

## The Effect of Educational Background Music on Reducing Salt Intake at a University Canteen

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### Abstract

**Objective:** Reducing salt intake is a priority action for addressing the worldwide crisis of non-communicable diseases, and its various public approaches should be developed. Educational background music (BGM) on reducing salt intake may nudge consumers at a canteen in choosing healthier meals or discretionary seasonings.

**Design:** The study design is a small-scale community trial that compared the control and the intervention periods.

**Subjects:** Subjects were unspecified consumers at a university canteen

**Interventions:** We displayed visual materials at a university canteen for 5 weeks (control period) and then broadcasted BGM for another 5 weeks (intervention period).

**Measures of outcome:** The consumption amount of discretionary seasonings and of soup in noodles and the consumption number of soup bowls and of noodles among the consumers, and the changes in the four abovementioned indices during both periods were compared by Mann–Whitney U test.

**Results:** Reductions in the consumption number of soup bowls and noodles were higher in the intervention period than those in the control period with statistical significance (median values: -7.5 and 5.4 per 100 rice consumers,  $p = 0.01$ ; ratios to rice consumers, -0.02 and 0.10,  $p = 0.02$ , respectively).

**Conclusion:** Using a dietary education song on salt intake as BGM may be effective in influencing individuals toward healthier menu choices rather than seasoning behavior at a university's canteen.

**Keywords:** Behavior modification, BGM, Population approach, Reduced salt diet, Health education

### Introduction

Cardiovascular diseases (CVDs) and cancers are the leading causes of death globally [1]. Excessive salt or salted food intake is a major risk factor for both CVD (due to high blood pressure) and gastric cancer [2]. Reducing salt intake was indicated as the second priority action for addressing the crisis of non-communicable diseases (NCDs), including CVDs and cancer, in the UN High-Level Meeting on NCDs, 2011 [3]. Based on the report that the major sources of salt intake in the UK were processed foods, such as bread, cereals, and meat products (83% of the total salt intake) [4], the UK government and food industry collaborated to reduce the salt content in these foods. Eventually, they succeeded in reducing approximately 1 g salt/day in the average intake during 2000–2008 [5]. However, this strategy may be unsuitable for countries with different dietary patterns: for instance, bread and processed meat intakes were only 39 and 13 g/day in Japan, respectively [6], despite it being 87 and 62 g/day in the UK, respectively [7]. This approach by the UK government led to a reduction of only 1 g salt/day even in countries where the intake of these processed foods is relatively high; however, this approach may have little impact in countries where intake of these processed foods is lower. Therefore, an additional population approach to reduce salt intake should be considered for both the countries. Particularly, in countries, such as Japan, Korea, and China, where the primary sources of salt equivalent are soups and discretionary seasonings added to homemade foods or to cooked food already at the table (i.e., soy sauce and miso), public approaches raising the individuals' awareness on reducing salt intake may be effective [8].

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A song regarding the appropriate amount of salt intake consisting of interesting sound and lyrics that encourage salt intake reduction was developed and provided as an educational tool by the government of Nara Prefecture [9]. The effect of background music (BGM) without words or of unspecified category on eating behavior was only examined consumption amount, such as the total energy intake [10-12], and the results were inconsistent. To the best of our knowledge, the effect of a music on dietary education consisted of interesting sound and lyrics about dietary modification has not yet been examined. Some large-scale approaches using mass media, such as television (TV) and radio, to promote salt intake reduction have been reported [13]. Using educational songs as BGM is potentially becoming more frequent and versatile approach in food purchasing and/or eating environments (e.g., canteens in workplaces and schools) to nudge consumers toward healthier choices.

Thus, we examined the effect of a dietary educational song regarding the appropriate amount of salt intake as BGM on individual behavioral modification at a university canteen. This was conducted by comparing the control and intervention periods.

## Materials and Methods

### Study Design

We examined the effect of using a dietary educational song regarding the appropriate amount of salt intake as BGM on the users' behavioral modifications based on the sales record or leftover meals among unspecified consumer during the control and intervention periods in a university canteen in Japan. This intervention trial was approved by the Nara Women's University Institutional Review Board for epidemiological study (Approved on 16 June 2016). The study information was notified by means of posters, instead of personalized informed consent, at the canteen entrance because the assemblage of the subjects consisted of unspecified customers at the canteen.

Lunch time during weekdays (5 weeks) was set as the experimental period from June 2016 to August 2016 (control period) and from November 2016 to December 2016 (intervention period) (Figure 1). With regard to the possible replacement of the canteen users by admission and graduation and on comparability caused by different menu styles between different facilities, we scheduled control and intervention periods in different seasons. During the control period, we displayed posters and tabletop notes, and distributed leaflets, illustrating the Japanese Food Guide Spinning Top [14], as conventional visual manners, at the canteen. Conversely, during the intervention period, we

additionally broadcasted the dietary educational song as BGM at the entrance of the canteen.

### Evaluation Methods

We evaluated the following four indices in the canteen per each day of the week during the 5 weekdays before the start and end of the periods: (1) consumption amount of discretionary seasonings added per consumer, (2) consumption amount of soup in noodles (%) per canteen, (3) consumption number of soup bowls, and (4) consumption number of noodles per capita.

First, to determine the consumption amount of seasonings at the table (per 100 consumers) as a discretionary seasoning behavior, bottled soy sauce, ponzu (sour-tasting soy sauce), sauce (thickened Worcestershire sauce), and dressings were weighed before and after lunchtime. The differences were considered as the gross consumption of the day of each seasoning. These gross consumptions were divided by the number of canteen consumers during lunchtime based on the point-of-sale (POS) system. Second, the consumption amount of soup in noodles (%) was determined by the difference between the total amount of soup provided and total amount of leftover soup in the canteen. We classified the noodle menu into the following three types according to the recipe and bowl size for eating: Japanese, curry, and Chinese noodles. To determine the amount of leftover soup, we distributed measurement papers to the consumers who ordered noodles. Thereafter, either the consumers themselves or we measured the depths of leftover soups (in mm), and we then collected the measurement papers. We developed formulas to estimate the amount (ml) of leftover soup by depth (mm) measured according to the three aforementioned menu types. We poured water into the bowls and measured its amount (ml) and depth (mm) of the water in the bowls and then performed quadratic regression. Consequently, we obtained the following formulas: (1) amount of leftover soup in Japanese noodles (ml) =  $0.121 \times [\text{depth (mm)}]^2 + 5.244 \times \text{depth (mm)}$ ; (2) amount of leftover soup in curry noodles (ml) =  $0.095 \times [\text{depth (mm)}]^2 + 3.986 \times \text{depth (mm)}$ ; and (3) amount of leftover soup in Chinese noodles (ml) =  $0.161 \times [\text{depth (mm)}]^2 + 6.778 \times \text{depth (mm)}$  (Figure 2). The amounts of leftover soups were summed per each three menu types. We did not measure the leftover amount of cold Japanese noodles due to the different forms of bowls used. Third, the consumption number of soup bowls (salty taste) was obtained from the POS system. To evaluate the behavior on the discretionary selection of soup by the consumers, the consumption number of lunch set with miso soup was excluded from both the number of soup bowls and the total number of consumers. Then consumption number of soup bowls per 100 consumers of the

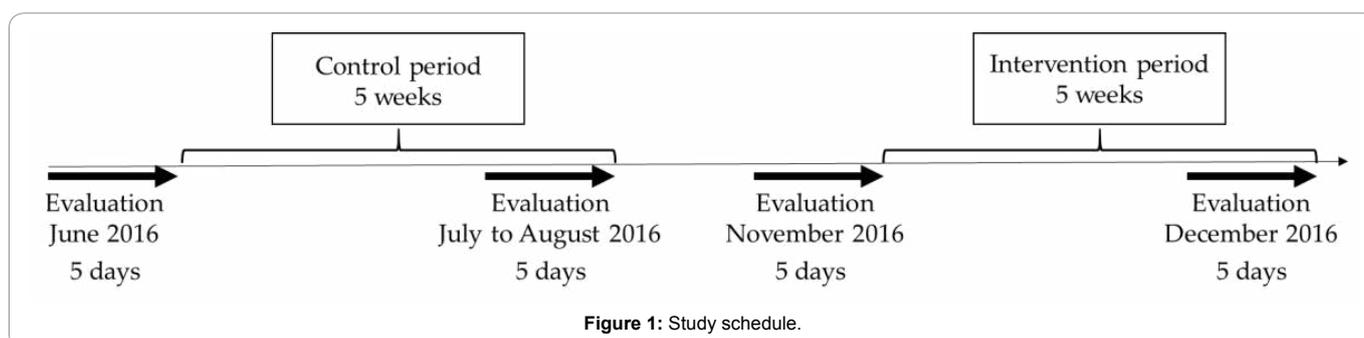


Figure 1: Study schedule.

day was calculated. Additionally, to evaluate the proportion of consumers who selected soup bowls with rice and to adjust the difference of lunch set provided (rice, main dish, some vegetable dishes, and soup) between the control and intervention periods, the consumption number of soup bowls was divided by the number of rice (including bowl rice [bowl of rice with food on top] and excluding curry rice) sold. Fourth, the consumption number of noodles, including cold Japanese noodles, was obtained from the data in the POS system. We determined the consumption number of noodles per 100 consumers of the day. The ratio of the consumption number of noodles to that of rice was determined to evaluate the influence on the consumers' menu selection for "staple food" (grain). In other words, we evaluated whether the consumers modified their menu choice from foods with higher salt content (noodles) to foods with less salt content (rice) as their staple food.

## Statistical Analysis

We compared the changes between the control and intervention periods. In this study, we assessed the changes in salt intake on a mass level, rather than on an individual level, in the said canteen during weekdays (Monday–Friday). In both the control and intervention periods, changes were calculated between each day's control and intervention periods. The differences in the changes between the control (n = 5 days) and intervention periods (n = 5 days) were analyzed by Mann–Whitney U test. We used the IBM SPSS Statistics 21.0 (IBM Japan, Ltd.) for all statistical analyses. The significance level was set at < 5% (two-sided test).

## Results

Table 1 shows the daily number of canteen consumers

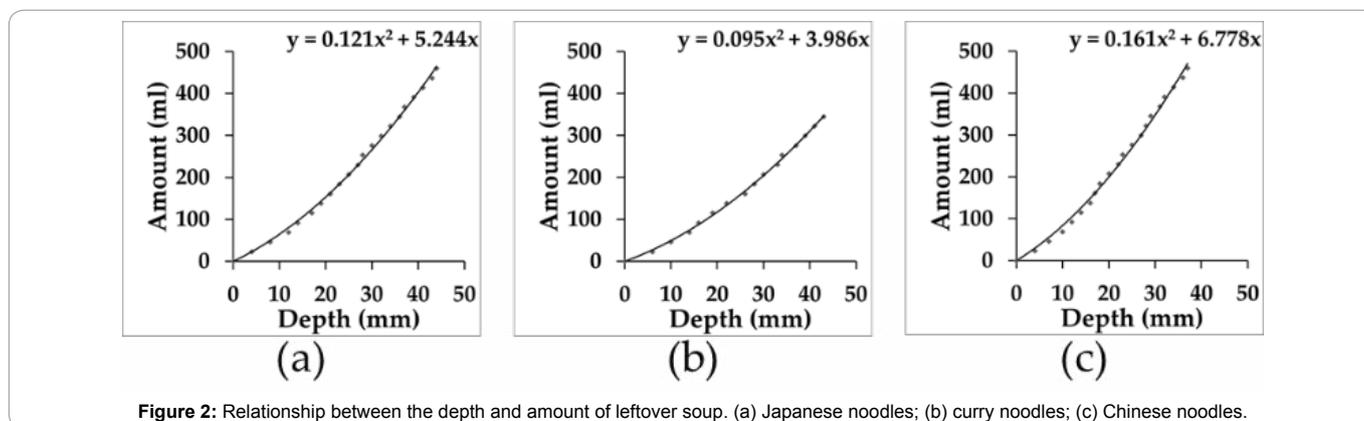


Figure 2: Relationship between the depth and amount of leftover soup. (a) Japanese noodles; (b) curry noodles; (c) Chinese noodles.

Table 1: Daily number of consumers and the consumed menu

|                                       | Before the period<br>(5 days) |                         | After the period<br>(5 days) |                         |
|---------------------------------------|-------------------------------|-------------------------|------------------------------|-------------------------|
|                                       | Median                        | (min, max) <sup>1</sup> | Median                       | (min, max) <sup>1</sup> |
| <b>Control period</b>                 |                               |                         |                              |                         |
| Number of consumers                   | 779                           | (769, 810)              | 784                          | (710, 821)              |
| Lunch set                             | 40                            | (27, 50)                | 0                            | (0, 0)                  |
| <b>Rice and bowl rice<sup>2</sup></b> |                               |                         |                              |                         |
| Rice                                  | 228                           | (196, 244)              | 209                          | (205, 219)              |
| Bowl rice <sup>3*</sup>               | 170                           | (153, 183)              | 165                          | (94, 208)               |
| Soup                                  | 179                           | (163, 188)              | 182                          | (160, 205)              |
| <b>Noodles</b>                        |                               |                         |                              |                         |
| Japanese noodles <sup>4, 5*</sup>     | 76                            | (69, 97)                | 66                           | (59, 73)                |
| Curry noodles                         | 3                             | (2, 4)                  | 6                            | (5, 12)                 |
| Chinese noodles <sup>6*</sup>         | 60                            | (48, 63)                | 86                           | (74, 93)                |
| Buffet (side dish and salad)          | 200                           | (186, 205)              | 191                          | (182, 210)              |
| Side dish, assort                     | 472                           | (457, 516)              | 542                          | (472, 570)              |
| <b>Intervention period</b>            |                               |                         |                              |                         |
| Number of consumers                   | 739                           | (728, 765)              | 758                          | (720, 782)              |
| Lunch set                             | 48                            | (45, 58)                | 50                           | (48, 59)                |
| <b>Rice and bowl rice<sup>2</sup></b> |                               |                         |                              |                         |
| Rice                                  | 212                           | (197, 227)              | 204                          | (140, 241)              |
| Bowl rice <sup>3†</sup>               | 139                           | (109, 159)              | 130                          | (105, 214)              |
| Soup                                  | 182                           | (174, 205)              | 152                          | (136, 188)              |
| <b>Noodles</b>                        |                               |                         |                              |                         |
| Japanese noodles <sup>4, 5†</sup>     | 85                            | (80, 92)                | 90                           | (86, 97)                |

|                               |     |            |     |            |
|-------------------------------|-----|------------|-----|------------|
| Curry noodles                 | 8   | (1, 10)    | 4   | (2, 7)     |
| Chinese noodles <sup>6†</sup> | 45  | (37, 49)   | 40  | (30, 47)   |
| Buffet (side dish and salad)  | 186 | (173, 240) | 210 | (158, 221) |
| Side dish, assort             | 465 | (427, 471) | 458 | (414, 470) |

1: min, minimum; max, maximum. 2: Excluding curry rice. 3\*: The provided seasonal menus of bowl rice in the control period were as follows: [Before the period] cold green tea on rice with pickled plum and chicken, salty chicken bowl rice, and basil seed rice. [After the period] whitebait bowl rice (tasteless), fried chicken with tartar sauce bowl rice, and simmered pork bowl rice. 3†: The provided seasonal menus of bowl rice in the intervention period were as follows: [Before the period] bowl rice with salty salmon, Taiwan mixed rice, Korean porridge, and pork–mushroom with grated yam rice bowl. [After the period] raw seafood bowl rice (tasteless), Korean porridge with Korean pickles, and Hijiki seaweed rice. 4: Cold Japanese noodles were excluded for comparison among periods because these were provided in differently shaped bowls. The values of before and after the control period were 87 and 80, respectively, when cold Japanese noodles were included. 5\*: The provided seasonal menus of Japanese noodles in the control period were as follows: [Before the period] Udon or Soba with chicken and cold sesame soy milk soup and Udon or Soba with tuna. [After the period] Udon or Soba with okra and grated yam. 5†: The provided seasonal menus of Japanese noodles in the intervention period were as follows: [Before the period] Udon or Soba with minced chicken and starchy soup. [After the period] Udon or Soba with vegetable and grated ginger. 6\*: The provided seasonal menus of Chinese noodles in the control period were as follows: [Before the period] cold tomato noodles; cold, fried chicken noodles; cold, vegetable noodles; and cold Korean noodles. [After the period] cold, tomato noodles; cold, fried chicken noodles; cold, vegetable noodles; and cold noodles with chicken and greens. 6†: The provided seasonal menus of Chinese noodles in the intervention period were as follows: [Before the period] Chinese noodles with thick, white soup. [After the period] Chinese noodles with curry soup.

**Table 2:** Changes in the consumption amount of discretionary seasonings

|                                               | Before the period (5 days) |                         | After the period (5 days) |                         | Change <sup>1</sup> |                         | p <sup>3</sup> |
|-----------------------------------------------|----------------------------|-------------------------|---------------------------|-------------------------|---------------------|-------------------------|----------------|
|                                               | Median                     | (min, max) <sup>2</sup> | Median                    | (min, max) <sup>2</sup> | Median              | (min, max) <sup>2</sup> |                |
| <b>Control period</b>                         |                            |                         |                           |                         |                     |                         |                |
| <b>Consumption amount</b>                     |                            |                         |                           |                         |                     |                         |                |
| Soy sauce (g)                                 | 35                         | (25, 93)                | 197                       | (43, 328)               |                     |                         |                |
| Ponzu (g)                                     | 306                        | (253, 450)              | 425                       | (167, 565)              |                     |                         |                |
| Sauce (g)                                     | 102                        | (43, 113)               | 136                       | (111, 168)              |                     |                         |                |
| Dressing (g)                                  | 1862                       | (1514, 1918)            | 1651                      | (1278, 1842)            |                     |                         |                |
| Total (g)                                     | 2324                       | (1848, 2430)            | 2314                      | (1606, 2837)            |                     |                         |                |
| <b>Consumption amount (per 100 consumers)</b> |                            |                         |                           |                         |                     |                         |                |
| Soy sauce (g)                                 | 4.6                        | (3.2, 11.8)             | 24.0                      | (6.0, 41.8)             | 20.5                | (1.4, 38.6)             |                |
| Ponzu (g)                                     | 38.9                       | (32.9, 55.6)            | 51.8                      | (23.3, 72.1)            | -1.3                | (-9.6, 34.1)            |                |
| Sauce (g)                                     | 13.2                       | (5.3, 14.4)             | 17.2                      | (13.7, 23.7)            | 9.8                 | (-0.6, 11.9)            |                |
| Dressing (g)                                  | 239.0                      | (196.9, 246.6)          | 224.4                     | (178.2, 232.5)          | -16.0               | (-58.9, 4.4)            |                |
| Total (g)                                     | 301.0                      | (240.3, 309.2)          | 314.6                     | (224.0, 361.9)          | 9.4                 | (-22.8, 60.8)           |                |
| <b>Intervention period</b>                    |                            |                         |                           |                         |                     |                         |                |
| <b>Consumption amount</b>                     |                            |                         |                           |                         |                     |                         |                |
| Soy sauce (g)                                 | 54                         | (34, 91)                | 221                       | (154, 237)              |                     |                         |                |
| Ponzu (g)                                     | 324                        | (195, 342)              | 312                       | (286, 357)              |                     |                         |                |
| Sauce (g)                                     | 173                        | (111, 207)              | 151                       | (140, 207)              |                     |                         |                |
| Dressing (g)                                  | 1778                       | (1375, 2127)            | 1570                      | (1377, 1913)            |                     |                         |                |
| Total (g)                                     | 2327                       | (1922, 2540)            | 2307                      | (1967, 2669)            |                     |                         |                |
| <b>Consumption amount (per 100 consumers)</b> |                            |                         |                           |                         |                     |                         |                |
| Soy sauce (g)                                 | 7.1                        | (4.5, 12.5)             | 28.8                      | (20.3, 31.3)            | 16.3                | (10.9, 26.9)            | 0.75           |
| Ponzu (g)                                     | 42.4                       | (26.8, 45.8)            | 41.3                      | (39.0, 45.7)            | 0.0                 | (-3.7, 12.2)            | 0.75           |
| Sauce (g)                                     | 22.8                       | (14.5, 28.0)            | 19.9                      | (18.3, 27.4)            | 0.8                 | (-8.3, 5.4)             | 0.12           |
| Dressing (g)                                  | 233.9                      | (186.1, 292.2)          | 207.7                     | (191.3, 244.6)          | -24.0               | (-90.9, 34.8)           | 0.92           |
| Total (g)                                     | 306.2                      | (260.1, 348.9)          | 304.4                     | (273.2, 341.3)          | 1.5                 | (-61.5, 52.9)           | 0.75           |

1: Changes were calculated using the following formula: consumption amount after the period - consumption amount before the period. 2: min, minimum; max, maximum. 3: The p-value for comparing the changes between periods was calculated by the Mann-Whitney U test.

and consumers by menu types for each period. The content of some menu types, such as bowl rice, varied with the period or season. The total number of consumers had slightly increased after both periods. Although, the total number of consumers was slightly smaller before and after the intervention period than that in the control period; a similar correlation was noted for the consumption number of rice and bowl rice. Although the lunch set was not provided over the 5 evaluation days after the control period, they were only 5% to 6% of the total number of consumers.

Table 2 depicts changes in the consumption amount of discretionary seasonings. No statistically significant difference was noted regarding the changes in the consumption amount between the control and intervention periods. Although the consumption of soy sauce, sauce, and total seasonings increased after both periods, these increments were lower in the intervention period than those in the control period without statistical significance: the median values of changes in the intervention and control periods were 16.3 and 20.5 g ( $p = 0.75$ ) for soy sauce, 0.8 and 9.8 g ( $p = 0.12$ ) for sauce, and 1.5 and 9.4 g ( $p = 0.75$ ) for the total seasonings, respectively. Furthermore, with regard to dressings, the consumption amount decreased after both periods, and the decrease in the intervention period was greater than that in the control period (median values: -24.0 and -16.0 g, respectively), however, the decrease was not statistically significant ( $p = 0.92$ ).

Table 3 presents the changes in the consumption amount of soup in noodles. While the percentage of the consumption amount of soup in Japanese noodles decreased after the intervention period (median value: -7.0 points) but increased after the control period (median value: 0.6 points). However, no statistically significant difference was noted ( $p = 0.35$ ). For soups in Chinese and curry noodles, the decrease was not higher in the intervention period than that in the control period.

Table 4 shows the changes in the consumption number of soup bowls. Both the consumption number per 100 consumers and that per 100 rice consumers decreased after the intervention period (median values: -4.7 and -7.5, respectively) but increased after the control period (median values: 0.7 and 5.4, respectively). Correspondingly, the changes were statistically significant ( $p = 0.03$  and  $p = 0.01$ , respectively).

Table 5 describes the changes in the consumption number of noodles. Both the consumption number per 100 consumers and its ratio to the rice consumers decreased after the intervention period (median values: -0.2 and -0.02, respectively) but increased after the control period (median values: 3.0 and 0.10, respectively). Subsequently, the changes were statistically significant ( $p = 0.01$  and  $p = 0.02$ , respectively).

## Discussion

We examined the effect of using the dietary education song regarding the appropriate amount of salt intake as BGM in a

**Table 3:** Changes in the consumption amount of soup in noodles

|                                                  | Before the period (5 days) |                         | After the period (5 days) |                         | Change <sup>1</sup> |                         |                |
|--------------------------------------------------|----------------------------|-------------------------|---------------------------|-------------------------|---------------------|-------------------------|----------------|
|                                                  | Median                     | (min, max) <sup>2</sup> | Median                    | (min, max) <sup>2</sup> | Median              | (min, max) <sup>2</sup> | p <sup>3</sup> |
| <b>Control period</b>                            |                            |                         |                           |                         |                     |                         |                |
| <b>Consumption amount of soup in noodles (%)</b> |                            |                         |                           |                         |                     |                         |                |
| Japanese noodles <sup>4</sup>                    | 52.4                       | (52.1, 54.6)            | 53.0                      | (41.8, 61.2)            | 0.6                 | (-10.5, 7.8)            |                |
| Curry noodles                                    | 75.6                       | (71.1, 90.3)            | 62.6                      | (59.7, 81.5)            | -14.1               | (-18.5, -4.9)           |                |
| Chinese noodles                                  | 35.4                       | (28.0, 44.4)            | 20.7                      | (14.0, 27.1)            | -18.1               | (-23.4, -8.3)           |                |
| <b>Intervention period</b>                       |                            |                         |                           |                         |                     |                         |                |
| <b>Consumption amount of soup in noodles (%)</b> |                            |                         |                           |                         |                     |                         |                |
| Japanese noodles <sup>4</sup>                    | 62.8                       | (59.2, 66.2)            | 53.9                      | (52.6, 76.8)            | -7.0                | (-11.9, 10.6)           | 0.35           |
| Curry noodles                                    | 83.6                       | (53.7, 86.7)            | 64.4                      | (60.8, 81.0)            | -2.6                | (-24.5, 8.9)            | 0.60           |
| Chinese noodles                                  | 54.0                       | (48.7, 57.8)            | 51.2                      | (45.5, 56.8)            | -3.1                | (-8.5, 6.7)             | 0.02           |

1: The changes were calculated using the following formula: consumption amount after the period – consumption amount before the period. 2: min, minimum; max, maximum. 3: P-value for the comparison of changes between the periods was calculated by the Mann–Whitney U test. 4: Excluding cold Japanese noodles.

**Table 4:** Changes in the consumption number of soup bowls

|                                                     | Before the period (5 days) |                         | After the period (5 days) |                         | Change <sup>1</sup> |                         |                |
|-----------------------------------------------------|----------------------------|-------------------------|---------------------------|-------------------------|---------------------|-------------------------|----------------|
|                                                     | Median                     | (min, max) <sup>2</sup> | Median                    | (min, max) <sup>2</sup> | Median              | (min, max) <sup>2</sup> | p <sup>3</sup> |
| <b>Control period</b>                               |                            |                         |                           |                         |                     |                         |                |
| <b>Consumption number of soup bowls<sup>4</sup></b> | 179                        | (163, 188)              | 182                       | (160, 205)              |                     |                         |                |
| per 100 consumers <sup>5</sup>                      | 24.0                       | (21.8, 26.1)            | 23.9                      | (22.3, 26.1)            | 0.7                 | (-3.8, 2.1)             |                |
| per 100 rice consumers                              | 46.2                       | (40.6, 48.3)            | 53.4                      | (43.9, 53.5)            | 5.4                 | (3.2, 7.3)              |                |
| <b>Intervention period</b>                          |                            |                         |                           |                         |                     |                         |                |
| <b>Consumption number of soup bowls<sup>4</sup></b> | 182                        | (174, 205)              | 152                       | (136, 188)              |                     |                         |                |
| per 100 consumers <sup>5</sup>                      | 25.8                       | (25.3, 30.2)            | 20.9                      | (19.5, 26.3)            | -4.7                | (-5.8, -0.1)            | 0.03           |
| per 100 rice consumers                              | 53.9                       | (49.2, 56.9)            | 42.8                      | (40.9, 52.4)            | -7.5                | (-13.2, 1.3)            | 0.01           |

1: Changes were calculated using the following formula: consumption number after the period – consumption number before the period. 2: min, minimum; max, maximum. 3: P-value for the comparison of changes between the periods was calculated by the Mann–Whitney U test. 4: Excluding miso soup with lunch set. 5: Excluding consumers who ordered lunch set.

**Table 5:** Changes in the consumption number of noodles

|                                      | Before the period (5 days) |                         | After the period (5 days) |                         | Change <sup>1</sup> |                         |                |
|--------------------------------------|----------------------------|-------------------------|---------------------------|-------------------------|---------------------|-------------------------|----------------|
|                                      | Median                     | (min, max) <sup>2</sup> | Median                    | (min, max) <sup>2</sup> | Median              | (min, max) <sup>2</sup> | p <sup>3</sup> |
| <b>Control period</b>                |                            |                         |                           |                         |                     |                         |                |
| <b>Consumption number of noodles</b> | 153                        | (142, 160)              | 171                       | (165, 181)              |                     |                         |                |
| per 100 consumers                    | 19.3                       | (18.4, 20.5)            | 21.8                      | (20.8, 25.5)            | 3.0                 | (1.5, 5.0)              |                |
| ratio to rice number                 | 0.38                       | (0.36, 0.44)            | 0.46                      | (0.4, 0.55)             | 0.10                | (0.03, 0.16)            |                |
| <b>Intervention period</b>           |                            |                         |                           |                         |                     |                         |                |
| <b>Consumption number of noodles</b> | 136                        | (126, 149)              | 134                       | (131, 136)              |                     |                         |                |
| per 100 consumers                    | 18.4                       | (16.6, 20.3)            | 17.6                      | (17.4, 18.2)            | -0.2                | (-2.9, 0.9)             | 0.01           |
| ratio to rice number                 | 0.38                       | (0.35, 0.46)            | 0.37                      | (0.36, 0.42)            | -0.02               | (-0.10, 0.05)           | 0.02           |

1: Changes were calculated using the following formula: consumption number after the period – consumption number before the period. 2: min, minimum; max, maximum. 3: P-value for the comparison of changes between periods was calculated by the Mann–Whitney U test.

university canteen by comparing the consumption amount of discretionary seasonings and noodle soups or choices of salty tasting menu between the intervention and control periods. The reductions in the consumption amount of discretionary seasonings and soups in noodles were not statistically larger in the intervention period than those in the control period. In contrast, the consumption numbers of soup bowl with rice and of noodles as the staple diet were decreased in the intervention period than those in the control period, and these were considered statistically significant. These results suggest that using the dietary education song as BGM at a canteen influences the individual's choice on salty tasting menu rather than the salt intake behaviors at the

table. Furthermore, as a potential mechanism of the influences for groups, the BGM might work as a trigger of the group dynamics toward healthier choices, although it is unclear whether the effects can be explained by the synchronization of brain activity and/or being on the same wavelength [15].

To our knowledge, this is the first study that examined the effect of using a dietary education song regarding salt intake as BGM. Some reports on nationwide campaigns focused on the reducing salt intake and increasing the awareness using mass media (TV, radio, newspapers, and billboards) by the UK and Ireland governments as a large-scale population approach are available [5, 16-18]. However, such approach may potentially

lack versatility or regionality and continuity. An intervention using a song regarding the appropriate amount of salt intake is available on a smaller scale such as in municipalities and canteens in workplaces or schools. This type of intervention can be advantageous to reduce salt intake. Using educational songs as BGM is potentially becoming a more versatile approach in the food environment, including canteens in workplaces and schools.

The results of our study demonstrate that using a dietary education song regarding the appropriate amount of salt intake as BGM at a canteen influences the consumers to avoid noodles and soup bowls on their menu choices. This suggests that such measures will help the population in reducing salt intake in the Asian diet culture because soups such as miso soup and noodle soup comprise relatively major diet sources for Asian people [19-20]. In Japan, miso soup and noodle soup contribute to 16.4% of salt intake [19]. In Korea, people consume an excessive amount of salt from soup or stew [20]. Therefore, the food choices of canteen consumers or supermarket shoppers can be nudged toward healthier meal selections [21, 22] using educational song as BGM based on the behavioral and economic theories of decision-making “nudge” [23].

In the present study, however, we set the control and intervention periods in different seasons. We observed that the reduction in the consumption number of soup bowls with rice was larger in the intervention period during autumn and winter than in the control period during early summer. From autumn to winter, hot soups were likely chosen due to the lower outside air temperature. With this assumption, the true magnitude of the change in the consumption number of soup bowls between the intervention and control periods may have been underestimated.

Moreover, we evaluated the consumption behavior among daily consumers of the canteen, which changes menus weekly. With regard to the consumption amount of noodle soup, Chinese noodles with curry soup, provided with the assumption of eating soup, were provided only after the intervention period although they were not provided in any other week. Therefore, the difference in the reduction of the consumption amount of noodle soup between the intervention and control periods might be underestimated.

These non-uniformities can also cause increments in the consumption amount of soy sauce in both control and intervention periods. Certain types of bowl rice with tasteless and raw seafood on rice led to the assumption that consumers use soy sauce discretionally at the table were provided after both control and intervention periods. However, the increment was smaller in the intervention period than in the control period and it was considered not statistically significant.

Our study has several limitations. First, we did not assess the salt intake or related behaviors on an individual level as outcomes. Instead, we utilized the POS system or measured the amount of leftover soup in noodles per day of the week as outcomes. Accordingly, a further examination on the behavioral modification related to the salt intake on an individual level is warranted. Second, we cannot exclude the seasonal factor caused by setting the control and intervention periods in different seasons. The main reason is that a new batch of students was enrolled in the university in the following year during the same season. Thus, as mentioned earlier, the difference of the outside temperature

between the control (early summer) and intervention (early winter) periods would have resulted in an underestimation of the true magnitude of difference in the change in the consumption number of soup bowls, such as miso soup.

The present study was conducted in the canteen of a women’s university where the students have several dietary problems, such as high consumption of snack foods or convenience foods [24,25] attributable to the lack of interest in own health promotion. It may be meaningful that the modification of menu choice toward a reduced salt diet with the influence of educational BGM was observed among such young participants. This further effect is likely to be expected on middle-aged people, who have higher level of awareness on the prevention of NCDs and reduced salt diet.

## Conclusions

Using a dietary education song regarding the appropriate amount of salt intake as BGM is effective in influencing the individuals regarding their menu choice rather than the behavior of discretionary seasoning at the table in a university canteen.

## Author Contributions

RT conceptualized, supervised, and administrated the project. SM and YT performed formal analysis. SM wrote the first draft. YS, HN, and RT performed investigation. All authors reviewed and commented on subsequent drafts of manuscript.

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