

## Original Article

# Sodium reduction in South Korean restaurants: A Daegu-based intervention project

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**Background and Objectives:** Koreans tend to have high sodium intake in restaurants. This study assessed the effect of the sodium reduction project in restaurants in Daegu Metropolitan City. **Methods and Study Design:** A total of 156 sodium reduction menu items offered by 90 restaurants were categorized into 11 food groups to compare sodium content and salinity before and after the project. In total, 162 owners and staff members of the restaurants, as well as 727 of their customers, were surveyed on their perceptions of and satisfaction with the sodium reduction project. **Results:** Average salinity of the menu items was significantly reduced from 0.70% prior to the project to 0.49% after the project ( $p < 0.001$ ), and average sodium content was also significantly reduced from 1,470 mg to 980 mg ( $p < 0.001$ ). The food groups with the highest sodium reduction rate were soups (46.0%) and grilled dishes (39.5%), with an average sodium reduction rate of 36.1%. The restaurant owners' average satisfaction score with the project was 39.6 points (out of 50). Customers responded that the sodium reduction menus were moderate (62.4%) and bland (27.9%), and the taste was good (48.9%) and excellent (25.0%). Approximately 52.0% and 18.6% of customers were satisfied and very satisfied, respectively, with the sodium reduction menu. **Conclusions:** Overall, the sodium reduction project in restaurants in Daegu had a positive effect because it successfully reduced the sodium content of food while also boosting the satisfaction of the restaurant owners and staff and their customers with the project.

**Key Words:** restaurant menu, eating out, salinity, sodium content, sodium reduction

## INTRODUCTION

The excessive intake of sodium not only increases the risk of high blood pressure, stroke, cardiovascular disorder, gastric cancer, and Alzheimer disease but also may lead to complications in those with type 2 diabetes.<sup>1-7</sup> In addition, a systematic analysis of 195 countries suggested that the excessive intake of sodium was the number one cause of death.<sup>8</sup> In this regard, the WHO recommended a 30% reduction in sodium intake in its Global Action Plan for the Prevention and Control of Noncommunicable Diseases 2013–2020.<sup>9</sup> Studies have reported that sodium intake of less than 2,300 mg/day is associated with a lower risk of cardiovascular disease and mortality<sup>10,11</sup> and a higher probability of maintaining normal blood pressure.<sup>12</sup> Although the sodium intake of Koreans exhibits a decreasing trend, it remains twice that of the Korean Dietary Reference Intake (2,000 mg).<sup>13</sup>

In the United States and the United Kingdom, sodium consumption is commonly associated with processed food and eating out,<sup>14-16</sup> but the sodium intake of Koreans is mostly derived from seasonings, such as salt, soy sauce, and soybean paste.<sup>13</sup> The Heartbeat Award (HBA) scheme was launched in 1990 in the United Kingdom to motivate restaurants to serve food rich in fiber and with less sodium, total fat, and added sugars. HBAs were conferred to restaurants that provided healthy menus. Following the implementation of this project, those who dined at HBA restaurants exhibited improved dietary attitudes and nutritional knowledge.<sup>17</sup>

Similarly, in South Korea, the Ministry of Health and Welfare established the National Nutrition Management

Act. This Act requires local governments to formulate and implement a plan for reducing sodium content in food establishments.<sup>18</sup> In 2015, the Korean Ministry of Food and Drug Safety launched the sodium reduction project in restaurants to reduce the daily sodium intake of citizens by 3,500 mg by 2020. To be designated a sodium reduction restaurant, 20% of a restaurant's menu items should have its sodium content (per serving) reduced by 10% to less than 1,300 mg or by more than 30% for menu items with more than 2,000 mg per serving. To be eligible, the sodium reduction menu should be operated in place for over one month, and an on-site inspection is also required.<sup>19</sup>

The rate of eating out in Korea in 2018 was 43.5% and 26.9% for males and females, respectively. A higher income level is also associated with a higher frequency of eating out.<sup>13</sup> According to a study in 2017,<sup>20</sup> take-out menus offering soup, stew, and broth exhibited significantly higher sodium content than did home-cooked and institutional meals. This suggests that regular consumption of take-out meals leads to excessive sodium intake.

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To assess the effectiveness of the sodium reduction project, the following three criteria were designated: sodium reduction rate, on-site inspection, and owner and customer satisfaction. Therefore, this study compared the sodium content of sodium reduction menus before and after the project and evaluated the restaurants sodium reduction practices. Surveys were also conducted to measure the satisfaction of restaurant owners, staff, and their customers with the sodium reduction project and sodium reduction menus.

## METHODS

### *Selection of restaurants and study design*

Study participants were gathered from the websites of the Daegu Metropolitan City ([www.daegu.go.kr](http://www.daegu.go.kr)), Daegu Food ([www.daegufood.go.kr](http://www.daegufood.go.kr)), and the Salt Reduction Center ([www.saltdown.com](http://www.saltdown.com)) in April 2018. Figure 1 presents the flow chart of restaurant participation and withdrawal. Initially, 104 restaurants participated in the sodium reduction project; however, 14 restaurants eventually dropped out.

The participating restaurants were categorized into new restaurants and follow-up restaurants. New restaurants are those that apply to join the project for the first time or apply again because they were not previously designated as sodium reduction restaurants. Follow-up restaurants are those that were designated as sodium reduction restaurants in the previous year, had been operated for a year, and were reapplying to retain the qualification. Data were collected from May to November 2018. This study was approved by the Ethical Committee at Kyungpook National University (IRB KNU 2018-0065). Written informed consent was obtained from all subjects.

### *Selection of menus for sodium reduction*

Over 20% of all available menu items were selected for sodium reduction by restaurant owners. Sodium reduction menus excluded those of foods that do not require cooking (e.g., sashimi and raw meat), seasonal menus, and personalized menus such as table d'hôte menus.

One serving of a sodium reduction menu was defined according to the menus provided in the Food and Nutrition Fact Book<sup>21</sup> because each restaurant defines a serving differently. If no corresponding item was available, one item on the menu that had similar ingredients and recipe

was used. If none was available, the one serving offered by the restaurant was used.

### *Education, training, and consulting for sodium reduction*

Prior to project initiation, sodium reduction education and training were provided separately for the staff of the selected restaurants (n=90), local government employees (n=8), and the consumer food hygiene observers (n=16), who trained and supported restaurant owners in eight administrative districts. Topics included the importance of the project, the relationship between sodium and health, low-sodium recipes, and the use of the mobile application (app) Na-Codi for salinity management. On the basis of salinity and sodium-content data, which were collected during the early stages of the project, two occasions for consultation were provided for each of the restaurants to coordinate in terms of low-sodium recipes in the project menus. After the consultation, restaurants were required to record the salinity of the menu at least once a week for one month.

### *Evaluation method for on-site inspection*

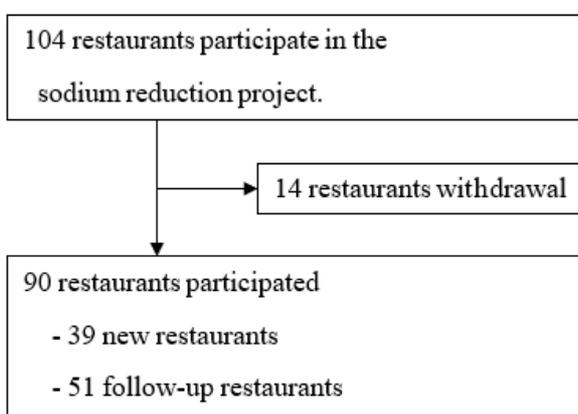
The evaluation method for on-site inspection is presented in Table 1. On-site inspection of restaurants was conducted in accordance with the guidelines<sup>19</sup> for restaurants operating for over one month with sodium reduction menus. The evaluation items consisted of two categories, namely required items and optional items. For new restaurants, the required items were sodium reduction menu ratio (20 points), sodium reduction rate (20 points), and salinity meter equipment (10 points). The optional items included sodium control for a month (10 points), sodium content control (10 points), use of measuring tools (10 points), sodium control in kimchi (10 points), and no seasoning containers on tables (10 points), for a total of 100 points.

For follow-up restaurants, signboard attachment (10 points) and menu board attachment (10 points) were added to the evaluation, and the values for sodium reduction menu ratio and sodium reduction rate were adjusted from 20 to 10 points, for a total of 100 points.

Sodium reduction menu ratio evaluates whether the restaurant selected 20% or more of its menu items for the sodium reduction project, and the sodium reduction rate examines the extent of sodium reduction in the menu. The sodium control for a month assesses whether restaurants had checked the salinity at least once a week during one month. The sodium control in kimchi item evaluates whether low-sodium kimchi is served. The signboard attachment and menu board attachment items investigate whether the designated restaurant attached a signboard publicizing its sodium reduction status and a notice of sodium reduction on its menu provided by the Ministry of Food and Drug Safety. The label "Sodium Reduction Restaurant" was awarded if a restaurant satisfied all the required items with a score of 70 or higher and did not have a history of administrative action.

### *Measurement of salinity and sodium content*

A mystery shopper purchased sodium reduction menu items from participating restaurants that had been implementing the sodium reduction measures for at least a



**Figure 1.** Flow chart of restaurant participation and withdrawal.

**Table 1.** Evaluation method for on-site inspection of restaurants

| Evaluation items       |  | New restaurants   | Follow-up restaurants   |
|------------------------|--|---|---|
| Required items<br>(50) | Sodium reduction menu ratio (20/10)    | 15: 20%~<30%,<br>17: 30%~<50%,<br>20: ≥50%  | 6: 20%~<30%,<br>8: 30%~<50%,<br>10: ≥50%  |
|                        | Sodium reduction rate (20/10)          | 15: 10%~<20%,<br>17: 20%~<40%,<br>20: ≥40%  | 6: 10%~<20%,<br>8: 20%~<40%,<br>10: ≥40%  |
|                        | Salinity meter equipment (10/10)       | Yes: 10, No: 0  | Yes: 10, No: 0  |
|                        | Signboard attachment (-/10)            | -   | Yes: 10, No: 0  |
|                        | Menu board attachment (-/10)           | -   | Yes: 10, No: 0  |
| Optional items<br>(50) | Sodium control for a month (10)        | 0: once a month<br>4: more than once a month<br>7: 3 times a month<br>10: once a week | 0: once a month<br>4: more than once a month<br>7: 3 times a month<br>10: once a week |
|                        | Sodium content control (10)            | Yes: 10, No: 0  | Yes: 10, No: 0  |
|                        | Use of measuring tools (10)            | Yes: 10, No: 0  | Yes: 10, No: 0  |
|                        | Sodium control in kimchi (10)          | Yes: 10, No: 0  | Yes: 10, No: 0  |
|                        | No seasoning containers on tables (10) | Yes: 10, No: 0  | Yes: 10, No: 0  |

month. To measure the salinity of the food, one serving of the menu item was cooled to room temperature and uniformly crushed with a hand blender (Philips HR-1672, Hungary). Then, 20 to 50 g of the homogenate was diluted three to four times with distilled water to prepare a solution. The salinity meter readings were recorded, and the average salinity value was calculated. The sodium content per serving was calculated by dividing the salinity value (%) by 100 (% equivalent) and then multiplying that by the product of one serving (g), 1,000 (mg equivalent), and 0.4 (sodium content in salt).

#### Calculation of sodium reduction rate

The sodium reduction rate was calculated using the following equation.

$$\text{Sodium reduction rate (\%)} = (\text{standard sodium content [mg]} - \text{sodium content per serving after the project [mg/portion size]}) \div \text{standard sodium content (mg)} \times 100.$$

Standard sodium content refers to the average sodium content calculated for each of the most popular menu items in Korea since 2012. For the calculation, dishes were collected from restaurants, and the values were analyzed and published in the Food and Nutrition Fact Book<sup>21</sup> by the Ministry of Food and Drug Safety.

#### Survey of perception and satisfaction with the sodium reduction project

A survey was conducted to evaluate the perceptions and satisfaction of relevant stakeholders regarding the sodium reduction project during the first on-site inspection, from September to October 2018. The survey gauged the opinions of the owners and staff of the restaurants that participated in the project in eight districts of Daegu Metropolitan City and 1,095 customers. A total of 889 valid responses (162 owners and staff and 727 customers) were used for the statistical analysis.

Perception of the sodium reduction project was surveyed with two questions: one pertained to the taste of food in general restaurants in Daegu and the other pertained to the taste of food in the restaurants participating

in the project. Satisfaction with the project was measured using 10 questions based on the study by Kim et al.<sup>22</sup> These questions examined the use of a salinity meter and the Na-Codi app, training on measuring salinity and use of the Na-Codi app, materials for sodium reduction, low-sodium cooking consultation, education of consumer food hygiene observers, interest and support of local government personnel, effectiveness of the project on reducing sodium intake of Daegu citizens, willingness to recommend participation in the project to other restaurants, willingness to continue participation, and overall satisfaction with the project. A five-point Likert scale was used for scoring (1="strongly disagree," 2="disagree," 3="neutral," 4="agree," and 5="strongly agree").

#### Statistical analysis

The survey data were statistically processed using SPSS version 25 (IBM, Armonk, NY, USA). A paired t-test was conducted to compare the differences in salinity and sodium content before and after the project and the pass or failure rates. Analysis of variance and Duncan's multiple range test were also conducted to compare the salinity and sodium content among food groups. The satisfaction of owners and staff with the project was analyzed using the t-test, and the satisfaction of customers with the sodium reduction menus was analyzed using the  $\chi^2$  test.

## RESULTS

### Characteristics of restaurants

Table 2 lists the characteristics of restaurants that participated in the project. A total of 156 menus were included in the project: 79 from new restaurants and 77 from follow-up restaurants. On average, restaurants were 213 m<sup>2</sup> in size and had 91.7 seats and 4.7 staff members.

### Comparison of salinity before and after participating in the project

Table 3 reveals the change in salinity in the menus by food group after the project. The salinity of all the menus decreased significantly from 0.70±0.32% to 0.49±0.25%

**Table 2.** Characteristics of restaurants that participated in the sodium reduction project<sup>†</sup>

| Characteristics               | New restaurants<br>(n=39) | Follow-up restaurants<br>(n=51) | Total<br>(n=90) |
|-------------------------------|---------------------------|---------------------------------|-----------------|
| No. of sodium reduction menus | 79                        | 77                              | 156             |
| Area (m <sup>2</sup> )        | 167±135                   | 250±200                         | 213±178         |
| No. of seats                  | 79.4±44.5                 | 99.6±73.1                       | 91.7±63.4       |
| No. of employees              | 4.4±3.9                   | 5.1±4.8                         | 4.7±4.3         |

<sup>†</sup>Data expressed as mean±SD.

**Table 3.** Salinity of sodium reduction menu items before and after the project<sup>†</sup>

| Dish group        | n   | Salinity (%)             |                         | t-value               |
|-------------------|-----|--------------------------|-------------------------|-----------------------|
|                   |     | Before                   | After                   |                       |
| Cooked rice       | 6   | 0.69±0.27 <sup>BC</sup>  | 0.40±0.13 <sup>A</sup>  | 2.604 <sup>*</sup>    |
| Noodle            | 18  | 0.63±0.26 <sup>ABC</sup> | 0.47±0.10 <sup>AB</sup> | 2.484 <sup>*</sup>    |
| Porridge          | 4   | 0.36±0.16 <sup>A</sup>   | 0.25±0.10 <sup>A</sup>  | 1.127 <sup>NS</sup>   |
| Soup              | 30  | 0.64±0.28 <sup>AB</sup>  | 0.46±0.19 <sup>A</sup>  | 4.220 <sup>***</sup>  |
| Broth             | 53  | 0.58±0.30 <sup>ABC</sup> | 0.34±0.22 <sup>AB</sup> | 7.851 <sup>***</sup>  |
| Stew              | 12  | 0.92±0.33 <sup>CD</sup>  | 0.68±0.19 <sup>BC</sup> | 3.784 <sup>**</sup>   |
| Grilled dishes    | 9   | 0.95±0.19 <sup>CD</sup>  | 0.70±0.21 <sup>C</sup>  | 2.751 <sup>*</sup>    |
| Salad             | 5   | 1.07±0.35 <sup>D</sup>   | 0.88±0.19 <sup>C</sup>  | 1.937 <sup>NS</sup>   |
| Stir-fried dishes | 11  | 0.91±0.30 <sup>BCD</sup> | 0.67±0.27 <sup>BC</sup> | 2.095 <sup>NS</sup>   |
| Steamed dishes    | 4   | 1.05±0.18 <sup>D</sup>   | 0.68±0.05 <sup>BC</sup> | 3.351 <sup>*</sup>    |
| Table d'hôte      | 4   | 0.77±0.44 <sup>BCD</sup> | 0.77±0.34 <sup>C</sup>  | 0.010 <sup>NS</sup>   |
| F-value           |     | 5.283 <sup>***</sup>     | 9.596 <sup>***</sup>    |                       |
| Total             | 156 | 0.70±0.32                | 0.49±0.25               | 10.424 <sup>***</sup> |

NS: not significant.

<sup>†</sup>Data expressed as mean±SD.

<sup>A-D</sup>Means with different letters in the same column are significantly different according to Duncan's multiple range test at  $p<0.05$ .

<sup>\*</sup> $p<0.05$ , <sup>\*\*</sup> $p<0.01$ , <sup>\*\*\*</sup> $p<0.001$ .

( $p<0.001$ ). Broth ( $p<0.001$ ) and soup ( $p<0.001$ ) had the highest sodium reduction rates after the project, decreasing from 0.58% to 0.34% and from 0.64% to 0.46%, respectively, followed by stew ( $p<0.01$ ), grilled dishes ( $p<0.05$ ), and steamed dishes ( $p<0.05$ ).

Before the project, salad (1.07%) and steamed dishes (1.05%) had the highest salinities. The least salty food was in the porridge group (0.36%) ( $p<0.05$ ). After the project, salad (0.88%), table d'hôte items (0.77%), grilled dishes (0.70%), stew (0.68%), and stir-fried dishes (0.67%) had significantly higher salinity than cooked rice (0.40%), porridge (0.25%), and soup (0.46%) ( $p<0.05$ ).

#### Comparison of sodium content before and after the project

Table 4 presents the changes in sodium content for all the menus after the project. On average, the sodium content per serving decreased significantly from 1,470±756 mg to 980±493 mg ( $p<0.001$ ).

Comparisons of the sodium content of the food groups before and after the project revealed that broth ( $p<0.001$ ) and soup ( $p<0.001$ ) exhibited the highest reduction, decreasing from 1,463±641 mg to 871±517 mg and from 1,722±967 mg to 1,146±449 mg, respectively, followed by stew ( $p<0.01$ ), cooked rice ( $p<0.05$ ), grilled dishes ( $p<0.05$ ), and noodles ( $p<0.05$ ).

The sodium reduction rate was the highest for broth (46.0%). The food groups with a sodium reduction rate of 30% or more were stir-fried dishes (39.5%), soups (35.8%), grilled dishes (34.8%), porridge dishes (33.5%), cooked rice dishes (31.8%), and steamed dishes (31.5%).

#### Evaluation from on-site inspections

The results of the on-site inspection of restaurants are summarized in Table 5. New restaurants that passed the evaluation (designated restaurants) obtained an average of 79.9 points out of 100, whereas non-designated restaurants obtained 60.3 points on average. A significant difference was observed in sodium reduction rate between the two aforementioned groups ( $p<0.001$ ), the greatest difference among all the evaluated items. For follow-up restaurants, the designated restaurants received on average 81.5 points out of 100, whereas the non-designated restaurants obtained an average of 69.0 points. Once again, sodium reduction rates exhibited the most significant difference between the two groups ( $p<0.001$ ), and a significant difference was also noted for sodium reduction menu ratio ( $p<0.05$ ). The remaining evaluation items did not have a significant influence on determining whether the restaurant was designated as being in the low-sodium category.

#### Perception of taste of sodium reduction menus

Figure 2 reveals stakeholders' perceptions of the taste of sodium reduction menu items. Among owners and staff, 64.2% and 29.6%, respectively, responded "moderate" and "bland." A corresponding 62.4% and 27.9% of customers responded similarly. By contrast, 51.1% and 42.0% of the owners and staff responded "salty" and "moderate," respectively, when assessing the taste of food offered by restaurants not participating in the project. Furthermore 48.7% of customers perceived the competitors' food as "salty" and 45.9% perceived it as

**Table 4.** Sodium content of sodium reduction menu items before and after the project<sup>†</sup>

| Dish group      | n   | Standard sodium content (mg) | Sodium content (mg/portion size) |           | t-value             | Sodium reduction rate (%) <sup>‡</sup> |
|-----------------|-----|------------------------------|----------------------------------|-----------|---------------------|--|
|                 |     |                              | Before                           | After     |                     |  |
| Cooked rice     | 6   | 1,480±659                    | 1,694±687                        | 900±429   | 3.162*              | 31.8±15.9                              |
| Noodle          | 18  | 1,792±585                    | 1,709±701                        | 1,309±424 | 2.496*              | 24.6±18.9                              |
| Porridge        | 4   | 1,014±361                    | 928±576                          | 642±258   | 0.982 <sup>NS</sup> | 33.5±29.9                              |
| Soup            | 30  | 1,899±889                    | 1,722±967                        | 1,146±449 | 4.065***            | 35.8±20.7                              |
| Broth           | 53  | 1,578±524                    | 1,463±641                        | 871±517   | 8.335***            | 46.0±26.5                              |
| Stew            | 12  | 1,629±308                    | 1,469±529                        | 1,080±306 | 3.784**             | 33.1±15.2                              |
| Grilled dish    | 9   | 1,434±629                    | 1,317±725                        | 974±581   | 2.552*              | 34.8±22.1                              |
| Salad           | 5   | 779±612                      | 702±655                          | 536±374   | 1.301 <sup>NS</sup> | 28.4±10.0                              |
| Stir-fried dish | 11  | 892±1                        | 777±240                          | 538±215   | 2.195 <sup>NS</sup> | 39.5±24.1                              |
| Steamed dish    | 4   | 1,494±389                    | 1,530±348                        | 982±116   | 2.976 <sup>NS</sup> | 31.5±14.7                              |
| Table d'hôte    | 4   | 2,137±926                    | 1,950±1,240                      | 1,485±540 | 1.103 <sup>NS</sup> | 26.8±18.0                              |
| Total           | 156 | 1,563±682                    | 1,470±756                        | 980±493   | 10.621***           | 37.2±23.0                              |

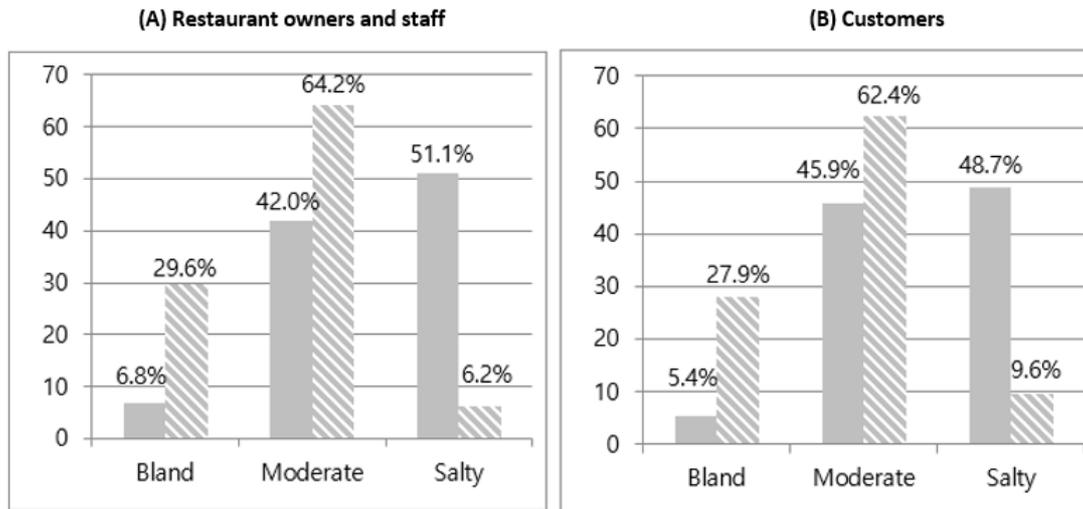
NS: not significant

<sup>†</sup>Data expressed as mean±SD<sup>‡</sup>Sodium reduction rate (%) = (standard sodium content [mg] – sodium content after project [mg/portion size]) ÷ standard sodium content (mg) × 100%.\**p*<0.05, \*\**p*<0.01, \*\*\**p*<0.001.**Table 5.** Evaluation of the project restaurants during on-site inspections<sup>†</sup>

| Evaluation item                        | New restaurants                      |                                      |                     | Follow-up restaurants                |                                      |                     |
|--|--------------------------------------|--------------------------------------|---------------------|--------------------------------------|--------------------------------------|---------------------|
|  | Pass <sup>‡</sup><br>( <i>n</i> =26) | Fail <sup>§</sup><br>( <i>n</i> =13) | t-value             | Pass <sup>‡</sup><br>( <i>n</i> =41) | Fail <sup>§</sup><br>( <i>n</i> =10) | t-value             |
| Sodium reduction menu ratio (20/10)    | 15.4±0.8                             | 15.2±0.6                             | 0.928 <sup>NS</sup> | 7.1±1.6                              | 6.0±0.0                              | 2.268*              |
| Sodium reduction rate (20/10)          | 18.8±1.6                             | 1.3±4.7                              | 17.125***           | 9.2±1.2                              | 1.6±3.5                              | 11.758***           |
| Salinity meter equipment (10)          | 10.0±0.0                             | 10.0±0.0                             | -                   | 10.0±0.0                             | 10.0±0.0                             | -                   |
| Sodium control for a month (10)        | 10.0±0.0                             | 10.0±0.0                             | -                   | 8.1±2.7                              | 7.4±4.1                              | 0.665 <sup>NS</sup> |
| Sodium content control (10)            | 7.3±4.5                              | 4.6±5.2                              | 1.669 <sup>NS</sup> | 6.1±4.9                              | 5.0±5.3                              | 0.622 <sup>NS</sup> |
| Use of measuring tools (10)            | 9.6±2.0                              | 10.0±0.0                             | 0.702 <sup>NS</sup> | 9.8±1.6                              | 10.0±0.0                             | 0.490 <sup>NS</sup> |
| No seasoning containers on tables (10) | 8.8±3.3                              | 7.7±4.4                              | 0.928 <sup>NS</sup> | 9.5±2.2                              | 8.0±4.2                              | 1.432 <sup>NS</sup> |
| Sodium control in kimchi (10)          | 0.0±0.0                              | 1.5±3.8                              | 2.118*              | 1.7±3.8                              | 1.0±3.2                              | 0.542 <sup>NS</sup> |
| Signboard attachment (10)              | -                                    | -                                    | -                   | 10.0±0.0                             | 10.0±0.0                             | -                   |
| Menu board attachment (10)             | -                                    | -                                    | -                   | 10.0±0.0                             | 10.0±0.0                             | -                   |
| Total score                            | 79.9±5.9                             | 60.3±8.8                             | 8.301***            | 81.5±7.7                             | 69.0±8.7                             | 4.511***            |

NS: not significant.

<sup>†</sup>Data expressed as mean±SD<sup>‡</sup>Satisfied all the required items with at least 70 points (out of 100) and did not have a history of administrative action.<sup>§</sup>Less than 70 points or have a history of administrative action.\**p*<0.05, \*\*\**p*<0.001.



**Figure 2.** Perception of the taste of the general restaurant menus and the sodium reduction restaurant menus by (A) restaurant owners and staff and (B) customers. Solid bars represent the taste of general restaurant menus and striped bars represent the taste of sodium reduction restaurant menus.

“moderate.”

#### Satisfaction with the sodium reduction project

The satisfaction levels of owners and staff with the project are presented in Table 6. The owners of the restaurants ( $41.1 \pm 7.11$ ) were more satisfied than the staff ( $38.4 \pm 5.55$ ;  $p < 0.01$ ). The satisfaction of the owners was significantly higher than that of the staff regarding training on measuring salinity and use of the Na-Codi app ( $p < 0.05$ ), materials for sodium reduction ( $p < 0.05$ ), education of consumer food hygiene observers ( $p < 0.05$ ), interest and support of local government personnel ( $p < 0.001$ ), and effectiveness of the projects in reducing the sodium intake of Daegu citizens ( $p < 0.01$ ). Overall, satisfaction was highest for education of consumer food hygiene observers ( $4.06 \pm 0.67$ ), followed by the use of a salinity meter and Na-Codi app ( $4.04 \pm 0.66$ ), and interest and support of local government personnel ( $4.03 \pm 0.69$ ).

The satisfaction levels of customers with the project are revealed in Table 7. In terms of satisfaction with sodium reduction menus, 51.8% of the customers responded “sat-

isfied,” and 28.0% and 18.6% responded “moderate” and “very satisfied,” respectively. In total, 77.9% of the customers who were aware that the restaurants they visited were participating in the sodium reduction project responded that the sodium reduction menu items tasted good and excellent, and 73.8% of them were satisfied and very satisfied with the menus. Among customers who were not aware of the status of the restaurant, 68.3% responded that the menu items tasted good and excellent, and 65.9% of them were satisfied or very satisfied with the menus. In total, 76% of the customers who recognized the necessity of reducing sodium intake in Korea thought that the sodium reduction menu items tasted good and excellent, and 74.4% of them were satisfied or very satisfied with the menus.

#### DISCUSSION

The decreased sodium content and scores observed during on-site inspections indicated that the project effectively reduced sodium content, and the high satisfaction of owners and customers also suggested the project’s effective-

**Table 6.** Satisfaction of restaurant owners and staff with the sodium reduction project<sup>†</sup>

|  | Owners<br>(n=74) | Staff<br>(n=88) | t-value | Total<br>(n=162) |
|--|------------------|-----------------|---------|------------------|
| Use of a salinity meter and Na-Codi app                                    | 4.14±0.75        | 3.97±0.58       | 1.59    | 4.04±0.66        |
| Training on measuring salinity and use of the Na-Codi app                  | 4.12±0.76        | 3.89±0.62       | 2.18*   | 3.99±0.69        |
| Materials for sodium reduction   | 4.05±0.77        | 3.76±0.66       | 2.60*   | 3.90±0.73        |
| Low-sodium cooking consultation  | 3.99±0.87        | 3.80±0.70       | 1.55    | 3.88±0.78        |
| Education of consumer food hygiene observers                               | 4.19±0.72        | 3.95±0.61       | 2.23*   | 4.06±0.67        |
| Interest and support of local government personnel                         | 4.26±0.70        | 3.84±0.62       | 3.99*** | 4.03±0.69        |
| Effectiveness of the project on reducing sodium intake of Daegu citizens   | 4.23±0.88        | 3.78±0.72       | 3.54**  | 3.99±0.83        |
| Willingness to recommend participation in the project to other restaurants | 4.05±0.89        | 3.81±0.87       | 1.78    | 3.92±0.89        |
| Willingness to continue participation                                      | 3.99±1.01        | 3.76±0.91       | 1.49    | 3.86±0.96        |
| Overall satisfaction with the project                                      | 4.05±0.86        | 3.82±0.74       | 1.88    | 3.93±0.80        |
| Total  | 41.1±7.11        | 38.4±5.55       | 2.71**  | 39.6±6.43        |

NS: not significant.

<sup>†</sup>Data expressed as mean±SD.

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

**Table 7.** Customer satisfaction with the sodium reduction menus<sup>†</sup>

|   | Known      | Unknown    | $\chi^2$ | Unnecessary | Neutral   | Necessary  | $\chi^2$ | Total      |
|---|------------|------------|----------|-------------|-----------|------------|----------|------------|
| Taste of sodium reduction menu          |            |            |          |             |           |            |          |            |
| Very bad                                | 9 (2.7)    | 2 (0.8)    |          | 2 (9.1)     | 0 (0.0)   | 9 (1.9)    |          | 11 (1.9)   |
| Bad                                     | 2 (0.6)    | 1 (0.4)    |          | 0 (0.0)     | 0 (0.0)   | 3 (0.6)    |          | 3 (0.5)    |
| Normal                                  | 63 (18.6)  | 74 (30.1)  | 23.11*** | 9 (40.9)    | 26 (32.9) | 102 (21.1) | 18.49*   | 137 (23.4) |
| Good                                    | 159 (46.9) | 127 (51.6) |          | 7 (31.8)    | 37 (46.8) | 242 (50.0) |          | 286 (48.9) |
| Excellent                               | 105 (31.0) | 41 (16.7)  |          | 4 (18.2)    | 16 (20.3) | 126 (26.0) |          | 146 (25.0) |
| No response                             | 1 (0.3)    | 1 (0.4)    |          | 0 (0.0)     | 0 (0.0)   | 2 (0.4)    |          | 2 (0.3)    |
| Satisfaction with sodium reduction menu |            |            |          |             |           |            |          |            |
| Very unsatisfied                        | 4 (1.2)    | 3 (1.2)    |          | 1 (4.5)     | 2 (2.5)   | 4 (0.8)    |          | 7 (1.2)    |
| Unsatisfied                             | 0 (0.0)    | 2 (0.8)    |          | 1 (4.5)     | 0 (0.0)   | 1 (0.2)    |          | 2 (0.3)    |
| Moderate                                | 85 (25.1)  | 79 (32.1)  | 24.75*** | 10 (45.5)   | 35 (44.3) | 119 (24.6) | 37.94*   | 164 (28.0) |
| Satisfied                               | 165 (48.7) | 138 (56.1) |          | 7 (31.8)    | 37 (46.8) | 259 (53.5) |          | 303 (51.8) |
| Very satisfied                          | 85 (25.1)  | 24 (9.8)   |          | 3 (13.6)    | 5 (6.3)   | 101 (20.9) |          | 109 (18.6) |
| Total                                   | 339 (100)  | 246 (100)  |          | 22 (100)    | 79 (100)  | 484 (100)  |          | 585 (100)  |

NS: not significant.

<sup>†</sup>Data expressed as N (%).\* $p < 0.05$ , \*\*\* $p < 0.001$ .

ness and feasibility, both of which were the primary goals of the project.

The average salinity of all 156 menus before the project was 0.70% with the salinity of soup being 0.64% and that of broth being 0.58%. In 2014 survey of South Korean take-outs, Jiang et al.<sup>23</sup> stated that the average salinity of soups, broths, and stews was 1.02%±0.35%, a higher level than what was found in this study.

In 2019, another Korean study<sup>24</sup> suggested that the reduced-salinity standard for clear soups was 0.5% or lower, 0.6% or lower for clear broths, 0.7% or lower for other broths and soups, and 0.8% or lower for bean paste stews. The current study revealed that the average salinity of all the menus decreased significantly to 0.49%±0.25% after the project ( $p<0.001$ ). Among the menu items, soups, broths, and stews exhibited the lowest average salinity of 0.46%±0.19%, 0.34%±0.22%, and 0.68%±0.19%, respectively, which were below the reduced-salinity standards.<sup>24</sup> In addition, in this study, a decrease was noted in the salinity of stir-fried dishes, from 0.91%±0.30% to 0.67%±0.27% and from 1.05%±0.18% to 0.68%±0.05% for steamed dishes, both of which were lower than the reduced-salinity standard of 0.9% or less.<sup>24</sup>

This study revealed that the average sodium content per serving before the project was 1,470±756 mg, reaching 73.5% of the recommended daily intake limit of 2,000 mg.<sup>25</sup> Such a high sodium content indicates the necessity of the sodium reduction project.

A study from Canada<sup>26</sup> indicated a sodium content per serving of 1,455 mg in 2010, which is a similar to the value in Korea before the project (1,470 mg). Research in Denmark<sup>27</sup> revealed that the sodium content per serving of worker lunches was 1,520±720 mg for men and 1,120±480 mg for women, which is slightly lower than the present study's results. A study among US citizens in 2010<sup>28</sup> indicated that 25% of entrées offered to adults and children exceeded 2,000 mg of sodium, and appetizers contained even more sodium. In 2009, the average sodium content per serving at cafeterias in office buildings in South Korea was as high as 2,778 mg.<sup>29</sup> The difference may be caused, for example, by diverse restaurants, menus, and measuring methods.

The implementation of the sodium reduction project led to an average decrease of 37% in sodium content per serving to 980±493 mg, which met the Ministry of Food and Drug Safety's goal of 1.300 mg or less. Among the food groups, broth had the highest sodium reduction rate, amounting to 46%, followed by stir-fried dishes (39.5%). Food groups with more than 30% reduction included soups (35.8%), grilled dishes (34.8%), and porridge dishes (33.5%). These results complied with the 30% sodium-intake reduction target established by the Global Action Plan for the Prevention and Control of Noncommunicable Disease 2013–2020.<sup>9</sup>

According to a study that analyzed the food groups contributing to sodium intake based on data from the Korea National Health and Nutrition Examination Survey (1998–2010), the major sources of sodium include kimchi (22.8%–31.7%), noodles and dumplings (10.5%–13.8%), soup and broth (10.2%–13.8%), and stew and hot pot (8.5%–11.2%).<sup>30</sup> These values indicate that the high consumption of soup and kimchi contributes to increasing

sodium intake in South Korea. Therefore, reducing the amount of sodium per serving in take-out menus is the key to decreasing sodium intake.

In this study, the on-site inspection results of the sodium reduction project revealed that 66.7% of the new restaurants were designated as sodium reduction restaurants and 80.4% of follow-up restaurants maintained their status. For evaluating the follow-up restaurants, additional items included attaching a signboard designating it a "Sodium Reduction Restaurant" and attaching a menu board with information regarding the sodium reduction menu items. These are marketing interventions that are considered effective in increasing the acceptability, awareness, and satisfaction of customers related to food with reduced sodium.<sup>31</sup>

Up to 51.1% of the restaurant owners in this project and 48.7% of their customers perceived the taste of the menus offered by general restaurants in Daegu as "salty," whereas 6.8% and 5.4%, respectively, perceived them as "bland." However, for the sodium reduction menus only 6.2% and 9.6% of the owners and customers perceived the taste as "salty," whereas as up to 29.6% and 27.9% perceived it as "bland," respectively. In a 2017 study involving 553 Daegu citizens, 74.1% evaluated the food in Daegu restaurants, in general, as "salty," and only 1.4% thought it was "bland."<sup>32</sup>

Restaurant owners in this project were the most satisfied with the education of consumer food hygiene observers, suggesting that these officers not only continue to visit the restaurants to provide sodium reduction education but also help in the measurement of salinity and teach stakeholders how to use the Na-Codi app. This finding also shows the effectiveness of providing salinity meters, training for using the app, and related materials. The sodium reduction project would be meaningless if it is promoted as merely a one-time event.

Salinity must be measured and recorded consistently, at least once a week, to maintain the low sodium content in menus. This continuous effort may lead to increased satisfaction with the interest, support, and help of local government personnel. In a study of 9,579 consumers in the US by Patel et al.<sup>33</sup> half of the consumers had a favorable opinion of the government's efforts to reduce sodium in restaurants menu and processed food. Similarly, in the current study, participating restaurant owners (41.1±7.11) and staff (38.4±5.55) also reported high satisfaction levels with the project led by the government.

With regards to the taste of sodium reduction menu items "good" accounted for 48.9% and "excellent" for 25.0% of the responses. Regarding satisfaction with sodium reduction menus, "satisfied" accounted for 51.8% and "very satisfied" for 18.6%, indicating high satisfaction despite the reduced sodium. In a study by Hong et al.,<sup>34</sup> 52% and 43% of customers responded "moderate" and "good" concerning their satisfaction with sodium reduction menus, respectively. In a study among buffet restaurant customers, taste, nutrition, and freshness were the aspects that most influenced their satisfaction, with taste being the most critical factor.<sup>35</sup> In addition, customer satisfaction was determined by the quality of menus, which includes elements such as variety, hygiene, taste, and price; customer satisfaction also had a substantial influ-

ence on return visits.<sup>36</sup>

Despite recognizing the importance and need for reducing sodium intake, nutritionists also consider it a difficult undertaking because of potential taste-related complaints.<sup>37</sup> Experts are also aware of the need to reduce sodium, but recognize the reluctance of individuals to purchase low-sodium products because of the perception that such products have less taste and are expensive.<sup>38</sup> Taste is a critical factor affecting customer satisfaction and return visits. Without improving the taste and perception of low-sodium products, raising awareness of sodium reduction is unlikely to change actual behavior.

In this study, up to 73.8% of the customers who were aware that the restaurants were participating in the sodium reduction project were satisfied with the menus. In a study by Kim et al.,<sup>39</sup> the preference for and satisfaction with seasonings were high when the restaurant's low-sodium status was indicated. This may be attributed to the fact that such information raises the expectations of health-conscious consumers. In a study by Liem et al.<sup>40</sup> people reported the lowest preference and demand for low-sodium soup, but after tasting it, the same soup achieved the highest preference and demand levels.

Philadelphia in the United States established a sodium reduction program for restaurants from 2012 to 2015 that involved the teaching of best practices. This program produced a meaningful result in terms of improving nutritional knowledge, perception, and self-efficacy of cooks after 36 months of low-sodium cooking education for frequently ordered menu items (shrimp and broccoli, chicken lo mein, and General Tso's chicken). However, after 3 years, researchers found that the perception of sodium reduction or self-efficacy was, again, poor.<sup>41</sup> Therefore, a sodium reduction project is not effective if it is only maintained in the short term. Reducing sodium intake requires continual education and management to change people's dietary behaviors.

### Conclusions

The sodium reduction project in restaurants in Daegu Metropolitan City had a positive effect because it successfully reduced the sodium content in food while also boosting the satisfaction of customers and restaurant owners and staff.

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### AUTHOR DISCLOSURES

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