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ORIGINAL ARTICLE

Management of Sodium-reduced Meals at Worksite Cafeterias: Perceptions, Practices, Barriers, and Needs among Food Service Personnel

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Abstract
Objectives: The sodium content of meals provided at worksite cafeterias is greater than the sodium content of restaurant meals and home meals. The objective of this study was to assess the relationships between sodium-reduction practices, barriers, and perceptions among food service personnel.
Methods: We implemented a cross-sectional study by collecting data on perceptions, practices, barriers, and needs regarding sodium-reduced meals at 17 worksite cafeterias in South Korea. We implemented Chi-square tests and analysis of variance for statistical analysis. For *post hoc* testing, we used Bonferroni tests; when variances were unequal, we used Dunnett T3 tests.
Results: This study involved 104 individuals employed at the worksite cafeterias, comprised of 35 men and 69 women. Most of the participants had relatively high levels of perception regarding the importance of sodium reduction (very important, 51.0%; moderately important, 27.9%). Sodium reduction practices were higher, but perceived barriers appeared to be lower in participants with high-level perception of sodium-reduced meal provision. The results of the needs assessment revealed that the participants wanted to have more active education programs targeting the general population. The biggest barriers to providing sodium-reduced meals were *use of processed foods* and *limited methods of sodium-reduced cooking* in worksite cafeterias.
Conclusion: To make the provision of sodium-reduced meals at worksite cafeterias more successful and sustainable, we suggest implementing more active education programs targeting the general population, developing sodium-reduced cooking methods, and developing sodium-reduced processed foods.

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1. Introduction

More than 25% of Koreans (13.9 million) use institutional food services everyday [1]. The worksite food service has the second highest number of customers (3.43 million) among users of institutional food services. When comparing the sodium content by meal type, the mean amount of sodium for a meal was greatest (2,236 mg) at the worksite cafeterias, followed by 1,959 mg from restaurant meals and 1,342 mg from home meals [2]. The sodium content of meals at the worksite itself is already over the tolerable upper intake level (2,000 mg/d). Excessive sodium consumption is associated with a significantly higher incidence of cardiovascular diseases and stroke [3,4]. Taking into consideration that a large portion of the Korean population and the large amount of sodium provided at worksite cafeterias, a sodium reduction intervention program is urgently needed to improve the nutritional status of workers in South Korea.

The Ministry of Food and Drug Safety has conducted a pilot project to increase the opportunities of employees for sodium-reduced meals at worksite cafeterias in 2014 [5]. A total of 18 worksite cafeterias participated in this sodium-reduction pilot project. Worksite cafeterias were required to gradually reduce the sodium content of meals from May to September 2014. They aimed to provide a lunch with $\leq$ 1,300 mg of sodium by the end of September. The mean sodium content was 1,542 mg for a lunch at the start of this project, which was reduced to 1,261 mg at the end of September. To expand the number of worksite cafeterias providing sodium-reduced meals at the national level, it is critical to identify sodium reduction-related perceptions, practices, barriers, and needs of food service personnel at worksite cafeterias.

A number of studies regarding the sodium reduction of institutional food services have been conducted in South Korea. We found that most of these studies were implemented in schools, child-care centers, and hospitals [6–8]. Although a few studies were implemented at worksite cafeterias, they only targeted consumers or showed the sodium content of meals consumed by workers [9,10]. Therefore, very limited research has been conducted on how food service personnel's factors are related to sodium reduction at worksite cafeterias. We aimed to identify the relationships between sodium-reduction related practices, perceived barriers, and the perception of food service personnel. We also assessed the need for the provision of sodium-reduced meals at worksite cafeterias.

2. Materials and methods

2.1. Participants and procedure

We conducted a cross-sectional study to examine the perceptions, practices, barriers, and needs regarding the provision of sodium-reduced meals among food service personnel at 17 worksite cafeterias. We collected data from 3–10 food service personnel at each worksite cafeteria in November, 2014. Before implementation of this survey, we received approval from the institutional review board at Hanyang University (IRB-HYI-14-083-1).

We initially collected data from 120 individuals; however, after eliminating those with missing data for the variables of interest, our data set finally included 104 participants.

2.2. General characteristics of participants

The self-reported questionnaire contained demographic characteristics such as age, sex, and education level. We also collected job-related information including job title, years of career, and number of customers at the worksite cafeterias.

2.3. Perceptions related to sodium reduction

We measured the degree of agreement to identify perceptions related to sodium-reduction among food service personnel. Each respondent was required to check the degree of agreement from strongly disagree to strongly agree regarding the following statement: *It is important to provide sodium-reduced meals at worksite cafeterias* [11].

2.4. Sodium-reduction practices

We assessed sodium-reduction practices related to the institutional food service. Sodium-reduction practices consisted of three parts: (1) cooking; (2) measuring the salinity; and (3) serving the menu. Regarding the cooking, we asked the participants about the use of measuring cups or spoons when adding seasonings and use of low sodium ingredients or alternative seasonings. Regarding the measurement of salinity, we examined the sodium content of soup, *kimchi*, and sauce. Regarding the serving, we examined the following two items: (1) serving appropriate portion size of meal; and (2) informing customers about the sodium content of meals. Participants identified the frequency of their sodium-reduction practices at the worksite cafeterias based on three categories: (1) $\leq$ 1 time/2 wk; (2) 1–4 times/wk; and (3) 5 times/wk.

2.5. Education for sodium reduction

The assessment of education regarding sodium reduction practices among food service personnel employed three items: (1) educating personnel on the significance of sodium reduction; (2) educating personnel on cooking methods or the use of alternative seasonings; and (3) educating personnel on methods of assessing the sodium content. Each question was measured by indicating one of two categories: (1) $\leq$ 5 times/y; and (2) $\geq$ 6 times/y.

2.6. Perceived barriers to providing sodium-reduced meals

We measured the perceived barriers regarding sodium reduction using seven items: (1) low perception of food service personnel; (2) low perception of customers; (3) limited number of sodium-reduced menu items; (4)

limitation of sodium-reduced cooking methods; (5) difficulties in serving appropriate size of meal without knowing the sodium content of food; (6) use of processed foods; and (7) difficulties in serving sodium-reduced meals due to increased cost, and lack of personnel. We used a 5-point Likert scale to examine the level of barriers from *strongly disagree* to *strongly agree*.

2.7. Needs to improve sodium-reduced diet

We used six items to examine the participants' needs for provision of sodium-reduced meals at worksite cafeterias: (1) the development of sodium-reduced processed foods; (2) the development of standard recipes with sodium-reduced meals; (3) the development of salt-alternative seasonings; (4) the development of educational materials for food service personnel; (5) the development of educational materials for customers; and (6) the implementation of more active education for the general population. Each item was assessed by a 5-point Likert scale from *strongly disagree* to *strongly agree*.

2.8. Statistical analysis

We conducted data analysis using SPSS version 21 (SPSS Inc., Chicago, IL, USA). To compare the practices, education, and perceived barriers in the perception of sodium reduction, we employed Chi-square tests for the data analysis of categorical variables and analysis of variance for the data analysis of continuous variables. We used Bonferroni test for *posthoc* testing; we employed Dunnett T3 tests when the variances were not equal. We set a p-value of < 0.05 as the level of significance.

3. Results

3.1. General characteristics of the participants

This research included 104 food service personnel working at 17 worksite cafeterias. The study participants were 35 men (33.7%) and 69 women (66.3%; Table 1). The mean age of the participants was 43 years, and more than one-third (36.5%) of the participants were aged $\geq$ 50 years. The most common type of job title was kitchen assistant ($n = 63$, 60.6%), followed by cook ($n = 37$, 35.6%). More than one-third of participants ($n = 37$, 35.6%) had $<$ 3 years of experience in their career. More than half of participants ($n = 58$, 55.8%) had high school education, followed by 2 years of college ($n = 27$, 26.0%) and 4 years of college ($n = 12$, 11.5%). Half of the participants worked at worksite cafeterias serving $<$ 1,000 customers for lunch, followed by $\geq$ 2,000 customers ($n = 24$, 23.1%), and 1,000−1,999 customers ($n = 28$, 26.9%).

Table 1. General characteristics of the participants.

	Total ($n = 104$)
Age (y)	43.09 ± 10.81
18−29	15 (14.4)
30−39	23 (22.1)
40−49	28 (26.9)
≥ 50	38 (36.5)
Sex	
Male	35 (33.7)
Female	69 (66.3)
Job title	
Cook	36 (34.6)
Kitchen assistant	63 (60.6)
Other	5 (4.8)
Career (y)	
< 3	37 (35.6)
3−< 6	29 (27.9)
6−< 9	8 (7.7)
≥ 9	30 (28.8)
Education level	
High school	58 (55.8)
2 y college	27 (26.0)
4 y college	12 (11.5)
Graduate school	1 (1.0)
Others	6 (5.8)
Number of customers at the worksite cafeteria	
< 1,000	52 (50.0)
1,000−1,999	28 (26.9)
≥ 2,000	24 (23.1)

Data are presented as n (%) or mean ± standard deviation.

3.2. Practices and the perception of sodium reduction

To cook sodium-reduced meals, more than half of the participants used measuring cups or spoons 5 times/wk ($n = 64$, 61.5%), and used low-sodium ingredients or alternative seasonings 5 times/wk ($n = 63$, 60.6%; Table 2). To measure the salinity, most participants checked the sodium content of soup 5 times/wk ($n = 96$, 92.3%). However, almost half of the participants checked the sodium content of sauces 5 times/wk ($n = 57$, 54.8%), and less than half of the participants checked the sodium content of pickled cabbage, called *kimchi* in Korea. To serve sodium-reduced meals, more than two-thirds of the participants served appropriate portion sizes of meals 5 times/wk ($n = 71$, 68.3%) and informed customers about the sodium content of meals 5 times/wk ($n = 69$, 66.3%). Compared with other groups, the *very important* group had a significantly higher frequency of cooking, measuring, and serving sodium-reduced meals ($p < 0.05$), but the *very important* group did not have a significantly higher frequency of checking the sodium content of soup.

3.3. Education and the perception of sodium reduction

More than half of the participants received education on the significance of sodium reduction $\geq$ 6 times/y ($n = 59$, 56.7%; Table 3). Three out of four participants had education regarding how to check the sodium

Table 2. Practices and the perception of sodium reduction.

	Total (n = 104)	Degree of agreement*			χ^2
		Neutral (n = 22)	Moderately important (n = 29)	Very important (n = 53)	
Cooking					
Use measuring cups or spoons when adding seasonings					
≤ 1 time/2 wk	8 (7.7)	5 (22.7)	1 (3.4)	2 (3.8)	19.185†
1−4 times/wk	32 (30.8)	7 (31.2)	15 (51.7)	10 (18.9)	
5 times/wk	64 (61.5)	10 (45.5)	13 (44.8)	41 (77.4)	
Use low sodium ingredients or alternative seasonings					
≤ 1 time/2 wk	10 (9.6)	5 (22.7)	2 (6.9)	3 (5.7)	18.227†
1−4 times/wk	31 (29.8)	11 (50.0)	11 (37.9)	9 (17.0)	
5 times/wk	63 (60.6)	6 (27.3)	16 (55.2)	41 (77.4)	
Measuring the salinity					
Check the sodium content of soup					
≤ 1 time/2 wk	2 (1.9)	1 (4.5)	0 (0.0)	1 (1.9)	2.305
1−4 times/wk	6 (5.8)	2 (9.1)	2 (6.9)	2 (3.8)	
5 times/wk	96 (92.3)	19 (86.4)	27 (93.1)	50 (94.3)	
Check the sodium content of kimchi					
≤ 1 time/2 wk	25 (24.0)	1 (4.5)	1 (3.4)	23 (43.4)	40.110‡
1−4 times/wk	35 (33.7)	14 (63.6)	17 (58.6)	4 (7.5)	
5 times/wk	44 (42.3)	7 (31.8)	11 (37.9)	26 (49.1)	
Check the sodium content of sauce					
≤ 1 time/2 wk	25 (24.0)	1 (4.5)	2 (6.9)	22 (41.5)	37.073‡
1−4 times/wk	22 (21.2)	12 (54.5)	9 (31.0)	1 (1.9)	
5 times/wk	57 (54.8)	9 (40.9)	18 (62.1)	30 (56.6)	
Serving					
Serve appropriate portion size of meal					
≤ 1 time/2 wk	15 (14.4)	6 (27.3)	1 (3.4)	8 (15.1)	16.907†
1−4 times/wk	18 (17.3)	7 (31.8)	8 (27.6)	3 (5.7)	
5 times/wk	71 (68.3)	9 (40.9)	20 (69.0)	42 (79.2)	
Inform the sodium content of meal to customers					
≤ 1 time/2 wk	8 (7.7)	0 (0.0)	1 (3.4)	7 (13.2)	14.280†
1−4 times/wk	27 (26.0)	11 (50.0)	9 (31.0)	7 (13.2)	
5 times/wk	69 (66.3)	11 (50.0)	19 (65.5)	39 (73.6)	

*Agreement regarding the importance of sodium reduction at worksite cafeterias; †$p < 0.01$; ‡$p < 0.001$. Data are presented as n (%).

content (n = 77, 74.0%). Almost two-thirds of participants also had education on cooking methods or using alternative seasonings for sodium-reduced meals (n = 70, 67.3%). Compared with the *moderately important* and *neutral* groups, the *very important* group had a significantly higher frequency of education on *the significance of sodium reduction* and *cooking method or using alternative seasonings* ($p < 0.05$).

Table 3. Education and the perception of sodium reduction.

		Degree of agreement*			
	Total ($n = 104$)	Neutral ($n = 22$)	Moderately important ($n = 29$)	Very important ($n = 53$)	χ^2
Educating food service personnel on the significance of sodium reduction					
$\leq$ 5 times/y	45 (43.3)	23 (59.1)	20 (69.0)	12 (22.6)	19.231†
$\geq$ 6 times/y	59 (56.7)	9 (40.9)	9 (31.0)	41 (77.4)	
Educating food service personnel about cooking method or using alternative seasonings					
$\leq$ 5 times/y	27 (26.0)	8 (36.4)	10 (34.5)	9 (17.0)	16.994†
$\geq$ 6 times/y	70 (67.3)	13 (59.1)	12 (41.4)	45 (84.9)	
Educating food service personnel about check of the sodium content					
$\leq$ 5 times/y	27 (26.0)	8 (36.4)	10 (34.5)	9 (17.0)	4.558
$\geq$ 6 times/y	77 (74.0)	14 (63.6)	19 (65.5)	44 (83.0)	

*Agreement regarding the importance of sodium reduction at worksite cafeterias; †$p < 0.001$. Data are presented as n (%).

3.4. Perceived barriers and the perception of sodium reduction

We obtained four items with relatively high scores (> 3 points) regarding perceived barriers to sodium reduction in the following order: (1) use of processed foods (3.62 points); (2) limitation of sodium-reduced cooking methods (3.28 points); (3) limited number of sodium-reduced menu items (3.26 points); and (4) difficulties in serving sodium-reduced meals due to increased cost and lack of personnel (3.24 points; Table 4). Two perceived barriers showed significant differences in the perception of sodium reduction. The *neutral* group had a significantly higher score compared to the *moderately important* and *very important* groups for *low perception of customers* ($p < 0.05$) and *difficulties in serving sodium-reduced meals due to increased cost and lack of personnel* ($p < 0.01$).

3.5. Needs assessment of food service personnel regarding sodium reduction at worksite cafeterias

Regarding the needs assessment of food service personnel, all six items had very high scores (> 4 points; Table 5). We identified that *implementation of more*

Table 4. Perceived barriers and the perception of sodium reduction.

		Degree of agreement*			
	Total ($n = 104$)	Neutral ($n = 22$)	Moderately important ($n = 29$)	Very important ($n = 53$)	F
Food service personnel perception regarding sodium reduction is low	2.37 ± 0.89	2.68 ± 0.72†	2.45 ± 0.69†	2.19 ± 1.02†	2.625
Customer perception regarding sodium reduction is low	2.91 ± 0.89	3.23 ± 0.92†	3.07 ± 0.75†	2.70 ± 0.91‡	3.498§
Number of sodium-reduced menu options is limited	3.26 ± 0.89	3.55 ± 0.60†	3.34 ± 0.77†	3.09 ± 1.02†	2.222
Sodium-reduced cooking methods are limited	3.28 ± 0.99	3.36 ± 0.66†	3.48 ± 0.91†	3.13 ± 1.13†	1.286
It is hard to serve appropriate sizes of meal without knowing the sodium content of food	2.72 ± 0.95	3.00 ± 0.76†	2.86 ± 0.95†	2.53 ± 0.99†	2.425
Due to the use of processed foods, it is hard to lower the sodium content	3.62 ± 1.00	3.59 ± 0.73†	3.38 ± 0.98†	3.75 ± 1.09†	1.343
Due to increased cost and lack of personnel, it is difficult to serve sodium-reduced meals	3.24 ± 1.12	4.00 ± 0.93†	3.14 ± 1.25†	2.98 ± 1.39‡	5.149‖

*Agreement regarding the importance of sodium reduction at worksite cafeterias; †,‡Indicates statistically significant differences; §$p < 0.05$; ‖$p < 0.01$. Data are presented as the mean ± standard deviation. 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree.

Table 5. Needs assessment of food service personnel.

	Total
We should develop sodium-reduced processed foods	4.12 ± 0.69
We should develop standard recipes for sodium-reduced meals	4.11 ± 0.70
We should develop salt-alternative seasonings	4.24 ± 0.76
We should develop educational materials for food service personnel	4.06 ± 0.72
We should develop educational materials for customers	4.18 ± 0.75
We should offer more active education regarding sodium reduction for the general population	4.30 ± 0.75

Data are presented as the mean ± standard deviation. 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree.

active education for general population had the highest score (4.30 points). The need with the second highest score (4.24 points) was *development of the salt alternative seasonings*. The remaining items had scores in the following order: the development of educational materials for customers (4.18 points); the development of sodium-reduced processed foods (4.12 points); the development of standard recipes for sodium-reduced meals (4.11 points); the development of educational materials for food service personnel (4.06 points).

4. Discussion

We identified the association of sodium-reduction practices and barriers to perception among food service personnel at worksite cafeterias. Participants who perceived the significance of sodium limitation tended to practice more and perceive less barriers regarding sodium reduction. There were a total of 104 participants, including 35 men (33.7%) and 69 women (66.3%), with a mean age of 43 years. We found a relatively high level of perception regarding the significance of sodium reduction among food service personnel. More than half of the participants ($n = 53$, 51.0%) responded that provision of sodium-reduced meals is very important, followed by moderately important ($n = 29$, 27.9%) and neutral ($n = 22$, 21.2%). The participants perceived the *use of processed foods*, *limitation of sodium-reduced cooking methods*, and *limited number of sodium-reduced menu items* as the top three barriers to providing sodium-reduced meals at worksite cafeterias.

The most important needs of food service personnel for sodium reduction were *implementation of more active education for general population*. A study revealed that the most critical barrier to provision of sodium-reduced meals among school dietitians was the students' negative evaluation of the taste [7]. The situation is the same in worksite cafeterias: the food service operators would be continuously challenged to satisfy the tastes of customers. Perlmutter et al [12] argued that when fat- and sodium-modified dishes were described as *healthful* to customers, customers were more willing to accept flavor differences. Similarly, active education including marketing sodium-reduced meals as healthful meals and providing nutrition information would be very effective strategies because they could encourage customers to accept changes in the flavor of sodium-reduced meals.

We identified *use of the processed foods* as the greatest barrier to sodium reduction at worksite cafeterias. Researchers have argued that use of processed and convenience foods would reduce cooking time, save costs, and increase institutional feeding productivity [13,14]. More than 70% of dietitians stated that they used processed or convenience foods in kimchi, seasonings, and preserved food categories at worksite cafeterias [14]. A considerable amount of sodium may be present in processed foods [15,16]. In South Korea, sodium-reduced processed foods have been introduced in some food groups: sauces (soy sauce, soybean paste), processed meats, noodles, and cheeses in the 2010s [17]. We need to make greater efforts to develop salt alternatives that could supplement sodium's properties and uses (i.e., taste, preservative quality, and physical properties), while also taking production cost into consideration.

Regarding the second greatest barrier to sodium reduction, we identified *limitation of sodium-reduced cooking methods* among food service personnel. The government needs to set a priority to remove the barriers of food service operating at worksite cafeterias. One study found that commonly practiced cooking methods included the *use of anchovy, kelp, and radish for stock* and *use of mushroom or vegetable powder for sodium-reduced sauce* in restaurants [18]. Kim [19] suggested sodium-reduced cooking methods for various dishes. For hot soups, it is recommended to use soybean powder, perilla powder, soy milk, ginger, and Japanese parsley. For cold soups, it is suggested to use vinegar, lemon juice, and nuts to prevent low-sodium soups from tasting bland. For vegetable dishes, one could add sweet, sour, and spicy flavors by using citron, apple, vinegar, and mustard. For fish and meat dishes, one could cook sodium-reduced dishes by using garlic, ginger, curry powder, citron, and lemon. To make sodium reduction successful at worksite cafeterias, it would be critical to develop diverse sodium-reduced cooking methods for various dishes and make these cooking methods easily accessible to food service personnel.

This research has provided useful information on perceptions, practices, barriers, and needs related to sodium-reduced meals among food service personnel at worksite cafeterias. Nevertheless, this study has a few limitations. First, we collected data from food service personnel participating in sodium-reduction projects. Because we did not include participants from a control cafeteria group in this survey, we could not compare sodium-reduction related perceptions and practices between intervention and control groups. Therefore, we suggest pre- and postplanned evaluation between intervention and control groups for future research. Second, perceived barriers and needs related to sodium reduction would differ by the characteristics of worksite cafeterias such as customer type, size of cafeteria, etc. Valuable information for designing tailored nutrition intervention programs could be obtained if we increase the sample size and further analyze the characteristics of worksite cafeterias.

The Ministry of Food and Drug Safety (MFDS) has supported sodium reduction in numerous ways. The MFDS provided small soup bowls to implement the pilot project of the small bowl choice program at worksite cafeterias in 2012 [20]. The size of the original soup bowl had a volume of 300 mL, and the size of the small soup bowl was 200 mL. Worksite cafeterias participating in this pilot project provided the original soup bowls as well as the small soup bowls, so that the consumers could choose one of two different bowls. The MFDS reported that the use of small soup bowls were able to reduce the sodium content by about 30% compared with the original soup bowl. In addition, the MFDS has supported the provision of salty taste assessment kits and provided educational posters on sodium reduction targeting consumers at worksite cafeterias [21]. One could argue that these actions would raise consumer awareness of sodium reduction. However, increased awareness of sodium reduction might not automatically lead to an increase in choosing the sodium-reduced meals. We identified in the previous work that taste and menu diversity were the top two needs to improve sodium-reduced diets among workers [9]. Moreover, the dietary guidelines for sodium reduction did not include specific actions according to the characteristics of consumers such as sex, age, occupation, etc. Therefore, we need to provide targeted messages by classifying consumers according to sodium reduction as well as improvement of taste and menu diversity to promote sodium reduction at worksite cafeterias.

This study has several food and nutrition policy and program implications. First, more active education programs should be implemented for the general population. The food service personnel were concerned about the customers' negative evaluation of sodium-reduced meals. If customers have increased levels of knowledge and perceptions regarding sodium reduction, they would be more willing to select the sodium-reduced meals and accept the changes of taste. Second, it is also necessary for food manufacturers to make more efforts to reduce the sodium content in processed foods. The food service personnel stated that it is hard to reduce the sodium level at worksite cafeterias due to the use of processed foods. The MFDS could encourage food companies to develop sodium-reduced packaged foods through the provision of incentives. Third, we need to develop more sodium-reduced cooking methods for various dishes used for worksite cafeterias and make them available to food service personnel.

Conflict of interest

All authors have no conflicts of interest to declare.

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