

Research Article

# Changes in the importance and performance of low-sodium management among childcare center cooks in Yongin, South Korea, after salinometer support programs: a descriptive study

Jiwoo Min<sup>1,2)\*</sup>, Youngmi Lee<sup>3,4),\*,†</sup>, Yunhee Chang<sup>3)</sup>, Yujin Lee<sup>3)</sup>

<sup>1)</sup>Graduate Student, Department of Food and Nutrition, Myongji University, Yongin, Korea

<sup>2)</sup>Team Leader, Yongin Center for Children's Foodservice Management, Yongin, Korea

<sup>3)</sup>Professor, Department of Food and Nutrition, Myongji University, Yongin, Korea

<sup>4)</sup>Director, Yongin Center for Children's Foodservice Management, Yongin, Korea

**Received:** May 14, 2024

**Revised:** July 8, 2024

**Accepted:** July 8, 2024

**†Corresponding author:**

**Youngmi Lee**

Department of Food and Nutrition,  
College of Natural Sciences, Myongji  
University, 116 Myongji-ro, Cheoin-  
gu, Yongin 17058, Korea  
Tel: +82-31-330-6206  
Fax: +82-31-335-7248  
Email: zeromi@mju.ac.kr

\*These authors contributed equally  
to this work.

**Objectives:** This study aimed to evaluate the importance and performance of sodium reduction practices among childcare center cooks in the Yongin area before and after a 3-month salinometer support program.

**Methods:** In total, 313 cooks employed in childcare centers in Yongin were surveyed before and after participating in a salinometer support program. The survey included questions on general information, sodium-related dietary habits, and perceived importance and performance levels of sodium reduction approaches in the purchasing, cooking, and serving areas. The centers were divided into childcare centers registered as group-feeding facilities (FS group, n = 68) and those not registered as such (non-FS group, n = 245). The differences between the two groups were analyzed.

**Results:** The overall importance levels increased significantly after the program in both the FS-group ( $P < 0.001$ ) and non-FS group ( $P = 0.005$ ). The overall performance levels also increased significantly in both groups ( $P < 0.001$  for all). Consequently, the significant difference between the importance and performance levels disappeared in both groups after the program. However, unlike the FS group, which showed no significant differences between the importance and performance levels after the program in all three areas, the non-FS group still demonstrated lower performance levels than importance levels in the purchasing ( $P = 0.011$ ) and serving ( $P = 0.034$ ) areas after the program.

**Conclusions:** The use of salinometers significantly enhanced the performance and importance of low-sodium management practices among cooks in childcare centers, especially in the FS group. The continuous monitoring of salinity measurements and tailored education specialized for the FS and non-FS groups are recommended.

**Keywords:** child; meals; sodium; cooking; program

© 2024 The Korean Society of Community Nutrition

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## INTRODUCTION

Early childhood is a period of active growth and development that makes the formation of proper eating habits crucial. Caregivers and childcare center cooks who prepare meals can influence the eating habits, behaviors, and food prefer-

ences of infants and young children [1]. As of 2021, the number of childcare centers established and operating nationwide has increased to 33,246, from 20,097 in 2001. In the same year, the number of children enrolled in childcare centers reached 1,184,716 [2]. Meanwhile, the daily sodium intake of infants and young children is increasing annually. For children aged 1–2 years, the daily sodium intake increased steadily: 1,198.9 mg in 2019, 1,233.9 mg in 2020, and 1,354.2 mg in 2021. For children aged 3–5 years, it remained high at 1,629.2 mg in 2019, 1,730.3 mg in 2020, and 1,630.4 mg in 2021 [3]. According to the 2020 Dietary Reference Intakes for Koreans, the adequate intakes (AIs) of sodium for ages 1–2 years and 3–5 years are 810 mg and 1,000 mg, respectively, indicating that Korean infants and young children consume more than 1.6 times their AI of sodium [4].

Infants and young children enrolled in childcare centers typically spend approximately 7 hours a day, receiving at least one meal (lunch or lunch and dinner) and two snacks (morning and afternoon) daily (attached Table of the Enforcement Rules of the Infant Care Act 8). Meals provided in childcare centers are generally reported to have high sodium content. Jung *et al.* [5] investigated the sodium intake in 12 childcare centers in the Gyeonggi region and found that the average sodium content per meal was 582.2 mg, with soups and stews contributing the most. Another study by Song and Lee [6] analyzed the sodium content of lunch menus collected from five childcare centers in North Gyeongsang Province and reported an average sodium content of 681 mg per meal. The menu with the highest sodium content consisted of kimbap, fish cake soup, spinach side dish, pickled radish salad, and kimchi, totaling 1,370 mg of sodium.

According to the 2021 Childcare Statistics, 29,575 cooks work in childcare centers nationwide, 99% of whom are women [2]. The AI of sodium for Korean women aged 19–64 years is set at 1,500 mg [4]. However, the actual intake in 2021 was much higher: 3,134.2 mg for ages 19–29 years, 3,334.4 mg for ages 30–49 years, and 3,293.6 mg for ages 50–64 years, which is 2 to 2.2 times the AI [3]. The characteristics of cooks, who typically consume high amounts of sodium, may influence excessive sodium intake in infants and young children in childcare centers. Ongoing studies have focused on

sodium reduction education for childcare center cooks and enrolled children [7,8], as well as analyses of soup salinity in childcare center meals [9,10]. Additionally, continuous salinity measurements using salinometers have been reported to effectively reduce soup salinity [9–12], supporting the need for salinometer support. However, only limited studies have investigated the importance and practice of sodium reduction by childcare center cooks or the effects of the continuous use of salinometers on these factors.

Meanwhile, as of December 2021, 793 childcare centers have been established and operating in Yongin City, Gyeonggi Province, with 29,272 children enrolled [2]. Yongin City has the third highest number of childcare centers in Gyeonggi Province, after Suwon City and Hwaseong City, and the highest number of enrolled children [2]. Therefore, this study aimed to understand the sodium-related eating habits and behaviors of childcare center cooks in Yongin City, Gyeonggi Province, and to analyze the changes in the importance and practice of low-sodium management before and after implementing a salinometer support program combined with sodium reduction nutrition education. This study provides essential data necessary for future sodium reduction education targeting childcare center cooks and suggests guidelines for desirable sodium intake in infants and young children.

## METHODS

### Ethics statement

This study was approved by the Institutional Review Board of Myongji University (MJU-2022-04-001-02). All participants were informed of the study purposes and protocols, and they provided written informed consent.

### 1. Study participants and period

This study was conducted in cooks working in childcare centers who participated in the 2022 salinometer support program among those registered with the Yongin Center for Children's Foodservice Management (Yongin CCFM). After collecting the pre-survey questionnaires from the study participants, salinometers were distributed along with usage instructions and sodium-related nutrition education. Subsequently, salinometers and

salinity measurement recording sheets were provided. The participants were then instructed to measure the salinity of soups and stews served in childcare centers daily for 3 months using salinometers. Educational materials developed by the Yongin CCFM related to salinometer usage, the necessity of sodium intake, problems with excessive intake, and low-sodium practices were utilized. Surveys were administered before and after the salinometer support program. The program ran from June to December 2022. During the survey, questionnaires were distributed to 354 participants, and all responses were collected thereafter. After excluding 41 questionnaires with insincere responses, only 313 questionnaires were analyzed (analysis rate: 88.4%).

## 2. Survey methods and content

The questionnaire items were based on those used in previous studies [1,13-21] and were modified or supplemented after consultation with seven experts in the field of food and nutrition to ensure validity.

### 1) General information

To obtain general information about childcare centers, the facility type and number of enrolled children were surveyed. For comparative analysis, the centers were divided into childcare centers registered as group feeding facilities (FS group, n = 68) and childcare centers not registered as group feeding facilities (non-FS group, n = 245). According to Article 2, Clause 12 of the Food Sanitation Act, a group-feeding facility refers to a nonprofit facility that continuously provides food to a specific group, serving meals to 50 or more people at a time (Enforcement Decree of the Food Sanitation Act 2). Non-group feeding facilities serve meals to fewer than 50 people at a time and are not established or operated as group foodservice facilities. Foodservice facilities were classified as national/public, private, home, workplace, corporate/organization, cooperative, and social welfare corporation according to Article 10 of the Infant Care Act. The following general information of the cooks were obtained: gender, age, cooking experience, and possession of cooking certifications.

### 2) Sodium-related eating habits

To understand the participants' usual sodium-related

eating habits, five items were constructed based on those reported in previous studies [1,13,15,19] including "I check the sodium content when purchasing food" and "I eat soup, stew, or noodle soup without leaving any broth." Each item was measured on a 5-point Likert scale, ranging from "always" (1 point) to "never" (5 points), with higher scores indicating "low-sodium" eating habits.

### 3) Importance and practice of low-sodium management

To examine the importance and practice of management strategies for sodium reduction, items were constructed based on those reported in previous studies [14,16,19,20]. Each item was modified and supplemented to suit childcare centers. The purchasing domain included three items such as "I check the sodium content when purchasing food." The cooking domain included six items such as "I check the sodium content with a salinometer after cooking." The serving domain includes three items such as "I serve soups and stews mainly with the solid ingredients." Overall, 12 items were constructed. The same items were used for assessing both importance and practice. Importance was measured on a 5-point Likert scale, ranging from "very unimportant" (1 point) to "very important" (5 points), while practice was rated from "never do it" (1 point) to "always do it" (5 points).

## 3. Statistical methods

The collected data were analyzed using IBM SPSS Statistics 27 (IBM Co.), and the results were expressed as frequencies and percentages or means and standard deviations. Chi-square or Fisher's exact tests were conducted to analyze the differences in distribution between the FS and non-FS groups. Independent sample t-tests or Welch's t-tests were performed to verify the differences in the means depending on the homogeneity of variance. Paired t-tests were used to compare the importance and practices of low-sodium management before and after the salinometer support program. A *P* value of < 0.05 was considered significant.

## RESULTS

### 1. General characteristics

The general characteristics of the childcare centers and cooks in this study are presented in Table 1. Among the 313 childcare centers evaluated, 68 (21.7%) comprised the FS group, while 245 (78.3%) comprised the non-FS group. The majority (75.0%) of the FS group were private centers, while the non-FS group consisted of 64.5% home-based centers and 29.0% private centers ( $P < 0.001$ ). With regard to the number of enrolled children, none of the centers in the FS group had 20 or fewer children. Instead, the centers in this group were evenly split between those with 21–49 children and those with 50

or more children (50% each). By contrast, the majority (76.7%) of the non-FS group had 20 or fewer children ( $P < 0.001$ ) largely due to the high proportion of home-based childcare centers in this group. The average numbers of enrolled children were 27.0, with 54.0 comprising the FS group and 19.5 comprising the non-FS group ( $P < 0.001$ ).

The average age of cooks was higher in the FS group (55.1 years) than in the non-FS group (51.3 years) ( $P < 0.001$ ). Cooks' careers were also longer in the FS group (5 years and 6 months) than in the non-FS group (4 years) ( $P = 0.025$ ). Approximately 92.6% of cooks in the FS group held cooking certifications, while only 18.8% in the non-FS group held such certifications ( $P < 0.001$ ).

**Table 1.** General characteristics of the study participants

Classification	FS group (n = 68)	Non-FS group (n = 245)	Total (n = 313)	P-value <sup>1)</sup>
<b>Childcare centers</b>				
Facility type				< 0.001
National/public	9 (13.2)	6 (2.4)	15 (4.8)	
Private	51 (75.0)	71 (29.0)	122 (39.0)	
Home	0 (0.0)	158 (64.5)	158 (50.5)	
Workplace	4 (5.9)	5 (2.0)	9 (2.9)	
Corporate/organization	1 (1.5)	2 (0.8)	3 (1.0)	
Cooperative	0 (0.0)	3 (1.2)	3 (1.0)	
Social welfare corporation	3 (4.4)	0 (0.0)	3 (1.0)	
No. of children				< 0.001
≤ 20	0 (0.0)	188 (76.7)	188 (60.1)	
21–49	34 (50.0)	57 (23.3)	91 (29.1)	
≥ 50	34 (50.0)	0 (0.0)	34 (10.9)	
Average	54.00 ± 20.11	19.47 ± 7.37	26.97 ± 18.24	< 0.001
<b>Cooks</b>				
Age (year)				< 0.001
30–49	10 (14.7)	100 (40.8)	110 (35.1)	
≥ 50	58 (85.3)	145 (59.2)	203 (64.9)	
Average	55.13 ± 6.39	51.33 ± 7.53	52.15 ± 7.46	< 0.001
Career				0.032
< 1 year	8 (11.8)	52 (21.2)	60 (19.2)	
1–5 years	32 (47.1)	129 (52.7)	161 (51.4)	
> 5 years	28 (41.2)	64 (26.1)	92 (29.4)	
Average (month)	66.47 ± 63.88	48.13 ± 58.38	52.11 ± 59.99	0.025
Cooking certification				< 0.001
Yes	63 (92.6)	46 (18.8)	109 (34.8)	
No	5 (7.4)	199 (81.2)	204 (65.2)	

n (%) or Mean ± SD.

FS group, childcare centers registered as group-feeding facilities; non-FS group, childcare centers not registered as group-feeding facilities.

<sup>1)</sup>χ<sup>2</sup>-test, Fisher's exact test, Student's t-test, or Welch's t-test.

## 2. Sodium-related eating habits

The analysis of sodium-related eating habits before the salinometer support program is presented in Table 2. The average scores for the five items were 3.72 for the FS group and 3.81 for the non-FS group, with no significant difference between the two groups. No significant differences were also observed in any of the individual items. The item “I check the sodium content when purchasing food” scored the lowest in both groups (FS, 3.19; non-FS, 3.32).

## 3. Importance and practice of low-sodium management

### 1) Changes in the importance of low-sodium management before and after the salinometer support program

Table 3 presents the changes in the importance of low-sodium management for both groups after the program. Overall, the importance score increased significantly from 4.23 to 4.35 ( $P < 0.001$ ). Both the FS ( $P < 0.001$ ) and non-FS ( $P = 0.005$ ) groups showed similar results, with the FS group showing the most substantial change.

Significant increases were observed in the purchasing ( $P = 0.017$ ), cooking ( $P = 0.001$ ), and serving ( $P < 0.001$ ) areas. Within these domains, individual variables showed notable differences. In the purchasing domain, the item “I check sodium content when purchasing food” showed a significant difference ( $P = 0.002$ ) in both

groups. In the cooking domain, the item “I check the sodium content with a salinometer after cooking” showed a significant overall difference ( $P < 0.001$ ) between the two groups. However, the item “I reduce the use of salt and sauces and instead use spices or herbs” showed a significant increase only in the FS group ( $P = 0.038$ ). In the serving domain, the item “I serve soups and stews mainly with the solid ingredients” ( $P = 0.005$ ) and “I post the sodium content of soups and stews” ( $P < 0.001$ ) showed significant increases overall, with some differences between the groups.

### 2) Changes in the practice of low-sodium management before and after the salinometer support program

Table 4 shows the changes in low-sodium management practices. Overall, the practice score increased significantly from 3.74 to 4.31 ( $P < 0.001$ ), with similar results observed in the FS ( $P < 0.001$ ) and non-FS ( $P < 0.001$ ) groups.

Significant increases were observed in the purchasing, cooking, and serving domains ( $P < 0.001$  for all). Individual items showed some differences between the groups. In the purchasing domain, the items “I check sodium content when purchasing food” and “I buy low-sodium products for sauces” showed significant increases in both groups and the non-FS group, while only the former item showed a significant increase in the FS group. In the cooking domain, three items

**Table 2.** Sodium-related dietary habits of the study participants

Item <sup>1)</sup>	FS group (n = 68)	Non-FS group (n = 245)	Total (n = 313)	P-value <sup>2)</sup>
I eat soup, stew, or noodle soup without leaving any broth <sup>3)</sup>	3.43 ± 0.98	3.39 ± 1.07	3.40 ± 1.05	0.809
When eating fried food, I dip it in a lot of soy sauce <sup>3)</sup>	4.16 ± 0.84	4.29 ± 0.74	4.26 ± 0.76	0.237
I think side dishes should be strongly seasoned <sup>3)</sup>	4.15 ± 0.80	4.24 ± 0.72	4.22 ± 0.74	0.335
When stressed, I crave spicy and salty food <sup>3)</sup>	3.66 ± 1.03	3.81 ± 0.96	3.78 ± 0.98	0.275
I check the sodium content when purchasing food	3.19 ± 0.94	3.32 ± 0.99	3.29 ± 0.78	0.342
Average	3.72 ± 0.51	3.81 ± 0.54	3.79 ± 0.53	0.209

Mean ± SD.

FS group, childcare centers registered as group-feeding facilities; non-FS group, childcare centers not registered as group-feeding facilities.

<sup>1)</sup>Five-point Likert scale (5 as never to 1 as always).

<sup>2)</sup>Student's t-test or Welch's t-test.

<sup>3)</sup>Reverse coding.

**Table 3.** Changes in the importance of low-sodium management after the salinometer support program

Variable	FS group (n = 68)			Non-FS group (n = 245)			Total (n = 313)		
	Before	After	P-value <sup>1)</sup>	Before	After	P-value <sup>1)</sup>	Before	After	P-value <sup>1)</sup>
Total average	4.06 ± 0.40 <sup>2)</sup>	4.27 ± 0.45	< 0.001	4.28 ± 0.50	4.37 ± 0.49	0.005	4.23 ± 0.49	4.35 ± 0.48	< 0.001
<b>Purchase</b>									
I check the sodium content when purchasing food	3.90 ± 0.69	4.12 ± 0.56	0.028	4.01 ± 0.75	4.14 ± 0.76	0.020	3.99 ± 0.74	4.14 ± 0.72	0.002
I buy low-sodium products for sauces	3.79 ± 0.70	3.87 ± 0.77	0.533	3.98 ± 0.77	4.05 ± 0.78	0.183	3.94 ± 0.76	4.01 ± 0.78	0.141
I reduce the purchase of processed foods like frozen foods	4.03 ± 0.67	4.10 ± 0.69	0.439	4.24 ± 0.71	4.27 ± 0.72	0.505	4.19 ± 0.70	4.24 ± 0.72	0.348
Average	3.91 ± 0.53	4.03 ± 0.57	0.121	4.07 ± 0.61	4.16 ± 0.62	0.060	4.04 ± 0.59	4.13 ± 0.61	0.017
<b>Cooking</b>									
I use natural seasonings such as kelp, anchovies, and mushrooms	4.60 ± 0.58	4.63 ± 0.57	0.708	4.63 ± 0.62	4.58 ± 0.59	0.257	4.63 ± 0.61	4.59 ± 0.59	0.384
I reduce the saltiness of soybean pastes by adding tofu or onions	4.26 ± 0.73	4.37 ± 0.69	0.265	4.46 ± 0.63	4.50 ± 0.63	0.421	4.42 ± 0.66	4.47 ± 0.64	0.222
I reduce the use of salt and sauces and instead use spices or herbs	3.79 ± 0.64	4.03 ± 0.75	0.038	4.07 ± 0.80	4.11 ± 0.81	0.446	4.01 ± 0.77	4.10 ± 0.80	0.099
I season soups and stews at the end of cooking	4.16 ± 0.86	4.38 ± 0.60	0.058	4.47 ± 0.66	4.51 ± 0.61	0.399	4.40 ± 0.71	4.48 ± 0.61	0.079
I blanch processed meat and fish products before cooking	4.31 ± 0.63	4.32 ± 0.66	0.867	4.50 ± 0.68	4.51 ± 0.64	0.813	4.46 ± 0.70	4.47 ± 0.65	0.774
I check the sodium content with a salinometer after cooking	3.94 ± 1.01	4.53 ± 0.61	< 0.001	4.18 ± 0.93	4.60 ± 0.60	< 0.001	4.13 ± 0.95	4.58 ± 0.60	< 0.001
Average	4.18 ± 0.47	4.38 ± 0.50	0.003	4.39 ± 0.50	4.47 ± 0.49	0.019	4.34 ± 0.50	4.45 ± 0.50	0.001
<b>Serving</b>									
Seasonings are served separately	4.21 ± 0.80	4.46 ± 0.58	0.021	4.44 ± 0.76	4.49 ± 0.77	0.425	4.39 ± 0.77	4.48 ± 0.73	0.073
I serve soups and stews mainly with the solid ingredients	3.97 ± 0.62	4.12 ± 0.68	0.142	4.18 ± 0.81	4.33 ± 0.74	0.017	4.14 ± 0.78	4.28 ± 0.73	0.005
I post the sodium content of soups and stews	3.74 ± 1.00	4.26 ± 0.61	< 0.001	4.13 ± 0.85	4.33 ± 0.76	0.002	4.04 ± 0.90	4.31 ± 0.73	< 0.001
Average	3.97 ± 0.55	4.28 ± 0.50	< 0.001	4.25 ± 0.67	4.38 ± 0.62	0.006	4.19 ± 0.65	4.36 ± 0.59	< 0.001

Mean ± SD.

FS group, childcare centers registered as group-feeding facilities; non-FS group, childcare centers not registered as group-feeding facilities.

<sup>1)</sup>Paired t-test.

<sup>2)</sup>Five-point Likert scale (1 as very unimportant to 5 as very important).

**Table 4.** Changes in the performance of low-sodium management after the salinometer support program

Variable	FS group (n = 68)		Non-FS group (n = 245)		Total (n = 313)	
	Before	After	P-value <sup>1)</sup>	Before	After	P-value <sup>1)</sup>
Total average	3.63 ± 0.38 <sup>2)</sup>	4.26 ± 0.51	< 0.001	3.77 ± 0.45	4.33 ± 0.50	< 0.001
<b>Purchase</b>						
I check the sodium content when purchasing food	3.49 ± 0.94	4.04 ± 0.84	< 0.001	3.82 ± 0.80	3.99 ± 0.82	0.007
I buy low-sodium products for sauces	3.53 ± 0.84	3.81 ± 0.92	0.058	3.86 ± 0.78	4.00 ± 0.78	0.024
I reduce the purchase of processed foods like frozen foods	3.94 ± 0.77	4.15 ± 0.82	0.109	4.13 ± 0.74	4.20 ± 0.72	0.210
Average	3.65 ± 0.63	4.00 ± 0.75	0.003	3.94 ± 0.63	4.06 ± 0.65	0.008
<b>Cooking</b>						
I use natural seasonings such as kelp, anchovies, and mushrooms	4.62 ± 0.57	4.63 ± 0.54	0.871	4.56 ± 0.71	4.60 ± 0.61	0.439
I reduce the saltiness of soybean pastes by adding tofu or onions	4.38 ± 0.71	4.32 ± 0.68	0.575	4.47 ± 0.71	4.48 ± 0.64	0.882
I reduce the use of salt and sauces and instead use spices or herbs	3.78 ± 0.79	4.03 ± 0.81	0.043	3.99 ± 0.83	4.10 ± 0.81	0.092
I season soups and stews at the end of cooking	4.28 ± 0.84	4.53 ± 0.53	0.034	4.45 ± 0.71	4.56 ± 0.62	0.032
I blanch processed meat and fish products before cooking	4.26 ± 0.91	4.37 ± 0.71	0.374	4.48 ± 0.73	4.53 ± 0.68	0.392
I check the sodium content with a salinometer after cooking	3.32 ± 1.31	4.57 ± 0.58	< 0.001	3.13 ± 1.37	4.54 ± 0.71	< 0.001
Average	4.11 ± 0.49	4.41 ± 0.49	< 0.001	4.18 ± 0.54	4.47 ± 0.51	< 0.001
<b>Serving</b>						
Seasonings are served separately	4.40 ± 0.88	4.47 ± 0.70	0.587	4.34 ± 0.91	4.53 ± 0.78	0.003
I serve soups and stews mainly with the solid ingredients	3.90 ± 0.79	4.09 ± 0.71	0.096	4.09 ± 0.86	4.29 ± 0.76	0.002
I post the sodium content of soups and stews	2.96 ± 1.20	4.09 ± 0.86	< 0.001	3.05 ± 1.31	4.12 ± 1.03	< 0.001
Average	3.75 ± 0.63	4.22 ± 0.60	< 0.001	3.82 ± 0.70	4.32 ± 0.68	< 0.001
Total (n = 313)	4.31 ± 0.50	4.31 ± 0.50	< 0.001	4.31 ± 0.50	4.31 ± 0.50	< 0.001

Mean ± SD.

FS group, childcare centers registered as group-feeding facilities; non-FS group, childcare centers not registered as group-feeding facilities.

<sup>1)</sup>Paired t-test.

<sup>2)</sup>Five-point Likert scale (1 as never to 5 as always).

demonstrated significant increases overall, with some differences between groups. In the serving domain, all items showed significant increases overall, although the differences between the groups persisted.

### 3) Analysis of the importance and practice of low-sodium management before and after the salinometer support program

Tables 5 and 6 present the analyses of the importance and practices of low-sodium management in the FS and non-FS groups, respectively. Overall, the practice scores were significantly lower than the importance scores before the program ( $P < 0.001$ ) in both groups, but this difference disappeared following the completion of the program owing to the larger increase in practice scores.

By domain, the purchasing and serving areas in the FS group showed similar trends, with the practice scores significantly lower than the importance scores before the program implementation, but no difference was observed after the program. The cooking domain showed high overall scores with no significant differences before or after the program. In the non-FS group, the cooking domain showed a trend similar to that of the FS group, while the purchasing and serving domains obtained persistently lower practice scores compared with the importance scores, even after the program.

## DISCUSSION

This study surveyed 313 cooks working in childcare centers who participated in the 2022 salinometer support program among those registered with Yongin CCFM. This study aimed to examine the sodium-related eating habits of childcare center cooks and changes in the importance-practice levels of low-sodium management before and after the salinometer support program. All cooks participating in this study were women, with an average age of 52 years. In a previous study investigating the stages of behavioral change for sodium reduction among childcare center cooks in Seoul, Gyeonggi, and Chungcheong provinces [17], the average age of the participating cooks was 49 years. Another study on sodium reduction education for childcare center cooks in Seoul [7] included participants with an average age of 51 years, similar to the participants in this study. This observation

indicates that most cooks working in childcare centers are middle-aged women. A previous study [22] analyzing the stages of behavioral change for sodium reduction in 553 housewives with an average age of 58 years found that the most challenging low-sodium dietary behavior was selecting food after checking the nutrition labels. Similarly, a study investigating the stages of behavioral change for sodium reduction among cooks [17] showed low scores for the item “selecting foods after checking nutrition labels.” In this study, the item “checking the sodium content when purchasing food” obtained the lowest score in the cooks’ usual eating habits domain. As childcare center cooks who prepare meals can influence the infants’ and young children’s eating habits, dietary behaviors, and food preferences [1], maintaining healthy eating habits among cooks is crucial. Therefore, providing capacity-building education for childcare center cooks to practice low-sodium eating habits, including methods for checking nutritional labels when purchasing food, is essential. In particular, Jung *et al.* [15], who conducted a low-sodium eating habits program, reported that longer program durations led to increased adherence to low-sodium eating habits. Thus, to achieve sustained educational effects, improvements in eating habits should be encouraged through continuous education rather than through one-time sessions.

Analysis of the importance and practice levels revealed that in the FS group, the items “checking the sodium content when purchasing food” and “buying low-sodium products for sauces” had an importance score of  $< 4.0$  before the salinometer support program, which was lower than those of other items. The scores for practice levels were also lower than those of other items. After the support program, both the importance and practice scores increased, reflecting positive changes. However, these scores were relatively low compared with those of other items, with “buying low-sodium products for sauces” being the only item to retain a score below 4.0 after the program. In the non-FS group, the practice level for checking sodium content when purchasing food remained lower than its importance level, even after the support program. This finding suggests the need for continuous education, especially for cooks in non-group feeding facilities. Similarly, a study investigating

**Table 5.** Analysis of the importance and performance of low-sodium management before and after the salinometer support program in the FS group

Variable	Before			After		
	Importance (n = 68)	Performance (n = 68)	P-value <sup>1)</sup>	Importance (n = 68)	Performance (n = 68)	P-value <sup>1)</sup>
Total average	4.06 ± 0.40 <sup>2)</sup>	3.63 ± 0.38 <sup>3)</sup>	< 0.001	4.27 ± 0.45	4.26 ± 0.51	0.853
<b>Purchase</b>						
I check the sodium content when purchasing food	3.90 ± 0.69	3.49 ± 0.94	0.002	4.12 ± 0.56	4.04 ± 0.84	0.450
I buy low-sodium products for sauces	3.79 ± 0.70	3.53 ± 0.84	0.011	3.87 ± 0.77	3.81 ± 0.92	0.509
I reduce the purchase of processed foods like frozen foods	4.03 ± 0.67	3.94 ± 0.77	0.334	4.10 ± 0.69	4.15 ± 0.82	0.536
Average	3.91 ± 0.53	3.65 ± 0.63	0.001	4.03 ± 0.57	4.00 ± 0.75	0.653
<b>Cooking</b>						
I use natural seasonings such as kelp, anchovies, and mushrooms	4.60 ± 0.58	4.62 ± 0.57	0.820	4.63 ± 0.57	4.63 ± 0.54	1.000
I reduce the saltiness of soybean pastes by adding tofu or onions	4.26 ± 0.73	4.38 ± 0.71	0.073	4.37 ± 0.69	4.32 ± 0.68	0.517
I reduce the use of salt and sauces and instead use spices or herbs	3.79 ± 0.64	3.78 ± 0.79	0.837	4.03 ± 0.75	4.03 ± 0.81	1.000
I season soups and stews at the end of cooking	4.16 ± 0.86	4.28 ± 0.84	0.031	4.38 ± 0.60	4.53 ± 0.53	0.017
I blanch processed meat and fish products before cooking	4.31 ± 0.63	4.26 ± 0.91	0.651	4.32 ± 0.66	4.37 ± 0.71	0.443
I check the sodium content with a salinometer after cooking	3.94 ± 1.01	3.32 ± 1.31	< 0.001	4.53 ± 0.61	4.57 ± 0.58	0.517
Average	4.18 ± 0.47	4.11 ± 0.49	0.154	4.38 ± 0.50	4.41 ± 0.49	0.423
<b>Serving</b>						
Seasonings are served separately	4.21 ± 0.80	4.20 ± 0.88	0.004	4.46 ± 0.58	4.47 ± 0.70	0.829
I serve soups and stews mainly with the solid ingredients	3.97 ± 0.62	3.90 ± 0.79	0.402	4.12 ± 0.68	4.09 ± 0.71	0.641
I post the sodium content of soups and stews	3.74 ± 1.00	2.96 ± 1.20	< 0.001	4.26 ± 0.61	4.09 ± 0.86	0.057
Average	3.97 ± 0.55	3.75 ± 0.63	0.002	4.28 ± 0.50	4.22 ± 0.60	0.255

Mean ± SD.

FS group, childcare centers registered as group-feeding facilities.

<sup>1)</sup>Paired t-test.

<sup>2)</sup>Five-point Likert scale (1 as very unimportant to 5 as very important).

<sup>3)</sup>Five-point Likert scale (1 as never to 5 as always).

**Table 6.** Analysis of the importance and performance of low-sodium management before and after the salinometer support program in the non-FS group

Variable	Before			After		
	Importance (n = 245)	Performance (n = 245)	P-value <sup>1)</sup>	Importance (n = 245)	Performance (n = 245)	P-value <sup>1)</sup>
Total average	4.28 ± 0.50 <sup>2)</sup>	3.77 ± 0.45 <sup>3)</sup>	< 0.001	4.37 ± 0.49	4.33 ± 0.50	0.072
<b>Purchase</b>						
I check the sodium content when purchasing food	4.01 ± 0.75	3.82 ± 0.80	< 0.001	4.14 ± 0.76	3.99 ± 0.82	0.001
I buy low-sodium products for sauces	3.98 ± 0.77	3.86 ± 0.78	0.010	4.05 ± 0.78	4.00 ± 0.78	0.178
I reduce the purchase of processed foods like frozen foods	4.24 ± 0.71	4.13 ± 0.74	0.006	4.27 ± 0.72	4.20 ± 0.72	0.116
Average	4.07 ± 0.61	3.94 ± 0.63	< 0.001	4.16 ± 0.62	4.06 ± 0.65	0.011
<b>Cooking</b>						
I use natural seasonings such as kelp, anchovies, and mushrooms	4.63 ± 0.62	4.56 ± 0.71	0.063	4.58 ± 0.59	4.60 ± 0.61	0.412
I reduce the saltiness of soybean pastes by adding tofu or onions	4.46 ± 0.63	4.47 ± 0.71	0.726	4.50 ± 0.63	4.48 ± 0.64	0.523
I reduce the use of salt and sauces and instead use spices or herbs	4.07 ± 0.80	3.99 ± 0.83	0.066	4.11 ± 0.81	4.10 ± 0.81	0.678
I season soups and stews at the end of cooking	4.47 ± 0.66	4.45 ± 0.71	0.548	4.51 ± 0.61	4.56 ± 0.62	0.074
I blanch processed meat and fish products before cooking	4.50 ± 0.68	4.48 ± 0.73	0.565	4.51 ± 0.64	4.53 ± 0.68	0.594
I check the sodium content with a salinometer after cooking	4.18 ± 0.93	3.13 ± 1.37	< 0.001	4.60 ± 0.60	4.54 ± 0.71	0.094
Average	4.39 ± 0.50	4.18 ± 0.54	< 0.001	4.47 ± 0.49	4.47 ± 0.50	0.974
<b>Serving</b>						
Seasonings are served separately	4.44 ± 0.76	4.34 ± 0.91	0.023	4.49 ± 0.77	4.53 ± 0.78	0.222
I serve soups and stews mainly with the solid ingredients	4.18 ± 0.81	4.09 ± 0.86	0.041	4.33 ± 0.74	4.29 ± 0.76	0.265
I post the sodium content of soups and stews	4.13 ± 0.85	3.05 ± 1.31	< 0.001	4.33 ± 0.76	4.12 ± 1.03	< 0.001
Average	4.25 ± 0.67	3.83 ± 0.70	< 0.001	4.38 ± 0.62	4.32 ± 0.68	0.034

Mean ± SD.

Non-FS group, childcare centers not registered as group-feeding facilities.

<sup>1)</sup>Paired t-test.

<sup>2)</sup>Five-point Likert scale (1 as very unimportant to 5 as very important).

<sup>3)</sup>Five-point Likert scale (1 as never to 5 as always).

the practices and factors hindering sodium reduction among middle school nutrition teachers/dietitians [20] showed low practice scores for using low-sodium products. Another survey on the use of low-sodium products among nutrition teachers/dietitians in elementary, middle, and high schools in the Gyeonggi area [14] found that 90.5% of the respondents did not use low-sodium products, owing to the “lack of information” and “high prices.” To achieve effective sodium reduction in childcare centers, education regarding low-sodium products that can be used in childcare centers and the methods for purchasing foods that can reduce sodium provision must be provided. In addition, various low-sodium products must be developed.

To reduce the excessive sodium content in children’s meals, the CCFM recommends a salt content of 0.5% in soups or stews served in childcare centers. To ensure appropriate salt content in menus, the use of salinometers in food service facilities is essential. However, a study on school meals in the Gyeonggi region [16] showed that although 86.6% of food service facilities possessed salinometers, only 62.7% used them to check the sodium content of soups or stews. However, a study on the sodium reduction practices of school nutrition teachers/dietitians [23] revealed that only 73.9% consistently used salinometers. This observation indicates that the utilization of salinometers in food service facilities remains unsatisfactory despite the differences in study participants. Education can enhance salinometer use. A previous study [7] on sodium reduction education for childcare center cooks in Seoul showed that the rate of salinometer use increased from 8.2% before education to 94.6% after education on the necessity and usage of salinometers. This study demonstrated that providing salinometers along with related education not only heightened the perceived importance of their use but also resulted in observable behavioral changes in checking and posting salt content. The practice level of using salinometers, initially one of the items with the lowest score (3.17 points) significantly increased to 4.55 after the program.

Previous studies have shown that food service facilities using salinometers have a lower average salt content compared with those that do not use salinometers [11]. A study monitoring the salt content of soups provided

by facilities registered with the CCFM indicated a trend of salt content decreasing with repeated measurements [9]. Kim and Pie [10] reported similar results. Jo and Han’s study [12] found that providing salinometers and conducting low-sodium education in children’s food service facilities resulted in a decrease in soup salt content from 0.46% to 0.41%, supporting the need for continuous education on sodium reduction. Managing the salt content of food service menus using salinometers is practical and applicable in the field [23]; thus, creating an environment where salinometers can be used along with related education could enhance the effectiveness of sodium reduction practices. Through the salinometer support program accompanied by related education, the perceived importance and practice levels of using salinometers increased in the FS and non-FS groups. Therefore, future efforts should continue to support voluntary and practical sodium management in childcare centers through salinometer provision, education, and monitoring.

In this study, both the FS and non-FS groups showed an increase in overall average importance scores after the program. The values obtained in the current study align with the levels reported in a previous study [21] on sodium reduction status and methods used in preparing school meals, despite the differences in the study participants. The practice scores also improved after the program, with the item “seasoning soups or stews at the end of cooking” reaching levels similar to those reported in a study [14] analyzing the awareness and practices of sodium reduction among nutrition teachers and dietitians in the Gyeonggi area. Changes in the perceived importance and practices related to sodium reduction differed between the FS and non-FS groups. In the FS group, no significant differences were found in the importance and practices related to purchasing, cooking, and serving after the program. In the non-FS group, the practice levels remained significantly lower than the importance levels in the purchasing and serving areas even after the program. Nevertheless, in all areas and for most items, the importance and practice levels of the FS group were lower than those of the non-FS group both before and after the program. Therefore, future education should prioritize intensive training across all areas for childcare centers with more than 50 children that

have group feeding facilities. For home childcare centers, which constitute the majority of nongroup feeding facilities, priority should be given to more vulnerable areas, such as checking sodium content when purchasing food and posting salt content.

Despite detailed upper limit standards for salt content in soup dishes consumed by adults [24], guidelines for salt content in soup dishes for infants and toddlers remain ambiguous, suggesting the need for more specific regulations. Because soups significantly contribute to sodium intake in infants and young children [5], managing their soup salt content is essential. Standards should balance reducing sodium with maintaining children's tastes and satisfaction. Additionally, a study [25] investigating the eating habits of childcare center children in Uiwang City found a high frequency of eating out (1–2 times a week). Another study [26] comparing the sodium content in home-cooked, restaurant, and school meals in Seoul showed that restaurant meals had the highest sodium content. To foster low-sodium eating habits in infants and young children, cooperation is essential both in food service facilities and at home. Consistent operation of salinometer lending programs is needed to support sodium reduction at home. Additionally, policy support is needed to encourage restaurants to voluntarily develop and provide low-sodium menus for children.

In the future, the CCFM should provide information on the health effects of consuming high-sodium foods and guidance on checking nutrition labels based on methods for reducing salt when eating and cooking, as suggested in a previous study [13] on sodium reduction programs. Additionally, presenting low-sodium recipes that utilize various vegetables and fruits or the natural taste of foods, along with methods to minimize sodium addition during cooking, will support cooks in gradually reducing sodium content. This study was limited to cooks working in feeding facilities that participated in the 2022 salinometer support program, limiting the generalizability to all children-feeding cooks nationwide. Additionally, the 3-month duration of the program restricted the analysis of long-term changes. Therefore, future research should include a larger, geographically diverse sample based on probability sampling methods and assess long-term effects. Furthermore, given that

infants and young children consume large amounts of sodium through snacks in addition to meals, studies on the importance and practice levels of childcare center staff regarding snacks consumed by children should be conducted.

## CONCLUSIONS

This study analyzed the changes in the importance and practice of low-sodium management among 313 cooks working in childcare centers participating in a salinometer support program. Results show that the program contributed to an overall increase in the importance and practices of low-sodium management in both groups. However, cooks in the non-FS group still demonstrated lower practice levels compared with the importance scores in the purchasing and serving areas. Future low-sodium education should prioritize more vulnerable areas based on the type of childcare center and consider factors such as checking sodium content when purchasing food and displaying salinity.

## CONFLICT OF INTEREST

There are no financial or other issues that might lead to conflict of interest.

## FUNDING

This research was supported by a grant from the Ministry of Food and Drug Safety and Yongin City.

## DATA AVAILABILITY

The participants of this study did not give written consent for their data to be shared publicly, so due to the sensitive nature of the research supporting data is not available.

## REFERENCES

1. Kim JN, Park S, Ahn S, Kim HK. A survey on the salt content of kindergarten lunch meals and meal providers' dietary attitude to sodium intake in Gyeonggi-do area. *Korean J Community Nutr* 2013; 18(5): 478-490.

2. Ministry of Health and Welfare. 2021 child care statistics [Internet]. Ministry of Health and Welfare; 2022 [cited 2024 Feb 01]. Available from: [https://www.mohw.go.kr/board.es?mid=a10412000000&bid=0020&act=view&list\\_no=371193&tag=&nPage=2](https://www.mohw.go.kr/board.es?mid=a10412000000&bid=0020&act=view&list_no=371193&tag=&nPage=2)
3. Korea National Health and Nutrition Examination Survey. 2021 national health statistics [Internet]. Korea Disease Control and Prevention Agency; 2022 [cited 2024 Feb 01]. Available from: [https://knhanes.kdca.go.kr/knhanes/sub04/sub04\\_04\\_01.do](https://knhanes.kdca.go.kr/knhanes/sub04/sub04_04_01.do)
4. Ministry of Health and Welfare, The Korean Nutrition Society. 2020 dietary reference intakes for Koreans: minerals. Ministry of Health and Welfare; 2020 [cited 2024 Feb 01]. Available from: [https://www.mohw.go.kr/board.es?mid=a10411010100&bid=0019&tag=&act=view&list\\_no=362385](https://www.mohw.go.kr/board.es?mid=a10411010100&bid=0019&tag=&act=view&list_no=362385)
5. Jung HR, Lee MJ, Kim KC, Kim JB, Kim DH, Kang SH, et al. Survey on the sodium contents of nursery school meals in Gyeonggi-do. *J Korean Soc Food Sci Nutr* 2010; 39(4): 526-534.
6. Song D, Lee K. Study on sodium contents of kindergarten lunch meals in Gyeongsangbuk-do area. *Korean J Food Cook Sci* 2016; 32(5): 648-655.
7. Shin H, Lee Y. The effectiveness of Na reduction program for cook in child-care center: focus on self-reevaluation and strengthen consciousness. *Korean J Community Nutr* 2014; 19(5): 425-435.
8. Oh SM, Yu YL, Choi HI, Kim KW. Implementation and evaluation of nutrition education programs focusing on increasing vegetables, fruits and dairy foods consumption for preschool children. *Korean J Community Nutr* 2012; 17(5): 517-529.
9. Park HN, Kim SM. Salinity monitoring of soups of the institutions enrolled at center for children's foodservice management. *J East Asian Soc Diet Life* 2016; 26(6): 507-516.
10. Kim HW, Pie JE. Comparison of salinity of soups on the use of bluetooth salinity meter at childcare centers in Anyang area. *J Converg Cult Technol* 2020; 6(4): 435-443.
11. Lee J, Kim JY, Kim S. A survey on the salinity of soups and the perception of salty taste according to the color of soup bowls in the children's foodservice institute. *J Converg Food Spat Des* 2017; 12(3): 17-32.
12. Jo CY, Han JS. Effects of a practice program for low-salt meals on infant foodservices - focusing on infant foodservices registered in center for children's foodservice management in Busan metropolitan city. *J East Asian Soc Diet Life* 2018; 28(1): 66-75.
13. Shin EK, Lee HJ, Jun SY, Park E, Jung YY, Ahn MY, et al. Development and evaluation of nutrition education program for sodium reduction in foodservice operations. *Korean J Community Nutr* 2008; 13(2): 216-227.
14. Lee JH. Awareness and practice of sodium reduction by elementary, middle and high school dietitians in Gyeonggi area. *J East Asian Soc Diet Life* 2012; 22(6): 734-743.
15. Jung EJ, Son SM, Kwon JS. The Effect of sodium reduction education program of a public health center on the blood pressure, blood biochemical profile and sodium intake of hypertensive adults. *Korean J Community Nutr* 2012; 17(6): 752-771.
16. Lee K. Use of salimeters and sodium reduction education in school foodservice in the Gyeonggi area. *J Korean Diet Assoc* 2013; 19(2): 173-181.
17. Ahn Y, Kim KY, Kim K, Pyun J, Yeo I, Nam K. Nutrition knowledge, eating attitudes, nutrition behavior, self-efficacy of childcare center foodservice employees by stages of behavioral change in reducing sodium intake. *J Nutr Health* 2015; 48(5): 429-440.
18. Kim YS, Lee HM, Kim JH. Sodium-related eating behaviors of parents and its relationship to eating behaviors of their preschool children. *Korean J Community Nutr* 2015; 20(1): 11-20.
19. Jeong MJ. A study on the dietary behaviors related to the sodium intake and the sodium reduction enforcement status in school meals by the school nutrition teachers and dietitians in Jeju. [master's thesis]. Jeju National University; 2015.
20. Ha IH, Lyu ES. Awareness, practice, and obstruction of sodium reduction by middle school dietitians in Busan area. *Korean J Food Cook Sci* 2015; 31(2): 225-232.
21. Kim SH, Shin EK, Lee YK. Sodium reduction practice and importance-performance analysis of sodium reduction methods in school foodservice in Daegu. *Korean J Community Nutr* 2020; 25(5): 386-395.
22. Ahn SH, Kwon JS, Kim K, Yoon JS, Kang BW, Kim JW, et al. Study on the eating habits and practicability of guidelines for reducing sodium intake according to the stage of change in housewives. *Korean J Community Nutr* 2012; 17(6): 724-736.
23. Kim EK, Kim HY. School dietitian awareness, practice, and sodium reduction plan in school meal service. *Korean J Food Cook Sci* 2016; 32(2): 222-232.
24. Ministry of Food and Drug Safety. Guidelines for operation and management of sodium reduction practice restaurants

[Internet]. Ministry of Food and Drug Safety; 2019 [cited 2024 Feb 01]. Available from: [https://www.foodsafetykorea.go.kr/portal/board/board.do?menu\\_grp=MENU\\_NEW03&menu\\_no=4852](https://www.foodsafetykorea.go.kr/portal/board/board.do?menu_grp=MENU_NEW03&menu_no=4852)

25. Kim HW, Gil B. Dietary habit survey of preschool children in Uiwang-si, Gyeonggi-do. *J East Asian Soc Dietary Life* 2017; 27(1): 29-40.
26. Park Y, Yoon J, Chung SJ. Comparison of the sodium content of Korean soup-based dishes prepared at home, restaurants, and schools in Seoul. *J Nutr Health* 2020; 53(6): 663-675.