.11 | 3.29 | 3.44 | 3.20 | $2.99^{a}$ | $3.21^{b}$ | $3.41^{c}$ | 3.36 | $3.25^{a}$ | $3.37^{ab}$ | $3.46^{b}$ |
| When eating out, I am able to eat small portions of soup and side dishes.[1)2)3)4)] | 3.68 | 3.48 | 3.72 | 3.80 | 3.57 | $3.32^{a}$ | $3.61^{b}$ | $3.72^{b}$ | 3.80 | $3.65^{a}$ | $3.84^{b}$ | $3.87^{b}$ |
| When eating out, I am able to ask the cook to prepare food with less salt.[1)2)3)4)] | 3.47 | 3.22 | 3.49 | 3.67 | 3.36 | $3.05^{a}$ | $3.41^{b}$ | $3.58^{b}$ | 3.58 | $3.40^{a}$ | $3.58^{b}$ | $3.76^{c}$ |
| When eating out, I am able to ask for the seasoning on the side.[1)2)3)] | 3.34 | 3.21 | 3.34 | 3.48 | 3.21 | $3.05^{a}$ | $3.21^{ab}$ | $3.38^{b}$ | 3.48 | 3.38 | 3.47 | 3.58 |
| When eating out, I am able to leave the liquid when having soup or stew.[1)2)3)] | 3.64 | 3.50 | 3.66 | 3.73 | 3.47 | $3.29^{a}$ | $3.51^{b}$ | $3.56^{b}$ | 3.81 | 3.72 | 3.80 | 3.91 |
| When eating out, I am able to use a separate bowl to monitor the amount of soup that I eat.[1)2)3)] | 3.74 | 3.58 | 3.74 | 3.89 | 3.56 | $3.32^{a}$ | $3.59^{b}$ | $3.76^{c}$ | 3.91 | 3.86 | 3.89 | 4.02 |

[1)] Statistically significantly different between men and women using multiple linear regression adjusting for age groups ($P < 0.05$).

[2)] Statistically significantly different among three age groups in all participants using multiple linear regression adjusting for gender ($P < 0.05$).

[3)] Statistically significantly different among three age groups in men using ANOVA and bonferroni adjustment for post-hoc analyses ($P < 0.05$), different superscript means statistically significantly difference at 0.05 level.

[4)] Statistically significantly different among three age groups in women using ANOVA and bonferroni adjustment for post-hoc analyses ($P < 0.05$), different superscript means statistically significantly difference at 0.05 level.

age using multiple linear regression models. Men showed higher scores than women (16.2 vs. 15.2) after adjusting for age, indicating that men are more likely to engage behaviors that lead to higher sodium intake. After adjusting for gender, younger participants showed higher scores than older participants (15.9, 15.8, and 15.4) and these differences were statistically significant ($P = 0.04$ for group comparison and $P = 0.03$ for trend).

There was no significant difference in awareness of WHO-

**Table 4.** Sodium-intake-related self-efficacy for food shopping and home cooking among participants

| Age group (n) | All | | | | Men | | | | Women | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All | 20-29 | 30-49 | 50-59 | All | 20-29 | 30-49 | 50-59 | All | 20-29 | 30-49 | 50-59 |
| I am able to check nutrition labeling and choose low-sodium packaged foods.[1)2)3)4)] | 3.72 | 3.55 | 3.75 | 3.84 | 3.62 | 3.42[a] | 3.65[b] | 3.75[b] | 3.83 | 3.69[a] | 3.85[ab] | 3.93[b] |
| I am able to choose natural foods rather than processed foods.[1)2)3)4)] | 4.11 | 3.92 | 4.12 | 4.27 | 4.05 | 3.85 [a] | 4.04[b] | 4.26[c] | 4.17 | 3.99[a] | 4.20[b] | 4.28[b] |
| I am able to recommend low-sodium food to others.[1)2)3)] | 3.48 | 3.37 | 3.46 | 3.64 | 3.40 | 3.27[a] | 3.38[b] | 3.59[b] | 3.57 | 3.49 | 3.55 | 3.69 |
| I am able to cook/eat less salty food at home.[1)2)3)4)] | 3.78 | 3.60 | 3.79 | 3.95 | 3.66 | 3.46[a] | 3.67[b] | 3.85[c] | 3.91 | 3.75[a] | 3.92[b] | 4.04[b] |
| I am able to choose low-sodium seasonings.[1)2)3)] | 3.74 | 3.63 | 3.74 | 3.82 | 3.62 | 3.43[a] | 3.63[b] | 3.81[c] | 3.85 | 3.85 | 3.86 | 3.84 |

[1)] Statistically significantly different between men and women using multiple linear regression adjusting for age groups ($P$< 0.05).
[2)] Statistically significantly different among three age groups in all participants using multiple linear regression adjusting for gender ($P$< 0.05).
[3)] Statistically significantly different among three age groups in men using ANOVA and bonferroni adjustment for post-hoc analyses ($P$< 0.05), different superscript means statistically significantly difference at 0.05 level.
[4)] Statistically significantly different among three age groups in women using ANOVA and bonferroni adjustment for post-hoc analyses ($P$< 0.05), different superscript means statistically significantly difference at 0.05 level.

recommended sodium intake levels according to gender, although younger people were more aware than older groups. Trends were similar for both men and women. However, only sub-group analyses among women showed a statistical difference. Regarding intention to change sodium intake, 90.2% of female participants considered reducing sodium intake in their daily eating practices, whereas 83.8% of male participants did so. In addition, more people considered reducing sodium intake among older groups than younger groups (79.2% in 20s, 88.5% in 30-40s, and 91.3% in 50s). Both men and women followed this trend.

The majority of participants considered reducing sodium intake. Yet, only less than one third of participants showed an effort to reduce sodium intake when eating out, and there was no gender difference. When comparing different age groups of the same gender, patterns were distinct. Older participants showed greater effort (41.5% in 50s) than younger participants (20.2% in 20s), and these patterns were the same for both men and women.

*Eating behaviors and self-efficacy by age and gender*

Table 3 shows the mean values of the five-point scale questions on eating behaviors and self-efficacy for sodium intake reduction when eating out at full-service restaurants and food service facilities (i.e., school and worksite cafeterias). The results of each question showed that female participants have better eating behaviors and higher self-efficacy than male counterparts. In addition, most of the questions showed that older participants have better behaviors and higher self-efficacy than younger participants. In terms of self-efficacy for food shopping and home cooking, the patterns were similar, as shown in Table 4. Female and older participants showed higher mean values for self-efficacy, and male and younger participants showed lower mean values.

## DISCUSSION

The results show that the perceived behaviors and level of self-efficacy regarding low sodium intake behaviors differ by age and gender. The overall patterns are as follows: 1) Female participants tend to have better behaviors and intentions towards lowering sodium intake than male counterparts, 2) participants in their 20s have the lowest intention to change their current sodium intake and the lowest self-efficacy measures.

One can easily conceive of why the older population is more watchful of their sodium intake and have stronger intention and self-efficacy to change their current diet. In South Korea, one in three adults older than 30 years are hypertensive [2], and it is assumed that older populations are more likely to alter their diet due to their existing health conditions. Younger populations may not consider the risk of chronic diseases, and it is known that price, convenience, and taste all affect the dietary choices of young people [15]. This difference in factors influencing dietary choices among different age groups may have translated into lower self-efficacy and lower intention to alter current sodium intake habits among participants in their 20s.

Unlike psychosocial factors, some behavioral factors showed different patterns. Especially for women, certain measures showed higher scores among the 30-40s than 20s age group, such as "having higher scores" in Table 2. Compared to women in their 20s, a higher number of female participants in their 30s and 40s responded positively regarding eating behaviors that promote high sodium intake (49.3% vs. 52.0%). This might be explained by the fact that there are many young Korean women who are conscious of their weight [2]. Accordingly, young women who want to lose weight may pay more attention to their diet and salt intake. This hypothesis is corroborated by the estimated sodium intake levels in the national survey, which showed that sodium intakes were 3,943 mg/day for women in their 20s and 4,491 mg/day for women in their 30-40s [2].

The data also showed that women are generally more conscious of their sodium intake than men. This gender difference has been discussed in previous studies. For example, one study on sodium intake among Korean adults found that eating behaviors related to sodium intake are more ideal among women compared to men [12]. This study result is in line with the actual sodium intake level measured by the national survey. The recent survey showed that the estimated sodium intakes using 24-hour recalls are 5,705 mg for men and 4,085 mg for women [2]. Low intention to change their nutritional behaviors and low self-efficacy of reducing sodium intake can be

translated into higher intake of high sodium foods among men.

It is crucial to develop and deliver nutrition messages that resonate with specific populations. Given the different dietary habits and psychosocial factors regarding sodium intake, different messages and intervention strategies should be developed, especially for people in early adulthood. In our results, younger participants were more knowledgeable of sodium intake recommendations, whereas their intention and self-efficacy were lower for reducing sodium intake. On the other hand, a smaller number of older participants knew of an upper limit of sodium intake, whereas their intention, self-efficacy, and perceived behaviors were more favorable for reducing sodium intake. In addition, there were gender differences in these measures. Hence, these differences should be taken into account when designing sodium reduction campaigns and educational materials targeting specific audiences for more effective program outcomes.

This is the first study to examine differences in sodium intake-related behavioral and psychosocial factors among different age and gender groups, and the results will guide targeted message development and intervention strategies. Despite the new information that this study provides, there are several limitations that should be considered. First, the survey questionnaire did not collect key measures such as socio-economic status and medical histories, which have been associated with nutritional behaviors in previous studies. Second, as the sampling pool was formed by the survey research firm, these participants registered themselves and were willing to take part in surveys with small monetary compensation. Therefore, we should not rule out selection bias when interpreting the results. Lastly, we only asked about perceived eating behaviors and intentions. Without objective measures of sodium intake, either by dietary assessment or 24-hour urine collection, we cannot confirm the actual sodium intake level among participants. Previous studies with limited participants have confirmed a correlation between eating behaviors and actual sodium intake [16,17]. Yet, future research is needed to confirm the actual sodium intake levels and their associations with various psychosocial factors using nationally representative samples.

To prevent chronic diseases in later adulthood, more aggressive sodium intake intervention should be developed to target young adults, a previously neglected population. Although the actual sodium intake level could not be determined in this study, it is important to improve awareness, intention, and self-efficacy for improvement of dietary choices among younger people. In the field of nutrition and weight management, college-level interventions have shown some success in other countries [18,19]. Therefore, future sodium reduction intervention can be planned and implemented at the college and university levels as a means of preventing future health complications associated with high sodium intake.

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