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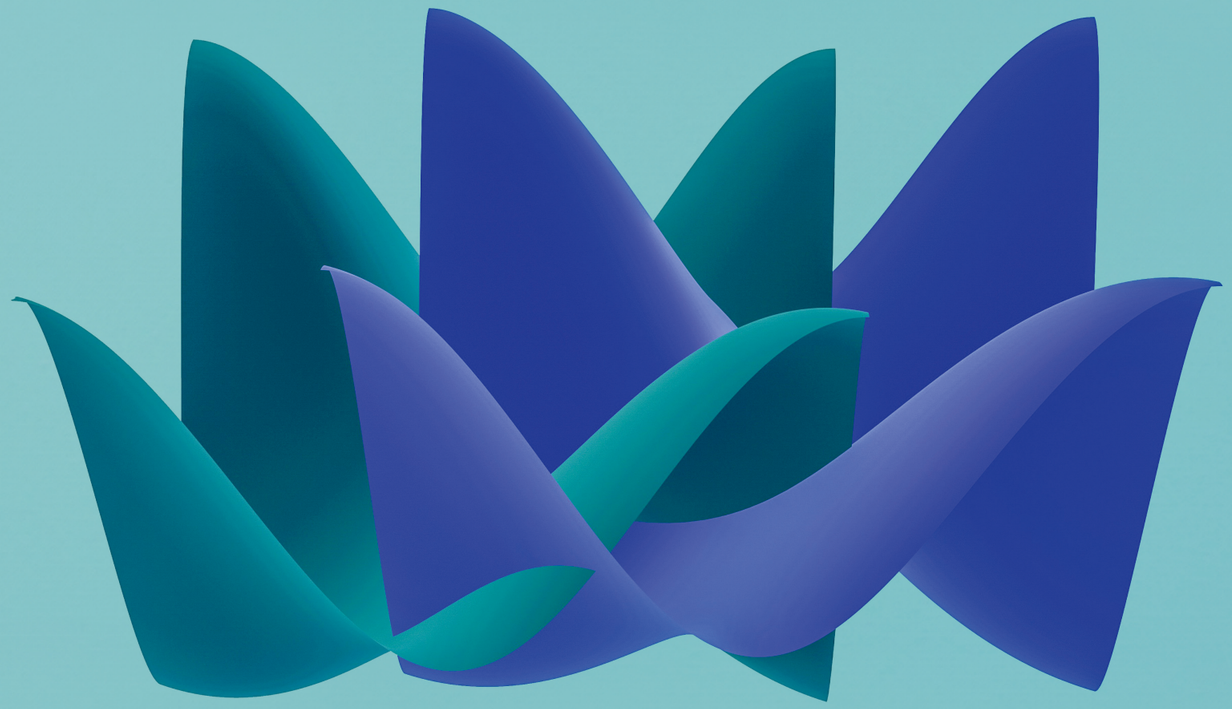

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AIMS AND SCOPE

The *Korean Journal of Community Nutrition* is the official peer-reviewed journal of the Korean Society of Community Nutrition. It was launched in 1996. The previous primary titles were Jiyeog sahoe yeong-yang hag-hoeji (pISSN 1226-0983) from vol. 1, no. 1 to vol 3. no. 5, and Daehan Jiyeok sahoe yeong-yang hakoeji (pISSN 1226-0983, eISSN 2287-1624) from vol. 4, no. 1 to vol. 27 no. 4. The English title (parallel tilte) was Korean Journal of Community Nutrition from vol. 4, no. 1 to vol. 27 no. 4. The *Korean Journal of Community Nutrition* has been the current primary title since October, 2022 (eISSN 2951-3126). The abbreviated title of the journal is *Korean J Community Nutr.* It is published bimonthly in February, April, June, August, October and December. It began to be published only as an e-journal from 2022.

BACKGROUND

KJCN was first published in March, 1996. Three issues were published in 1996, and then five issues per year was published from 1997 to 2001. Since 2002, KJCN has become a bimonthly journal. It is published in February, April, June, August, October and December. This work was supported by the Korean Federation of Science and Technology Societies(KOFST) grant funded by the Korean government. The abbreviated title of the journal is 'Korean J Community Nutr'.

DISTRIBUTION

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ABSTRACTING AND INDEXING

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Research Article

Eating habits and dietary supplement utilization according to food-related lifestyle among Korean adults: a cross-sectional study

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Objectives: This study investigated the association between eating habits and the utilization of dietary supplements (DSs) according to food-related lifestyle (FRL) among Korean adults.

Methods: This study included a total of 300 participants (150 men and 150 women) in their 20s to 60s living in Seoul and Gyeonggi Province. We identified two groups by factor and cluster analysis: an 'active pursuit' group and a 'passive pursuit' group. Differences in eating habits and DS utilization between the two groups were analyzed by chi-square test and t-test. Logistic regression analysis was used to analyze the effect of variables on DS consumption according to FRL.

Results: There were significant differences between the two groups in terms of age, alcohol drinking frequency, total dietary score, change in DS consumption after coronavirus disease 2019, and current DS consumption ($P < 0.05$). The proportion who perceived many health benefits of DSs was higher in the 'active pursuit' group than in the 'passive pursuit' group ($P = 0.003$). The most commonly consumed type of DSs was multivitamins & minerals for the 'active pursuit' group, and omega-3 fatty acids for the 'passive pursuit' group. The 'an active pursuit' group consumed DSs 2.93 times more (95% confidence interval [CI]: 1.44–5.97) compared to the 'passive pursuit' group, after adjusting for confounders. In the 'active pursuit' group, the health pursuit (odds ratio [OR] = 6.54, 95% CI: 1.44–29.61) and rational consumption pursuit factors (OR = 0.26, 95% CI: 0.08–0.83) were associated with DS consumption, whereas only the health pursuit factor had a significant association (OR = 5.37, 95% CI: 2.08–13.88) within the 'passive pursuit' group. However, total dietary score and DSs consumption did not show a relationship.

Conclusions: By understanding the consumption characteristics of DSs according to FRL, this can serve as basic data necessary for promoting health through the utilization of DSs and healthy behaviors.

Keywords: adults; dietary supplements; lifestyle factors

INTRODUCTION

Dietary supplements (DSs) contain one or more dietary compounds, such as vitamins, minerals, amino acids, or other substances, which are intended to provide nutritional or physiological effects [1]. The use of DSs is steadily increasing worldwide, with approximately 50%–75% of the population worldwide taking DSs regularly and nearly half of the population in the US taking them regularly [2]. The sales of DSs increased significantly worldwide in the aftermath of the coronavirus disease 2019 (COVID-19) pandemic. At the beginning of the pandemic, sales of some DSs showed three-digit growth rates in Poland [3]. Recent reports suggested that the Korean market for DSs would exceed $4.52 billion by 2022 [4]. Depending on their age, sex, and physical condition, consumers use DSs for various reasons, including immune support, health promotion, and therapeutic purposes [5].

Social and economic changes are changing our lifestyles, which affect our diets. Improved living standards, women's advancements in society, increased numbers of single-person households, and COVID-19 have greatly impacted dietary lifestyles. Food-related lifestyles (FRLs) reflect consumers' values and consciousness, and their unique characteristics are reflected in their eating habits [2,6]. The FRL is an important marketing tool for companies, which classifies consumer groups with similar dietary needs through market segmentation [7]. Previous studies on FRL include selection attributes of home meal replacements (HMR) according to FRL in single-person households [8], beef consumption behavior among Korean women [9], agri-food consumer competency, and organic food purchase intentions [10]. The selection attributes of HMR by FRLs clustered into three groups in factor and cluster analysis: "utilitarians" (19.3%), "health-conscious utilitarians" (22.2%), and "variety-seeking" (58.5%) [8]. A study on beef consumption behavior among Korean women, according to FRL, classified FRL into three groups: health, safety, quality, trend, and convenience. The health safety pursuit group had the highest score for most information [9]. In the Agri-food Consumer Competency Index, exploratory consumers had the highest score, followed by safety-seeking and passive consumers [10]. DS users also exhibit distinct health habits and characteristics. DS users generally engage in healthier behaviors, such as regular exercise, balanced diets, and avoiding smoking and excessive alcohol consumption [11]. These individuals often have higher health awareness and are more proactive in managing their well-being. Research on FRL patterns has mainly been conducted on HMR selection attributes, beef consumption patterns, agricultural food consumer capabilities, and organic food purchases. However, there has been little research on DS consumption according to FRL patterns. We hypothesized that health-pursuit consumers will change their eating behaviors and DS usage based on their FRL.

Proper eating habits form the basis of balanced nutritional intake and are a major factor in determining an individual's health status. Irregular eating habits not only disrupt physical health but also affect psychological conditions and emotional stability [12]. As dietary choices and nutrient intake are commonly influenced by income, people with lower incomes are more likely to have lower-quality and less nutrient-dense diets [11,13]. People using DSs are characterized by health-related habits, including better dietary patterns, higher physical activity, maintenance of normal body weight, and tobacco avoidance [14]. Based on these findings, people who consume DSs appear to try to maintain good eating habits and are interested in their health.

However, despite the ever-growing market for DSs, research on the characteristics of consumers who purchase DSs is lacking, and research on the relationship between DSs and eating habits according to FRL is rare. Therefore, this study aimed to investigate the relationship between eating habits according to the FRL and the use of DSs among Korean adults.

METHODS

Ethics statement

The informed written consent was obtained from each participant. The study protocol was approved by the Institutional Review Board of Shinhan University (approval number: SHIRB-202305-HR-184-02).

1. Study design and participants

Survey participants in their 20s to 60s were recruited

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from the Seoul and Gyeonggi-do regions. The questionnaire used in this study was developed through discussions with an expert group comprising three nutrition specialist based on relevant literature [10,11,15]. The main survey was conducted between June 8 and June 12, 2023, via convenience sampling. A self-administered questionnaire was used for the survey. The research participants were selected through a professional survey company in Korea (Macromill Embrain Co.), and an online survey was conducted. The purpose of the study and the research method were explained to the participants through a pre-information page before the survey, and written consent was obtained before survey initiation. The written consent form included information on the purpose of the study, participants, data collection methods, confidentiality of participants' information, and exclusion of participants from the study at any time during the survey if they wanted to opt out. Only participants who understood the purpose of the study and agreed to provide information were allowed to respond to the survey. A total of 300 responses were collected from the online survey, all of which were included in the final analyses.

2. Data collection and survey

A questionnaire was constructed to evaluate the use of DSs based on the results of related previous studies and preliminary surveys. In June 2023, a preliminary survey was conducted on participants ranging from their 20s to 60s, totaling 67 individuals. Following this, the survey questionnaire was extensively modified and supplemented, including allowing multiple responses, revising response options, and enhancing descriptions to ensure clarity and comprehensiveness. Changes in DSs consumption after COVID-19, current consumption status, reasons for taking DSs, place of purchase of DSs, how to get DS information, type of DSs consumed, and health effects after DS consumption were investigated. Multiple responses were allowed regarding DSs currently being consumed. In addition, satisfaction and perception of the health benefits of DSs were investigated using a five-point Likert scale (1: not at all, 5: very much).

Total dietary scores were assessed using the 20 indicators of eating habits, including "have three meals a day", "rarely eat processed food", "do not eat salty foods", and "eat fruits > 2 times per day", etc. [15]. Questions on dietary habits were based on a five-point Likert scale (1: not at all, 5: very much). Regarding questions on dietary habits, higher scores (total dietary scores on a 100-point scale) indicated better dietary habits.

To understand the FRL of the survey participants, as described previously [10,11], the food-related life items involved the pursuit of health (six questions), convenience (four questions), gastronomy (seven questions), and rational consumption (three questions). The questionnaire consisted of 20 questions. Each item was measured using a five-point Likert scale (1: not at all, 5: very much).

3. Statistical analysis

SAS version 9.4 (SAS Institute Inc.) was used to perform all statistical analyses. The analyzed results are presented as means ± standard deviation or numbers (%). The combination of factor analysis and cluster analysis for FRL is an integrated approach to customer segmentation, which is useful for developing targeted marketing strategies for DS usage. To factorize the FRL of the survey participants, an exploratory factor analysis was conducted using a principal component analysis. In the factor analysis, a factor loading cut-off point of 0.50 was used for retaining items, and factors with an eigenvalue equal to or greater than 1 were retained. In the principal component factor analysis and varimax rotation used for factor analysis, the factor extraction criterion comprised 17 final items out of 20 total items. A total of four factors were extracted, which involved the patterns of 'gastronomy pursuit' (six questions), 'health pursuit' (six questions), 'convenience pursuit' (three questions), and 'rational consumption pursuit' (two questions) according to the characteristics of the composed questions. A reliability analysis, using Cronbach's alpha, was used to test the reliability and internal consistency of each food-related factor. A Cronbach's alpha coefficient value above 0.5 was considered minimum [16]. K-means cluster analysis, a type of non-hierarchical cluster analysis, was conducted using the factor scores of the four factors extracted through factor analysis. Classification into two clusters, the differences in FRL factors and dietary scores for each cluster were determined using a two-tailed independent sample t-test. A chi-square test was

conducted on the demographic information, current DSs consumption, and health behavior of each group to identify their characteristics. To analyze the factors associated with DSs consumption according to FRL group, odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using logistic regression analysis. Logistic regression was employed to evaluate the impact of being in the 'active pursuit' group compared to the 'passive pursuit' group, which served as the reference group, on DS consumption. Additionally, logistic regression was used to assess the influence of continuous variable scores related to FRL on DS consumption. To analyze the association between total dietary score and DS consumption, age, sex, and alcohol drinking frequency were included as these confounding variables. Theses confounding variables were chosen based on significant differences observed between groups in terms of age and alcohol consumption frequency, as well as physiological differences such as sex. When analyzing the associations of FRL factors and groups with DS consumption, the total dietary score was added to the above confounding variables. Statistical significance was set at $P < 0.05$.

RESULTS

1. Factor analysis and clustering according to the FRL group

The results of the factor and reliability analyses to classify the clusters according to the FRL of the participants in this study are presented in Table 1. The reliability analysis of the measurement concept demonstrated Cronbach's α values of 0.840 for 'gastronomy pursuit', 0.810 for 'health pursuit', 0.794 for 'convenience pursuit', and 0.551 for 'rational consumption pursuit'. The 'gastronomy pursuit' pattern attributed more importance to taste than price when choosing food and preferred tableware or kitchen utensils. Participants in this group also liked to go to new restaurants, cafés, and good restaurants, and post them on social network service online communities. The 'health pursuit' pattern involved an interest in health, such as awareness of food intake and healthy food for nutrition, health, and weight management; checking food additives and the country of origin when purchasing food; and purchasing organic food. The attributes of the 'convenience pursuit' pattern included eating instant food when busy, enjoying fast food, and frequently purchasing ready-to-eat food. The attributes of 'rational consumption' pattern included reducing the time spent preparing meals, purchasing discount products when purchasing food, and comparing price and quality when purchasing products.

K-means cluster analysis, a type of non-hierarchical cluster analysis, was conducted using the factor scores of the four factors extracted through factor analysis. All participants were classified into two groups, and the differences in FRL factors in each group were examined (Table 2). All clusters showed significant differences ($P < 0.001$). Group 1, named the 'active pursuit' group, exhibited high levels of all four FRL factor patterns, including gastronomy, health, convenience, and rational consumption pursuits. In group 2, all four FRL factor patterns—gastronomy, health, convenience, and rational consumption pursuits—were low, and the group was named the 'passive pursuit' group.

2. Demographic characteristics of FRL groups

Table 3 shows the demographic characteristics of the study participants according to the FRL group. The average age of the 'active pursuit' group (41.99 ± 13.19) was significantly lower than that of the 'passive pursuit' group (46.25 ± 14.00) ($P = 0.007$). There were no significant differences in other sociodemographic indicators between the two groups.

3. Health-related behaviors according to FRL

Table 4 shows health-related behavior status according to FRL pattern. There was a significant difference in alcohol drinking frequency according to FRL, with a lower proportion of "rarely" responses in the 'active pursuit' group (36.62%) compared to the 'passive pursuit' group (47.47%) ($P = 0.009$). The total dietary score was significantly higher in the 'active pursuit' group (62.63 ± 9.62) than in the 'passive pursuit' group (60.32 ± 10.32) ($P = 0.047$). Examination of the changes in DSs intake after COVID-19 revealed that 46.48% of the participants in the 'active pursuit' group reported an increased intake, compared to 25.32% in the 'passive pursuit' group ($P < 0.001$).

The DS consumption rate in the 'active pursuit' group

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Table 1. Results of factor analysis for FRL

Variable	Gastronomy pursuit	Health pursuit	Convenience pursuit	Rational consumption pursuit
I do not mind spending money on food	0.519			
I like going to restaurants that have been introduced on TV or food blogs	0.766			
I like going to new restaurants and cafes	0.846			
I like to post pictures taken at fancy restaurants or cafes on social media or other online communities	0.773			
I prefer a restaurant with a nice view or a nice interior	0.816			
I like tableware and kitchen utensils with pretty shapes and colors	0.657			
I tend to eat food considering nutrition and health		0.566		
I am very interested in health, so I tend to eat health supplements and natural foods		0.598		
Low (no) pesticides I tend to buy and eat antibiotic-free, organic foods		0.824		
When purchasing food, I check ingredients such as food additives		0.834		
I tend to check the country of origin when purchasing food		0.780		
I tend to make a list before buying groceries		0.545		
I like to eat fast food like hamburgers and sandwiches			0.786	
When I am busy, I often eat instant food meals			0.796	
I often buy ready-to-eat food from supermarkets, online stores, and department stores			0.786	
When shopping for groceries, I tend to buy discounted products first				0.773
I shop around and compare different stores or products before buying				0.545
Cronbach's α	0.840	0.810	0.794	0.551
Eigen value	3.511	3.440	2.273	1.679
Variance (%)	21.14	18.23	8.74	6.40
Accumulated variance (%)	21.14	39.37	48.11	54.51

Factor loadings are only displayed for values ≤ −0.50 or ≥ 0.50.
FRL, food-related lifestyle.

(90.14%) was significantly higher than that in the 'passive pursuit' group (77.22%) ($P = 0.003$).

4. Types of DS consumption

Table 5 shows the proportion of the top 5 DSs consumed according to FRL. An 'active pursuit' group's DS consumption ranked first in multivitamin & minerals (MVM) (17.46%), followed by omega-3 fatty acid (16.46%), probiotics (13.22%), vitamin C (12.22%), and vitamin A & lutein (6.98%) appeared in that order, and their cumulative ratio accounted for 66.33%. On the other hand, the top DS consumption in the 'passive pursuit' group is omega-3 fatty acid (16.08%), followed by MVM (15.79%), probiotics (14.33%), vitamin C (11.11%), and vitamin D (7.89%) appeared in that order, and their cumulative ratio accounted for 65.20%. The list of major DSs consumed was different according to FRL.

Table 6 shows the characteristics of DS utilization according to FRL. There was a difference in the perceived health benefit of DSs according to the FRL, with the percentage of respondents answering "much" regarding the perceived benefit of DSs in the 'active pursuit' group (57.81%) being significantly higher than the 'passive pursuit' group (45.90%) ($P = 0.003$).

5. Factors associated with DS consumption according to FRL

Table 7 shows the relationships between the factors associated with DS consumption according to FRL. Compared with the 'passive pursuit' group, the 'active

Table 2. Result of cluster analysis for FRL

Variable	Active pursuit (n = 142)	Passive pursuit (n = 158)	*P*-value[1)]
Gastronomy pursuit	3.01 ± 0.81	2.74 ± 0.74	0.003
Health pursuit	3.39 ± 0.58	2.78 ± 0.72	< 0.001
Convenience pursuit	3.42 ± 0.67	2.59 ± 0.76	< 0.001
Rational consumption pursuit	3.82 ± 0.65	3.28 ± 0.65	< 0.001

Mean ± SD.
FRL, food-related lifestyle.
[1)]The *P*-values were estimated using t-test.

Table 3. Sociodemographic characteristics of the participants according to FRL

Variable	Active pursuit (n = 142)	Passive pursuit (n = 158)	*P*-value[1)]
Age (year)	41.99 ± 13.19	46.25 ± 14.00	0.007
Sex			1.000
Male	71 (50.00)	79 (50.00)	
Female	71 (50.00)	79 (50.00)	
Education			0.839
High school	25 (17.61)	32 (20.25)	
College	99 (69.72)	106 (67.09)	
Graduated school	18 (12.68)	20 (12.66)	
Household income (ten thousand won)			0.736
< 200	11 (7.75)	13 (8.23)	
200–400	37 (26.06)	50 (31.65)	
400–600	48 (33.80)	49 (31.01)	
≥ 600	46 (32.39)	46 (29.11)	
Occupation			0.344
Student	12 (8.45)	9 (5.70)	
Worker	106 (74.65)	111 (70.25)	
Housewife	15 (10.56)	27 (17.09)	
Non-worker	9 (6.34)	11 (6.96)	
Marital status			0.083
Married	74 (52.11)	98 (62.03)	
Single	68 (47.89)	60 (37.97)	
Family type			0.456
1-person household	19 (13.38)	26 (16.46)	
Multi-person household	123 (86.62)	132 (83.54)	

Mean ± SD or n (%).
FRL, food-related lifestyle.
[1)]The *P*-values were estimated using the t-test or χ^2 test.

pursuit' group demonstrated a 2.70-fold higher possibility of DS consumption (Model 1: 95% CI 1.39–5.25) and a 2.93-fold higher possibility after adjusting for confounding variables (Model 2: 95% CI 1.44–5.97). In the total subjects, among the four FRL factors, only the 'health pursuit' factor consistently demonstrated a significant relationship with DS consumption before and after adjusting for confounding variables (Model 1: OR 2.96, 95% CI 1.90–4.62, $P < 0.001$; Model 2: OR 5.91, 95% CI 2.96–11.78, $P < 0.001$). As for FRL factors related to DS consumption, when adjusted for confounding variables, the 'health pursuit' factor (Model 2: OR 6.54, 95% CI 1.44–29.61) and the 'rational consumption pursuit' factor (Model 2: OR 0.26, 95% CI 0.08–0.83) were shown to be associated in the 'active pursuit' group ($P < 0.05$, respectively). On the other hand, in the 'passive

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Table 4. Health-related behaviors according to FRL

Variable	Active pursuit (n = 142)	Passive pursuit (n = 158)	*P*-value[1)]
Subjective health status			0.338
Poor	39 (27.46)	47 (29.75)	
Moderate	69 (48.59)	84 (53.16)	
Good	34 (23.94)	27 (17.09)	
Stress level			0.079
Low	23 (16.20)	41 (25.95)	
Moderate	57 (40.14)	63 (39.87)	
High	62 (43.66)	54 (34.18)	
Sleep quality			0.904
Poor	34 (23.94)	37 (23.42)	
Moderate	54 (38.03)	64 (40.51)	
Good	54 (38.03)	57 (36.08)	
Alcohol drinking frequency			0.009
Rarely	52 (36.62)	75 (47.47)	
1–3 times/month	39 (27.46)	36 (22.78)	
1–2 times/week	38 (26.76)	26 (16.46)	
3–4 times/week	5 (3.52)	17 (10.76)	
≥ 5–6 times/week	8 (5.63)	4 (2.53)	
Smoking status			0.082
Present smoker	21 (14.79)	39 (24.68)	
Past smoker	31 (21.83)	35 (22.15)	
Never	90 (63.38)	84 (53.16)	
Total dietary score	62.63 ± 9.62	60.32±10.32	0.047
Change in DSs consumption after COVID-19			< 0.001
Decrease	5 (3.52)	7 (4.43)	
No change	71 (50.00)	111 (70.25)	
Increase	66 (46.48)	40 (25.32)	
Current DSs consumption (%)	128 (90.14)	122 (77.22)	0.003

n (%) or Mean ± SD.
FRL, food-related lifestyle; DSs, dietary supplements; COVID-19, coronavirus disease 2019.
[1)]The *P*-values were estimated using the t-test or χ^2.

Table 5. Top 5 DSs consumed according to FRL in the participants consuming DSs[1)]

Rank	Active pursuit		Passive pursuit	
	DSs	Consumption rate	DSs	Consumption rate
1	Multivitamin & mineral	70 (17.46)	Omega-3	55 (16.08)
2	Omega-3	66 (16.46)	Multivitamin & mineral	54 (15.79)
3	Probiotics	53 (13.22)	Probiotics	49 (14.33)
4	Vitamin C	49 (12.22)	Vitamin C	38 (11.11)
5	Vitamin A & lutein	28 (6.98)	Vitamin D	27 (7.89)
	Cumulative value	266 (66.33)	Cumulative value	223 (65.20)
	Total	401 (100)	Total	342 (100)

n (%).
DSs, dietary supplements; FRL, food-related lifestyle.
[1)]Multi-responses.

Table 6. DSs utilization characteristics according to FRL in the participants consuming DSs (n = 250)

Variable	Active pursuit (n = 128)	Passive pursuit (n = 122)	*P*-value[1)]
Reason for using DSs			0.546
To strengthen the immune system	61 (47.66)	58 (47.54)	
Due to lack of nutrients	19 (14.84)	16 (13.11)	
For disease prevention	17 (13.28)	25 (20.49)	
To recover from fatigue	22 (17.19)	17 (13.93)	
To increase strength and muscle mass	8 (6.25)	4 (3.28)	
For cosmetic effect	1 (0.78)	2 (1.64)	
Place of purchase of DSs			0.466
Department store and supermarket	9 (7.03)	7 (5.74)	
Pharmacy	15 (11.72)	17 (13.93)	
Online site	104 (81.25)	96 (78.69)	
Others	0 (0.00)	2 (1.64)	
Method of information of DSs			0.863
People around me	42 (32.81)	37 (30.33)	
TV and radio	10 (7.81)	13 (10.66)	
SNS (e.g., Instagram, Facebook, etc.)	24 (18.75)	25 (20.49)	
Internet information	51 (39.84)	45 (36.89)	
Others	1 (0.78)	2 (1.64)	
Health effect after DS consumption			0.137
Increase immunity	31 (24.22)	22 (18.03)	
Weight control	6 (4.69)	2 (1.64)	
Intestinal health	8 (6.25)	12 (9.84)	
Fatigue recovery	37 (28.91)	27 (22.13)	
Others	4 (3.13)	9 (7.38)	
No effect	42 (32.81)	50 (40.98)	
Satisfaction of DSs			0.307
Little	7 (5.47)	12 (9.84)	
Moderately	54 (42.19)	55 (45.08)	
Much	67 (52.34)	55 (45.08)	
Perceived health benefit of DSs			0.003
Little	1 (0.78)	12 (9.84)	
Moderately	53 (41.41)	54 (44.26)	
Much	74 (57.81)	56 (45.90)	

n (%).
DSs, dietary supplements; FRL, food-related lifestyle; SNS, social network service.
[1)]The *P*-values were estimated estimated using χ^2.

pursuit' group, only the 'health pursuit' factor (Model 2: OR 5.37, 95% CI 2.08–13.88) showed a significant association when adjusted for confounding variables ($P < 0.001$). Total dietary score showed a relationship with DS consumption in the a 'passive pursuit' group (Model 1: OR 1.04, 95% CI 1.00–1.08, $P < 0.05$), but there was no significant relationship after adjusting for confounding variables.

DISCUSSION

This study investigated eating habits and DS utilization according to FRL. The results of this study showed that the 'active pursuit' group was more likely to consume DSs than the 'passive pursuit' group. Particularly after the outbreak of COVID-19, there was an increase in DS consumption within the 'active pursuit' group, with MVM being the primary supplements taken. Among the

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Table 7. ORs for DSs consumption according to FRL

Variable	Total (n = 300)	Active pursuit (n = 142)	Passive pursuit (n = 158)
DSs consumption			
Model 1[1)]	-	2.70 (1.39–5.25)[4)]**	1.00 (ref.)
Model 2[2)]	-	2.93 (1.44–5.97)**	1.00 (ref.)
FRL factor			
Gastronomy pursuit			
Model 1[1)]	1.04 (0.70–1.53)	0.69 (0.34–1.39)	1.09 (0.66–1.81)
Model 2[2)]	0.99 (0.66–1.48)	0.70 (0.34–1.46)	0.94 (0.54–1.63)
Health pursuit			
Model 1[1)]	2.96 (1.90–4.62)***	1.68 (0.66–4.32)	3.13 (1.75–5.60)***
Model 2[2)]	5.91 (2.96–11.78)***	6.54 (1.44–29.61)*	5.37 (2.08–13.88)***
Convenience pursuit			
Model 1[1)]	0.91 (0.63–1.31)	1.40 (0.61–3.24)	0.44 (0.26–0.75)**
Model 2[2)]	0.99 (0.64–1.53)	1.10 (0.44–2.73)	0.52 (0.27–1.01)
Rational consumption pursuit			
Model 1[1)]	0.82 (0.53–1.26)	0.27 (0.10–0.75)*	0.74 (0.41–1.34)
Model 2[2)]	0.73 (0.45–1.18)	0.26 (0.08–0.83)*	0.60 (0.31–1.15)
Total dietary score			
Model 1[1)]	1.02 (0.99–1.05)	0.96 (0.90–1.01)	1.04 (1.00–1.08)*
Model 2[3)]	1.02 (0.98–1.05)	0.96 (0.90–1.02)	1.03 (0.98–1.08)

Mean with 95% confidence intervals.
OR, odds ratio; DSs, dietary supplements; FRL, food-related lifestyle.
[1)]Model 1: crude.
[2)]Model 2: adjusted for age, sex, alcohol drinking frequency and total dietary score.
[3)]Model 2: adjusted for age, sex, and alcohol drinking frequency.
[4)]*P < 0.05, **P < 0.01, ***P < 0.001.

FRL factors, the health pursuit factor emerged as a factor influencing DS consumption.

The widespread use of DSs in adults may result from an individual's positive expectation that such product use will lead to better health outcomes. Among 21,603 adult MVM users and non-users in the 2012 National Health and Nutrition Examination Survey (NHANES), Paranjpe *et al.* [17] observed that MVM users self-reported 30% better overall health than non-users despite no clinically assessed differences in health. MVM users inherently had a more positive outlook on personal health regardless of their MVM use. Bailey *et al.*'s [18] study, including 11,956 adults in the 2007–2010 NHANES and Austin *et al.*'s [19] study of 5,536 Coast Guard and military personnel also found that MVM users were significantly more likely to self-report their overall health as excellent or good. Kim & Lee [20] also reported significantly higher beliefs that DSs provide health benefits or alleviate menopausal symptoms among DS consumers than among non-consumers in a population of 745 middle-aged women in South Korea. Indeed, DSs with nutrients can benefit some at-risk groups when meeting nutrient needs from the diet alone is difficult, owing to increased requirements, dietary restrictions, or intolerance [21]. In this study as well, the 'active pursuit' group, which had higher DSs consumption, perceived the health benefits of DS to be greater compared to the 'passive pursuit' group.

DSs use is often associated with the adoption of other healthy habits that are generally encouraged as part of a healthier lifestyle [11]. The consumption of DSs in adults is associated with health-related characteristics such as low body mass index, moderate alcohol consumption, non-smoking, abstinence, private health insurance, and higher education [18,20], and in this study, it was also found to be related to the alcohol consumption. People using DSs can be characterized by theirs health-related habits, including better dietary patterns, higher physical activity, maintenance of normal body weight, and tobacco avoidance [8]. Sicinska *et al.* [22]

reported that DS use was associated with healthier food patterns based on higher consumption of vegetables, fruits, whole grains, pulses, fish, seafood, and lower intakes of unprocessed and processed meat, offal, cakes, and alcoholic beverages [23], as well as higher diet quality scores; i.e., the Mediterranean Diet Score [24,25], and the Healthy Eating Index [26]. Consistent with previous studies, in the present study, the total dietary score as well as DS consumption were significantly higher in the 'active pursuit' group than in the 'passive pursuit' group. However, after adjusting for age, gender, and alcohol consumption frequency, there was no association between total dietary score and DS consumption, suggesting that further research is needed regarding the relationship between dietary intake and DS consumption. In this study, among the FRL factors, the health pursuit factor emerged as a factor influencing DS consumption. On the other hand, in the 'active pursuit' group, the rational consumption pursuit factor showed an association with lower DS consumption. The results of the present study might contribute to the improvement of health by providing basic data on personalized eating habits and DS use.

In this study, the 'active pursuit' group showed a greater increase in DS consumption after COVID-19 compared to the 'passive pursuit' group. The 'active pursuit' group's DS consumption ranked first in MVM, followed by omega-3 fatty acid, probiotics, vitamin C, and vitamin A & lutein. On the other hand, the top DS consumption in the 'passive pursuit' group is omega-3 fatty acid, followed by MVM, probiotics, vitamin C, and vitamin D. DSs are used by over half (52%) of US adults, ≥ 19 years of age, with MVM supplements the most frequently consumed supplement across all adult age groups [2]. Vitamin C, vitamin D, and omega-3 fatty acids are among the most popular nutrients taken with DSs [27,28]. The use of DSs is often justified by the desire to improve immunity and overall health, prevent illness, or treat viral infections, even before the COVID-19 outbreak [22,27,29]. Vitamins D and C were the most frequently supplemented compounds, followed by zinc, which was most often supplemented from the beginning of the pandemic in both editions of the PLife-COVID-19 Studies [1]. Omega-3 fatty acids, which are more commonly used in the healthy group, have been shown to enhance sleep quality and alleviate depression and anxiety in students [30,31]. Thus, the widespread use of DSs in adults may result from an individual's expectation that it will lead to better health outcomes [32].

The strength of this study lies in its integrated approach of combining factor analysis and cluster analysis, which not only enhances the reliability and validity of the research but also effectively segments customers based on their eating habits and DS use. This approach helps in developing targeted marketing strategies for DS usage. Additionally, because little research has been conducted on the use of DSs according to FRL in Korean adults, this study can be used as meaningful basic data in the field of public health. However, this study has several limitations, including the lack of a detailed exploration of factors related to FRL, eating habits, and DSs utilization. Additionally, since the study participants were only selected from the Seoul and Gyeonggi areas in Korea, the results may not be generalizable due to the non-representative sample. Another limitation is that the respondents were volunteers, not randomly selected, which might have introduced bias. Future research is needed to address these issues.

CONCLUSIONS

This study explored the relationship between eating habits and DS utilization according to FRL. This study confirmed that not only did the 'active pursuit' group have better dietary habits, but also higher DS consumption. Factors that may influence DSs consumption include the health pursuit factor or the rational consumption pursuit factor. After experiencing COVID-19, increased interest in health and the perception that DSs provides health benefits seem to have increased DS consumption. By understanding the consumption characteristics of DSs according to FRL, this can serve as basic data necessary for promoting health through the utilization of DSs and healthy behaviors. Therefore, the classification of eating habits and utilization of DSs according to FRL and developing strategies for personalized nutritional management by considering each group's characteristics and DS selection attributes are needed.

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CONFLICT OF INTEREST

The corresponding author, Ji-Myung Kim, serves as the Editor-in-Chief of the Korean Journal of Community Nutrition. To mitigate any potential conflicts of interest, Ji-Myung Kim abstained from the peer review and editorial decision-making process for this manuscript, which was managed by an independent associate editor. No other authors have any conflicts of interest to declare.

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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.

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Research Article

Effects of a nutrition education program on metabolic syndrome risk factors in middle-aged Korean adults: an intervention study

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Objectives: This study was conducted to evaluate the effects of a nutrition education program on metabolic syndrome in middle-aged Korean adults.
Methods: A total of 411 Korean adults 30–59 years of age were allocated randomly into three groups: the nutrition education group for promoting Han-sik consumption (HG), the nutrition education group for eating balanced diet (EG), and the control group (CG). The HG and EG received four face-to-face nutrition education sessions over 16 weeks to improve nutritional problems based on the individual's usual diet. Effectiveness of the program was evaluated with the differences of self-reported dietary behaviors, dietary intakes, anthropometric measurements and biochemical indices between the baseline and the end of the nutrition education program. The changes within groups were analyzed using paired t-test and McNemar test and effectiveness among three groups was analyzed by repeated analysis of variance.
Results: After the nutrition education, the percentages of participants who achieved the recommended food group consumption in the Korean Food Guidance Systems significantly increased in HG (P = 0.022). Body weight (P = 0.007), body mass index (P = 0.002), and triglycerides (P = 0.002) significantly decreased in HG. Waist circumference and diastolic blood pressure decreased in all three groups (P < 0.05).
Conclusions: This study found that tailored nutrition education program for middle aged Korean adults showed beneficial effects on improving dietary behaviors and metabolic syndrome risk factors. Further studies are needed to assess the long-term effects of the nutrition education programs on metabolic syndrome risks.

Keywords: nutrition education; Han-sik; eating a balanced diet; metabolic syndrome; middle-aged Korean adults

INTRODUCTION

Metabolic syndrome is a cluster of metabolic risk factors associated with increased risk of atherosclerotic cardiovascular diseases and type 2 diabetes mellitus [1,2]. Diagnostic risk factors for metabolic syndrome include elevated waist circumference, triglycerides, blood pressure, and fasting glucose and reduced high-density lipoprotein (HDL) cholesterol [2]. In Korea, prevalence of metabolic syndrome has increased substantially along with an increase in high blood pressure and high fasting glucose level [3].

Diet can have a significant impact on risk factors for metabolic syndrome. In the United States, the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) recommended therapeutic lifestyle changes (TLC) that included reducing saturated fat and cholesterol intakes, increasing dietary fiber, and adjusting total caloric intake to maintain a desirable body weight [1].

Several studies have reported that nutritional education can bring about beneficial effects on metabolic syndrome risk factors in various populations regardless of duration of the nutrition education. After 1-year of nutrition education in 54,385 adults aged 20–64 in Korea, the prevalence of metabolic syndrome components decreased significantly [4]. Another study conducted a nutritional education program on metabolic syndrome among 153 diabetic patients aged 20–79 in Kenya and found a significant reduction in body mass index (BMI) and low-density lipoprotein (LDL) cholesterol levels after 8 weeks of education [5]. A study on a 1-year nutritional education program for metabolic syndrome in 456 obese patients aged 18–77 in Spain also reported significant declines in body weight, body fat, and visceral fat [6]. Furthermore, results from a meta-analysis showed that tailored nutrition education was more effective in increasing fruits and vegetables consumption and reducing the percentage of energy from fat compared with generic nutrition education [7].

The “Han-sik,” a traditional Korean diet, is characterized mainly by a high proportion of grains and vegetables, a low proportion of animal foods, and cooking methods such as boiling or blanching in water rather than deep-frying or stir-frying in oil [8-10]. Due to its distinctive composition of major foods and the cooking style, Han-sik has been culturally recognized as a relatively healthy dietary pattern, comparable to the Dietary Approaches to Stop Hypertension (DASH) diet or a prudent dietary pattern [11,12]. However, scientific evidence on the beneficial effects of increasing Han-sik consumption through nutrition education programs on metabolic syndrome is very limited. Therefore, this study aimed to assess the effects of a nutrition education program on metabolic syndrome risk factors in middle-aged Korean adults.

METHODS

Ethics statement

All participants were provided written informed consent. The study protocol, approved by the Institutional Review Board of Jesaeng Hospital in Korea (IRB No. IMG 09-01), involved subject analysis conducted on the per-protocol (PP) set.

1. Participants

The target population of the nutrition education program was middle aged Korean adults. The sample size was determined to be 405 participants based on the result of previous studies, with a power of 80% and a type I error of 5% [13,14]. This calculation, performed using G*Power 3.1.9.7 software, meets the necessary sample size requirements for this study [15,16]. Study subjects were recruited at one hospital in South Korea, between July 2011–2012. A total of 411 subjects aged 30–59 years with two or more metabolic syndrome risk factors as detected in a general health screening examination, and who were not taking medications were selected. Metabolic syndrome was defined based on the NCEP ATP III, with the exception of the abdominal obesity criterion [2]. The Korean Society for the Study of Obesity (KOSSO)’s definition of abdominal obesity was used in this study [17]. Those who had three or more of the following five components were defined as having metabolic syndrome: abnormal blood glucose (fasting blood glucose ≥ 100 mg/dL), elevated blood pressure (≥ 130/85 mmHg), low serum HDL-cholesterol (< 50 mg/dL for women, < 40 mg/dL for men), hypertriglyceridemia (≥ 150 mg/dL), and abdominal obesity

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(waist circumference ≥ 85 cm for women, ≥ 90 cm for men).

The 411 subjects were stratified by gender and randomly assigned into three groups: the nutrition education group promoting Han-sik consumption (HG), the nutrition education group for eating a balanced diet (EG), and the control group with no intervention (CG; Figure 1).

2. Nutrition education program

Nutrition education to manage metabolic syndrome risk factors was focused on the individual's dietary problems based on the baseline dietary survey. The nutrition education was performed by trained dietitians. The HG and EG included meeting face-to-face with the trained dietitian four times in the 16 weeks according to the study protocol.

1) First session - Setting dietary goals

In the first session, dietary goals were set for all HG and EG participants to manage metabolic syndrome risks. The dietary goals were established based on the dyslipidemia treatment guidelines, the Korean Food Guidance System (KFGS), Dietary Reference Intakes for Koreans, and a review of the literature. A detailed description of the process of establishing individual' dietary goals was published previously [18]. Briefly, the dietary goals include four topics with seven guidelines: 1) keep a healthy weight (maintain a healthy weight, appropriate caloric intake), 2) adhere to acceptable macronutrient intake ranges (15% to 20% of total calories from total fat, 60% to 65% of total calories from carbohydrate), 3) increase specific nutrient intake (25 g/d or more of dietary fiber intake in men, 20 g/d or more of dietary fiber in women), and 4) reduce specific nutrient intake (2 g/d or less of sodium intake, 200 mg/d or less of cholesterol intake).

Both the HG and EG groups were provided with educational materials for dietary practice. The educational materials for HG group included menu planning methods with examples based on KFGS using Han-sik [18,19]. In contrast, the educational materials for EG group included menu planning methods with examples based on the KFGS using a regular diet [18,19]. The KFGS outlines the basic principles of meal planning with major food groups such as 'grains', 'meat, fish, eggs, beans', 'vegetables', 'fruits', 'milk, dairy products', and 'oils, fats, sugars' [20]. The dietary goals and composition of the

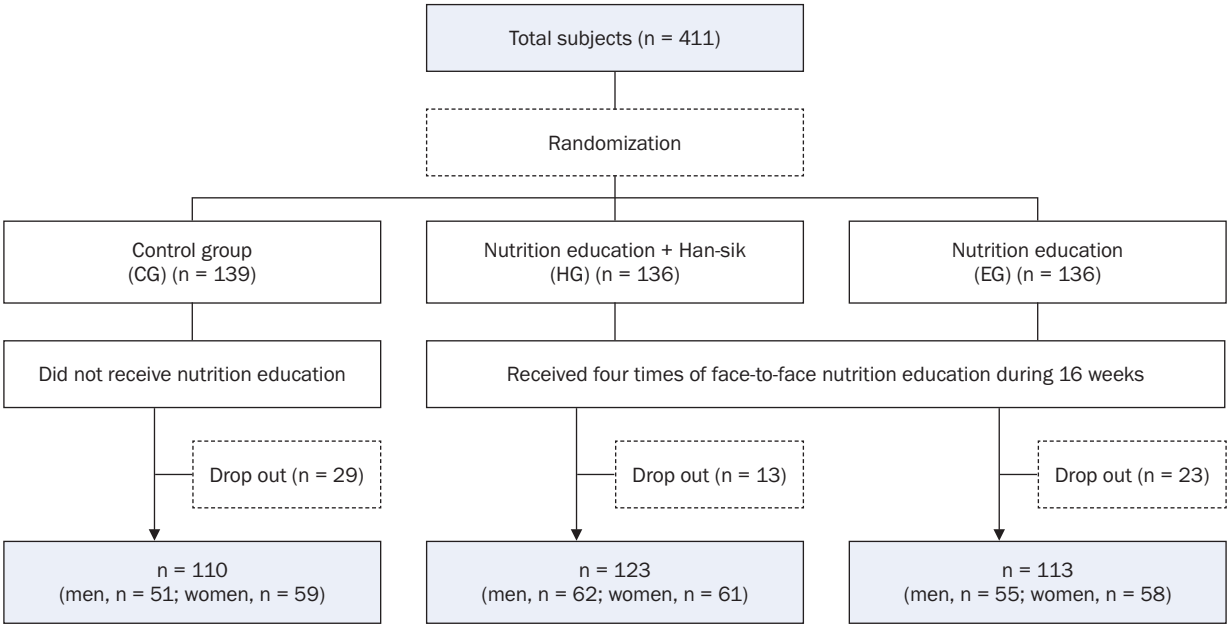

Fig. 1. Flow of the study process.
CG, control group with no intervention; HG, the nutrition education group for promoting the Han-sik consumption; EG, the nutrition education group for balanced diet.

nutrition education provided to both groups were identical; only the list of foods used in the menu planning differed (Figure 2) [18].

2) Remaining sessions - Tailored nutrition education

In the remaining three sessions, tailored nutrition education on personal dietary behaviors were provided for the HG and EG participants by trained dietitians, based on the personal dietary assessment results. During the

HG

EG

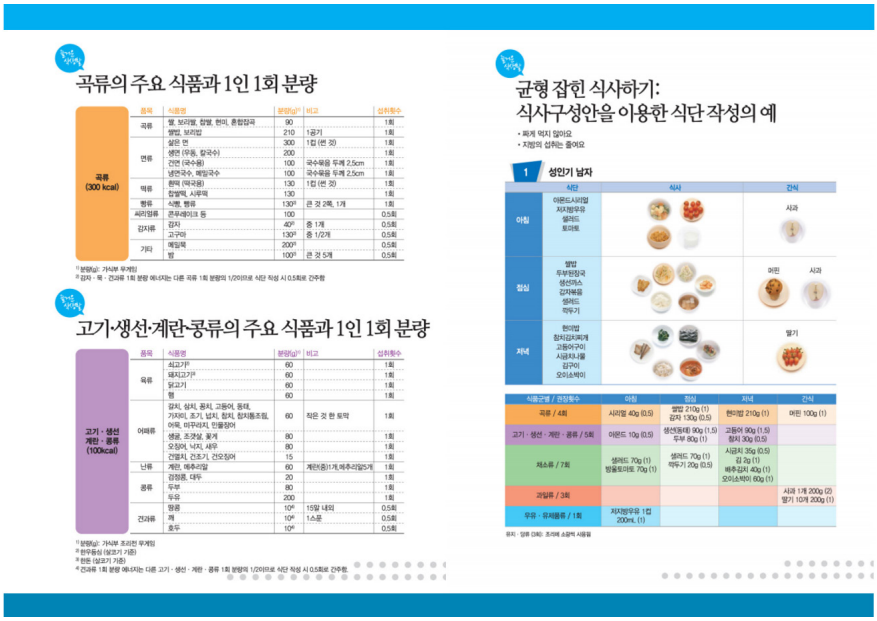

Fig. 2. Example of menu planning and presentation of single-serving sizes per meal for representative foods from both groups. HG, the nutrition education group for promoting Han-sik consumption; EG, the nutrition education group for balanced diet. Reproduced from Kang *et al*. (Korean J Nutr 2012; 45(6):552-561) [18].

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sessions, the individual consultation focused on helping the participants achieve their dietary goals such as appropriate caloric intake, macronutrient intake ranges, and adequate intakes of nutrients and food groups. The CG received no nutrition education.

3. Evaluation of the effectiveness of the nutrition education program

The effectiveness of the nutrition education program was evaluated using dietary behaviors, dietary intakes, anthropometric, and biochemical measurements.

1) Dietary behaviors

Dietary behaviors such as compliance with the dietary guidelines and food group guidance were measured using a questionnaire. The questionnaire included 12 questions with five answer categories (always = 5, frequently = 4, modestly = 3, seldom = 2, never = 1).

2) Dietary intake

The Dietary intake data were collected at three points (baseline, 8 weeks, and 16 weeks) with non-consecutive 3-day dietary records (two weekdays and one weekend day). Nutrient intakes were calculated using the CAN-pro 6.0 (Korean Nutrition Society). The intakes of six major food groups were calculated, and adherence score to KFGS was calculated as the percentage of food consumption by each food group relative to the recommended servings by age and sex [20,21]. The overall adherence of KFGS was evaluated as satisfying the following criteria in three or more food groups: 80% ≤ the adherence score of 'grains' and 'meat, fish, eggs, beans' < 120%, 80% ≤ the adherence score of 'vegetables', 'fruits', and 'milk, dairy products', and the adherence score of 'oils, fats, sugars' < 120% [20,21]. Han-sik usage was defined as the percentage of Han-sik items of all consumed dish items using Han-sik database [19].

3) Anthropometric and biochemical measurements

At baseline, 8 weeks and 16 weeks after the program, anthropometric and biochemical data were collected three points. All measurements were performed by trained health workers. The body weight and height were measured using an automatic height and weight scale (GL-150; G-Tech International). BMI was calculated as weight in kg divided by the square of height in meter. Waist circumference was measured using a tape measure at the narrowest part of the waist. Blood pressure was measured using automatic equipment (OMRON HEM-7220; OMRON Corp.). Blood samples were collected after at least 8 hours of fasting and analyzed by the Department of Laboratory Medicine at Jesaeng Hospital. The enzymatic colorimetric test (glycerol phosphate oxidase-p-aminophenazone, GPO-PAP), an enzymatic method, and Hexokinase-Glucose-6-Phosphate Dehydrogenase (HK-G6PD, UV) were used for measuring serum levels of triglycerides, HDL-cholesterol, and glucose, respectively.

4) Sociodemographic and lifestyle factors

Data on sociodemographic and lifestyle factors, such as sex, age, smoking status, alcohol drinking, physical activity, and dietary supplement use, were collected using a structured questionnaire. Smoking status was categorized as never smoked, quit smoking, or currently smoking. Alcohol intake at one time was grouped into four categories: do not drink, 1–2 glasses, 3–6 glasses, and 7 glasses or more. Physical activity was classified as 'regular' if the subject answered "yes" to moderate physical activity of at least 30 minutes at a time for 5 or more days per week or to intense physical activity of at least 20 minutes at a time for 3 or more days per week.

4. Statistical analyses

Data are presented as mean ± standard deviation for continuous variables and n (%) for categorical variables. Baseline characteristics among three groups were compared using analysis of variance (ANOVA) and χ^2 test. The differences between values at baseline and the end of the nutrition education program within each group were analyzed using the paired t-test for continuous variables and the McNemar test for categorical variables. To evaluate the effectiveness of the nutrition education program among the three groups, repeated ANOVA was used. The SAS software (ver. 9.3; SAS Institute Inc.) was used for all statistical analyses. The level of significance was set at $P < 0.05$.

Table 1. Baseline characteristics of participants in three groups

	CG (n = 110)	HG (n = 123)	EG (n = 113)	*P*-value[1]
Age (year)	46.2 ± 7.9	45.6 ± 7.7	47.8 ± 7.3	0.083
Sex				
Men	51 (46.4)	62 (50.4)	55 (48.7)	0.827
Women	59 (53.6)	61 (49.6)	58 (51.3)	
Smoking status				
Never smoked	62 (56.4)	67 (54.5)	61 (54.0)	0.832
Former smoking	25 (22.7)	33 (26.8)	25 (22.1)	
Currently smoking	23 (20.9)	23 (18.7)	27 (23.9)	
Alcohol intake at one time				
Do not drink	8 (7.3)	12 (9.8)	8 (7.1)	0.927
1–2 glasses	38 (34.5)	37 (30.1)	38 (33.6)	
3–6 glasses	31 (28.2)	41 (33.3)	33 (29.2)	
7 glasses and more	33 (30.0)	33 (26.8)	34 (30.1)	
Physical activity				
Regular[2]	23 (20.9)	23 (18.7)	22 (19.5)	0.913
Dietary supplement use				
User	50 (45.5)	53 (43.1)	48 (42.5)	0.894
Metabolic syndrome[3]	66 (60.0)	64 (52.0)	63 (55.8)	0.474
Metabolic syndrome components[4]				
Impaired blood glucose	47 (42.7)	53 (43.1)	56 (49.6)	0.507
Elevated blood pressure	77 (70.0)	89 (72.4)	93 (82.3)	0.078
Low HDL-cholesterol	47 (42.7)	43 (35.0)	35 (31.0)	0.178
Hypertriglyceridemia	77 (70.0)	66 (53.7)	54 (47.8)	0.002
Abdominal obesity	75 (68.2)	87 (70.7)	72 (63.7)	0.510

Mean ± SD or n (%).
CG, control group with no intervention; HG, the nutrition education group for promoting the Han-sik consumption; EG, the nutrition education group for balanced diet; HDL, high-density lipoprotein.
[1]*P* from chi-square test in categorical variables and ANOVA in continuous variables (duncan's grouping).
[2]Moderate physical activity of at least 30 min at a time for 5 or more days per week or intense physical activity of at least 20 min at a time of 3 or more days per week.
[3]Metabolic syndrome, those who had three or more of the following five components.
[4]Impaired blood glucose (fasting blood glucose ≥ 100 mg/dL), elevated blood pressure (≥ 130/85 mmHg), low HDL-cholesterol (< 50 mg/dL for women, < 40 mg/dL for men), hypertriglyceridemia (≥ 150 mg/dL), and abdominal obesity (waist circumference ≥ 85 cm for women, ≥ 90 cm for men).

RESULTS

Among the 411 participants who initially joined the nutrition education program initially, 346 participants (84.2%) completed four sessions (Figure 1). Table 1 shows the baseline characteristics of the participants who completed the program. There were no significant differences in baseline characteristics among the three groups, except for the percentages of participants with hypertriglyceridemia.

Table 2 shows the changes in self-reported adherence to the dietary guidelines for Koreans after the provision of nutrition education. Analysis across two-time points indicates that dietary behaviors–such as adequate intake of milk and dairy products, regular intake of three meals a day, eating less fried foods, and reducing the amount of oil when cooking–showed significantly greater improvement in the HG and EG groups compared to the CG group (P for group-by-time interaction < 0.05).

The changes in nutrient intake and adherence score to KFGS after the nutrition education are shown in Table 3. Upon the completion of the nutrition education, there was a significant decrease in energy, carbohydrate, fat, and sodium in EG (P < 0.05). In turn, several adherence

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Table 2. Self-reported changes in dietary behaviors during nutrition education[1)]

	CG (n = 110)				HG (n = 123)				EG (n = 113)				$P^{3)}$
	Before	After	Difference	$P^{2)}$	Before	After	Difference	$P^{2)}$	Before	After	Difference	$P^{2)}$	
Adequate intake of various whole grains	3.2 ± 0.9	3.4 ± 0.9	0.2 ± 1.0	0.107	3.1 ± 1.0	3.2 ± 0.8	0.1 ± 1.0	0.129	3.2 ± 1.0	3.4 ± 0.9	0.2 ± 0.9	0.010	0.749
Adequate intake of green/orange vegetables	3.0 ± 0.8	3.0 ± 0.9	0.1 ± 0.9	0.460	2.6 ± 0.8	2.9 ± 0.7	0.3 ± 0.8	0.001	2.8 ± 0.9	3.0 ± 0.7	0.2 ± 0.9	0.019	0.242
Adequate intake of fruits	2.9 ± 0.9	3.0 ± 0.9	0.1 ± 0.9	0.534	3.0 ± 0.8	3.1 ± 0.8	0.1 ± 0.9	0.289	3.1 ± 0.9	3.1 ± 0.8	0.0 ± 1.0	0.844	0.672
Adequate intake of milk and dairy products	2.6 ± 1.0	2.7 ± 1.0	0.1 ± 1.1	0.335	2.6 ± 1.2	3.1 ± 0.9	0.5 ± 1.2	< 0.0001	2.6 ± 1.0	3.1 ± 0.9	0.5 ± 1.0	< 0.0001	0.005
Regular intake of three meals a day	3.0 ± 1.1	3.2 ± 1.0	0.2 ± 0.8	0.008	3.0 ± 1.2	3.3 ± 1.0	0.3 ± 0.9	0.001	3.0 ± 1.0	3.5 ± 1.0	0.5 ± 0.8	< 0.0001	0.042
Meals are composed of variety of side-dishes	3.0 ± 0.8	3.0 ± 0.8	0.1 ± 0.8	0.247	3.0 ± 0.9	3.0 ± 0.8	0.1 ± 0.9	0.412	2.9 ± 0.8	3.2 ± 0.7	0.3 ± 0.8	0.0002	0.082
Appropriate caloric intake needed for energy balance	3.0 ± 0.9	3.2 ± 0.9	0.2 ± 1.0	0.044	3.2 ± 1.0	3.2 ± 0.8	0.1 ± 1.0	0.441	3.0 ± 0.9	3.2 ± 0.8	0.2 ± 1.1	0.082	0.633
Do not add extra salt or soy sauce	3.5 ± 0.9	3.5 ± 1.0	0.1 ± 1.0	0.516	3.4 ± 1.0	3.6 ± 0.9	0.2 ± 1.1	0.023	3.3 ± 1.0	3.6 ± 0.9	0.3 ± 1.1	0.012	0.317
Make Kimchi as low salty	2.9 ± 0.8	3.1 ± 0.8	0.1 ± 0.9	0.085	2.9 ± 0.8	3.1 ± 0.8	0.2 ± 0.7	0.003	3.0 ± 1.0	3.3 ± 0.7	0.3 ± 0.9	0.0002	0.324
Eat less fatty meat	3.1 ± 1.1	3.3 ± 1.1	0.2 ± 0.9	0.043	3.0 ± 1.1	3.3 ± 1.0	0.3 ± 0.9	< 0.0001	3.2 ± 1.0	3.5 ± 0.9	0.4 ± 0.9	< 0.0001	0.286
Eat less fried foods	3.4 ± 1.0	3.5 ± 0.9	0.1 ± 0.9	0.326	3.2 ± 1.0	3.6 ± 0.9	0.4 ± 0.9	< 0.0001	3.2 ± 1.0	3.6 ± 0.8	0.4 ± 0.9	< 0.0001	0.009
Reduce the amount of oil when cooking	3.3 ± 0.8	3.4 ± 0.8	0.1 ± 0.8	0.181	3.1 ± 0.9	3.5 ± 0.7	0.4 ± 0.7	< 0.0001	3.2 ± 0.8	3.6 ± 0.7	0.4 ± 0.8	< 0.0001	0.011

Mean ± SD.
CG, control group; HG, the education to increase Han-sik consumption group; EG, the education to promote a balanced diet group.
[1)]The score was answered as follows keeping the guideline: always = 5, frequently = 4, modestly = 3, seldom = 2, never = 1.
[2)]*P* from paired t-test in each three groups.
[3)]*P* from repeated ANOVA, group-by-time.

scores to KFGS changed after nutrition education. The adherence score of 'oils, fats, sugars' in HG, 'grains', 'vegetables', 'oils, fats, sugars' in EG, and 'grains', 'meat, fish, eggs, beans', and 'oils, fats, sugars' in CG decreased ($P < 0.05$). The adherence score of 'milk, dairy products' increased significantly only in HG ($P = 0.001$) (P for group-by-time interaction < 0.05). Percentages of participants meeting the recommendations for three or more food groups significantly increased from 32.5% to 46.3% in HG following nutrition education ($P = 0.022$). Similarly, in the EG, the percentage increased from 38.9% to 50.4%, approaching significance with a P-value of 0.058. Han-sik consumption did not change in any groups.

After receiving nutrition education, the changes in anthropometric and biochemical markers are presented in Table 4. In the HG group, there were significant reductions in body weight (72.7 kg to 72.2 kg, $P = 0.007$), BMI (26.3 kg/m^2 to 26.1 kg/m^2, $P = 0.002$), and waist circumference (89.4 cm to 88.0 cm, $P < 0.0001$) following nutritional education. Additionally, there were significant decreases in triglycerides (175.0 mg/dL to 153.4 mg/dL, $P = 0.002$) and systolic- (132.9 mmHg to 129.5 mmHg, $P = 0.016$) and diastolic- (86.6 mmHg to 84.0 mmHg, $P = 0.009$) blood pressure within this group. In the EG group, waist circumference (88.4 cm to 86.8 cm, $P < 0.0001$) and systolic- (135.8 mmHg to 130.8 mmHg, $P < 0.0001$) and diastolic- (89.1 mmHg to 84.8 mmHg, $P < 0.0001$) blood pressure were significantly reduced, while HDL cholesterol (50.9 mg/dL to 49.2 mg/dL, $P = 0.037$) showed a slight decrease. In the CG group, there were slight reductions in waist circumference (90.3 cm to 89.1 cm, $P < 0.0001$) and diastolic blood pressure (89.0 mmHg to 86.9 mmHg, $P = 0.044$). However, no significant differences were observed in the group-by-time interaction across the three groups.

The changes in prevalence of metabolic syndrome and its risk factors among the three groups after nutrition education are presented in Figure 3. After nutrition education, positive changes in metabolic syndrome risk factors were shown. Prevalence of elevated blood pressure and abdominal obesity was significantly decreased in both HG and EG ($P < 0.05$). Prevalence of hypertriglyceridemia and abdominal obesity was significantly decreased in CG ($P < 0.05$). Percentages of participants who did not have metabolic syndrome risk factors or

Table 3. The changes of nutrients and food group intakes among three groups after nutrition education

	CG (n = 110)				HG (n = 123)				EG (n = 113)				$P^{2)}$
	Before	After	Difference	$P^{1)}$	Before	After	Difference	$P^{1)}$	Before	After	Difference	$P^{1)}$	
Nutrient intakes													
Energy (kcal)	1,789.1 ± 569.5	1,683.3 ± 555.0	−105.8 ± 575.4	0.164	1,802.0 ± 605.1	1,686.9 ± 475.6	−115.1 ± 608.8	0.099	1,752.7 ± 516.1	1,582.7 ± 356.3	−170.0 ± 471.5	0.004	0.644
Carbohydrate (g)	258.5 ± 91.3	239.0 ± 71.0	−19.5 ± 83.7	0.079	260.4 ± 83.6	249.7 ± 68.7	−10.7 ± 84.5	0.276	255.8 ± 67.4	238.6 ± 54.2	−17.2 ± 62.6	0.035	0.662
Protein (g)	68.2 ± 25.7	63.5 ± 26.1	−4.7 ± 26.4	0.182	69.6 ± 27.3	68.1 ± 26.4	−1.5 ± 32.3	0.656	66.5 ± 27.0	61.8 ± 18.5	−4.7 ± 28.3	0.124	0.625
Fat (g)	41.8 ± 18.6	40.0 ± 21.5	−1.8 ± 25.1	0.515	44.0 ± 20.8	40.0 ± 17.4	−4.0 ± 22.4	0.104	43.0 ± 19.7	35.8 ± 14.3	−7.2 ± 22.0	0.002	0.218
% CHO	61.9 ± 8.2	61.7 ± 9.1	−0.1 ± 10.3	0.914	61.2 ± 8.6	61.7 ± 7.5	0.5 ± 10.5	0.613	61.8 ± 7.9	62.8 ± 7.3	0.9 ± 9.9	0.350	0.733
% protein	16.2 ± 3.5	16.1 ± 3.7	−0.1 ± 4.3	0.796	16.2 ± 4.2	16.6 ± 3.6	0.3 ± 5.2	0.508	15.7 ± 3.4	16.3 ± 3.7	0.6 ± 4.6	0.204	0.509
% lipid	21.9 ± 6.4	22.2 ± 7.4	0.3 ± 8.9	0.788	22.6 ± 6.4	21.7 ± 6.3	−0.8 ± 7.8	0.292	22.5 ± 6.4	21.0 ± 6.1	−1.6 ± 8.1	0.064	0.260
Dietary fiber (g)	22.8 ± 8.4	22.3 ± 9.2	−0.5 ± 7.8	0.645	23.9 ± 9.8	22.6 ± 8.7	−1.4 ± 11.5	0.253	23.9 ± 9.2	23.3 ± 8.4	−0.6 ± 9.2	0.590	0.780
Sodium (g)	3.5 ± 1.4	3.2 ± 1.3	−0.3 ± 1.4	0.158	3.5 ± 1.5	3.2 ± 1.0	−0.3 ± 1.6	0.094	3.6 ± 1.7	3.1 ± 1.0	−0.5 ± 1.5	0.011	0.505
Cholesterol (mg)	160.9 ± 96.0	155.0 ± 108.3	−5.9 ± 130.3	0.670	171.1 ± 106.2	160.9 ± 95.4	−10.1 ± 137.9	0.432	166.8 ± 104.8	143.8 ± 93.3	−22.9 ± 145.8	0.084	0.630
% Han-sik intake[3)]	77.5 ± 13.1	77.9 ± 12.7	0.3 ± 11.8	0.762	76.1 ± 12.0	77.2 ± 11.3	1.1 ± 12.4	0.311	76.0 ± 11.0	76.4 ± 13.5	0.4 ± 12.2	0.743	0.850
Adherence score to the Korean Food Guidance System[4)]													
Grains (%)	82.3 ± 35.9	73.6 ± 27.5	−8.8 ± 33.1	0.007	80.3 ± 28.4	78.6 ± 24.5	−1.7 ± 28.0	0.507	77.8 ± 24.7	73.3 ± 21.0	−4.5 ± 23.3	0.044	0.162
Meat·fish·eggs·beans (%)	93.8 ± 43.4	83.1 ± 44.7	−10.7 ± 52.7	0.035	93.4 ± 50.6	84.0 ± 45.1	−9.4 ± 60.0	0.085	88.9 ± 47.2	82.7 ± 37.0	−6.2 ± 55.6	0.238	0.827
Vegetables (%)	94.3 ± 45.1	94.8 ± 44.7	0.5 ± 47.2	0.912	98.8 ± 47.1	106.8 ± 124.4	7.9 ± 135.4	0.517	100.6 ± 51.3	87.3 ± 33.9	−13.2 ± 46.0	0.003	0.184
Fruits (%)	57.3 ± 53.9	56.9 ± 70.2	−0.4 ± 68.7	0.954	56.9 ± 56.0	49.3 ± 48.2	−7.6 ± 61.1	0.169	68.0 ± 71.7	62.6 ± 63.0	−5.4 ± 74.4	0.442	0.711
Milk·dairy products (%)	44.0 ± 64.2	44.3 ± 54.5	0.3 ± 68.0	0.966	51.0 ± 74.6	73.6 ± 60.2	22.6 ± 76.1	0.001	55.2 ± 66.4	55.4 ± 45.9	0.1 ± 71.9	0.983	0.023
Oils·fats·sugars (%)	123.6 ± 71.5	108.3 ± 71.7	−15.3 ± 70.8	0.025	133.6 ± 70.8	102.1 ± 65.6	−31.5 ± 68.5	< 0.0001	124.0 ± 64.6	93.7 ± 51.7	−30.3 ± 68.3	< 0.0001	0.149
Overall[5)]	42 (38.2)	30 (27.3)	−12 (−10.9)	0.070[6)]	40 (32.5)	57 (46.3)	17 (13.8)	0.022[6)]	44 (38.9)	57 (50.4)	13 (11.5)	0.058[6)]	0.001[7)]

Mean ± SD or n (%).

CG, control group with no intervention; HG, the nutrition education group for promoting the Han-sik consumption; EG, the nutrition education group for balanced diet; CHO, carbohydrate.

[1)]*P* from paired t-test in each three groups.

[2)]*P* from repeated ANOVA, group-by-time.

[3)]The percentage of Han-sik items of all consumed dish items using Han-sik database.

[4)]Adherence score to the Korean Food Guidance System (KFGS) was defined as the percentage of consumed daily servings from each food groups to the recommended servings of the KFGS for each age group by sex.

[5)]The number of participants whose intakes of food group meet three or more in the KFGS: 80% ≤ the adherence score of 'grains' and 'meat, fish, eggs, beans' < 120%, 80% ≤ the adherence score of 'vegetables', 'fruits', and 'milk, dairy products', and the adherence score of 'oils, fats, sugars' < 120%.

[6)]*P* from McNemar test.

[7)]*P* from chi-square test at the end of the nutrition education program.

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Table 4. The changes in anthropometric and serum biochemistry among three groups after nutrition education

	CG (n = 110)				HG (n = 123)				EG (n = 113)				
	Before	After	Difference	$P^{1)}$	Before	After	Difference	$P^{1)}$	Before	After	Difference	$P^{1)}$	$P^{2)}$
Anthropometry													
Weight (kg)	72.4 ± 12.5	72.0 ± 12.5	−0.3 ± 2.6	0.204	72.7 ± 13.0	72.2 ± 12.7	−0.5 ± 2.1	0.007	69.7 ± 11.6	69.8 ± 11.5	0.1 ± 1.7	0.592	0.097
Body mass index (kg/m^2)	26.7 ± 3.6	26.6 ± 3.7	−0.2 ± 0.9	0.080	26.3 ± 2.9	26.1 ± 2.7	−0.2 ± 0.8	0.002	25.9 ± 2.8	25.9 ± 2.9	0.0 ± 0.7	0.929	0.084
Waist circumference (cm)	90.3 ± 9.0	89.1 ± 8.9	−1.3 ± 2.8	< 0.0001	89.4 ± 8.0	88.0 ± 7.7	−1.3 ± 2.2	< 0.0001	88.4 ± 7.1	86.8 ± 6.6	−1.6 ± 2.8	< 0.0001	0.632
Lipid profile													
HDL cholesterol (mg/dL)	48.5 ± 11.7	48.9 ± 11.1	0.4 ± 7.6	0.600	51.6 ± 12.1	51.3 ± 12.4	−0.2 ± 8.5	0.751	50.9 ± 10.9	49.2 ± 10.4	−1.7 ± 8.3	0.037	0.162
LDL cholesterol (mg/dL)	130.3 ± 33.7	131.7 ± 34.9	1.4 ± 22.5	0.515	134.0 ± 40.9	132.4 ± 32.1	−1.6 ± 35.7	0.618	126.1 ± 33.4	126.9 ± 34.2	0.7 ± 28.6	0.785	0.715
Triglycerides (mg/dL)	219.1 ± 144.0	204.9 ± 152.8	−14.2 ± 139.8	0.290	175.0 ± 95.0	153.4 ± 75.8	−21.6 ± 76.2	0.002	182.6 ± 123.7	183.3 ± 121.9	0.7 ± 103.1	0.943	0.281
Blood pressure													
Systolic blood pressure (mmHg)	133.2 ± 18.1	132.4 ± 17.9	−0.8 ± 14.6	0.553	132.9 ± 17.1	129.5 ± 17.2	−3.4 ± 15.3	0.016	135.8 ± 16.4	130.8 ± 16.0	−5.0 ± 14.3	< 0.0001	0.106
Diastolic blood pressure (mmHg)	89.0 ± 12.0	86.9 ± 11.8	−2.2 ± 11.1	0.044	86.6 ± 12.3	84.0 ± 11.7	−2.6 ± 10.9	0.009	89.1 ± 11.3	84.8 ± 12.2	−4.3 ± 10.4	< 0.0001	0.277
Glucose homeostasis													
Fasting blood glucose (mg/dL)	101.4 ± 17.1	100.8 ± 17.6	−0.6 ± 10.2	0.539	101.7 ± 18.6	100.7 ± 14.3	−1.0 ± 10.5	0.289	102.4 ± 14.9	103.3 ± 19.2	1.0 ± 9.9	0.296	0.297
Insulin (μU/mL)	8.3 ± 7.6	8.5 ± 6.5	0.3 ± 9.1	0.753	7.5 ± 4.1	8.3 ± 7.3	0.8 ± 6.7	0.170	7.5 ± 7.0	8.0 ± 5.5	0.6 ± 8.8	0.488	0.873
HbA1c (%)	5.7 ± 0.8	5.6 ± 0.7	0.0 ± 0.3	0.189	5.6 ± 0.7	5.6 ± 0.6	0.0 ± 0.3	0.404	5.7 ± 0.6	5.7 ± 0.6	0.0 ± 0.3	0.403	0.256

Mean ± SD.
CG, control group with no intervention; HG, the nutrition education group for promoting the Han-sik consumption; EG, the nutrition education group for balanced diet, HDL, high-density lipoprotein; LDL, low-density lipoprotein; HbA1c, hemoglobin A1c.
[1)]*P* from paired t-test in each three groups.
[2)]*P* from repeated ANOVA, group-by-time.

had only one risk factor were increased after the nutrition education from 0% at baseline to 26.8% in HG, 26.6% in EG, and 19.1% in CG (data not shown).

DISCUSSION

In this study, four sessions of tailored nutrition education for HG and EG for managing metabolic syndrome risk factors during the 16 weeks were applied to middle-aged Korean adults. The tailored nutrition education not only resulted in decreasing prevalence of metabolic syndrome risk factors by improving adherence to the KFGS but also fostered healthier dietary behaviors among participants. The nutrition education program was designed to address metabolic syndrome risk factors through personalized dietary interventions based on individual dietary assessments. The HG and EG received nutrition education through meetings face-to-face with trained dietitians according to the study protocol. The HG received educational materials on menu planning methods based on KFGS using Han-sik, while the EG used examples based on KFGS using a regular diet.

After receiving nutrition education, beneficial changes in dietary intake were observed. For instance, nutrition education resulted in decreased intakes of 'oils, fats, sugars.' Results from previous studies showed that 'oils, fats, sugars' intake was associated with metabolic syndrome risk factors [22,23]. Given that high dietary fat intake would be expected to affect insulin sensitivity and the risk of developing type 2 diabetes, it seems crucial to emphasize not only reducing total fat intake but also considering the types of fats consumed in dietary recommendations [22]. Additionally, excessive consumption of sugar and sugar-sweetened beverages may be related to elevated glucose levels [23]. The adherence to 'milk, dairy products' increased significantly in HG after nutrition education ($P < 0.001$). The Han-sik list used in nutrition education was selected from a Han-sik perception survey [18,19]. Although the response rate for milk as Han-sik was lower than 25.0%, the HG was encouraged to consume one serving of milk per day for a balanced diet due to previous studies that have reported beneficial effects of milk and dairy products for reducing metabolic syndrome risk [24-29]. Beneficial associations of adherence to the recommendations

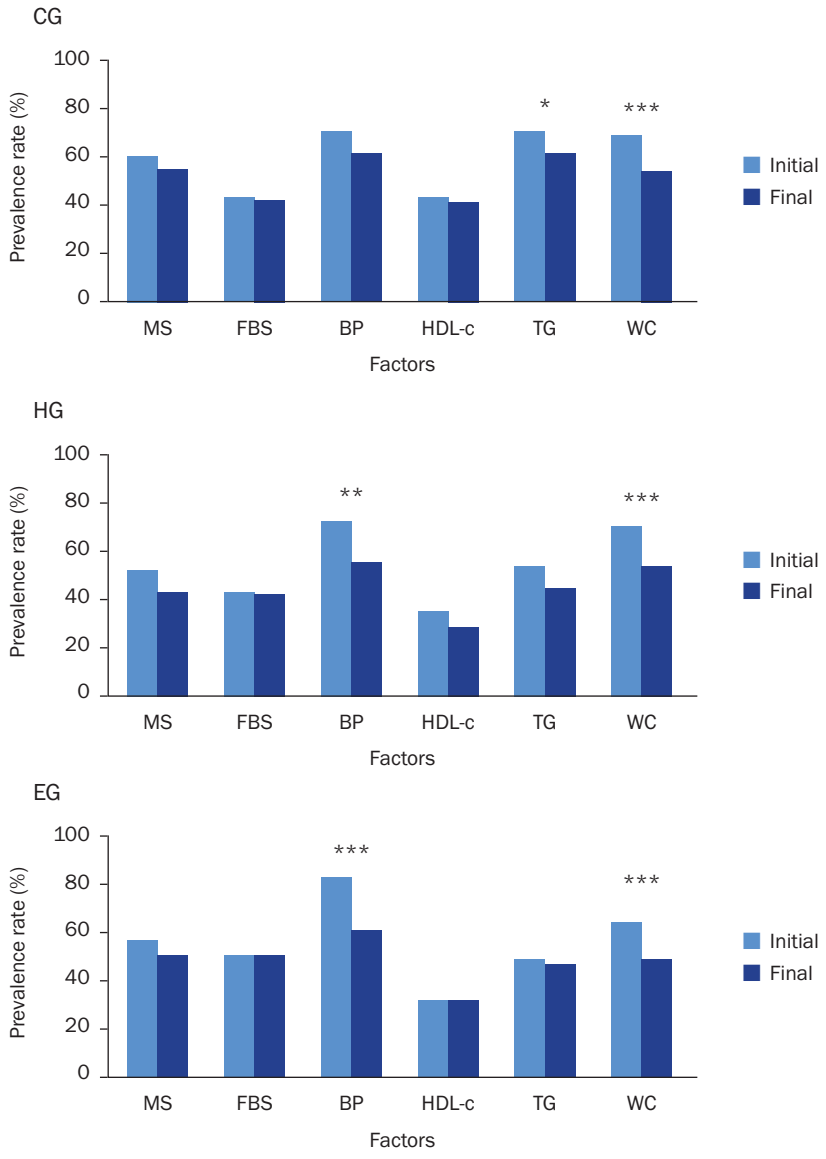

Fig. 3. The changes of prevalence of metabolic syndrome and its factors among three groups after nutrition education.
CG, control group with no intervention; HG, the nutrition education group for promoting the Han-sik consumption; EG, the nutrition education group for balanced diet; MS, metabolic syndrome; FBS, fasting blood glucose; BP, blood pressure; HDL-c, high-density lipoprotein-cholesterol; TG, triglyceride; WC, waist circumference.
MS, those who had three or more of the following five components; FBS (impaired blood glucose), fasting blood glucose ≥ 100 mg/dL; BP (elevated blood pressure) ≥ 130/85 mmHg; HDL-c (low HDL-cholesterol) < 50 mg/dL for women < 40 mg/dL for men; TG (hypertriglyceridemia) ≥ 150 mg/dL; WC (abdominal obesity) ≥ 85 cm for women ≥ 90 cm for men.
*P < 0.05, **P < 0.01, ***P < 0.001.

of 'milk, dairy products' with metabolic syndrome risk were observed in 596 Korean adults aged 30–59 years in a previous study [21].

At the end of the study, beneficial changes in anthropometric and serum biochemistry measurements were observed in both HG and EG. Body weight, body mass index, waist circumference, triglycerides, systolic and diastolic blood pressure were observed in HG. In EG, waist circumference, systolic and diastolic blood pressure decreased after nutrition education. The changes

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in metabolic syndrome risk factors were similar in both the HG and EG groups. This similarity may likely be attributed to the comparable nutrition education both groups received, aimed at preventing or managing metabolic syndrome risk factors. Specifically, the HG group benefited from increased consumption of Han-sik, while the EG group incorporated menu planning methods using a regular diet. Regarding Han-sik consumption, there was no significant increase in the Han-sik consumption rate following the nutrition education. However, it is noteworthy that the Han-sik consumption rate among the middle-aged Korean adults participating in this study remained high, comprising approximately 80% of their daily intake of dishes. The control group also showed some improvement in abdominal obesity and hypertriglyceridemia at the end of the study. Because all participants in this study might be motivated sufficiently to get a health examination by themselves three times.

A previous study conducted in Korea found that 10 women aged 50 to 60 years were divided into Han-sik and westernized Korean groups for two weeks of dietary intervention, and the Han-sik group downregulated eight plasma miRs associated with type 1 and type 2 diabetes [30]. However, this study differs from the previous study in that participants were not admitted to the hospital, engaged in their daily life, and provided nutritional counseling.

In a study conducted in foreign countries that did not consume Han-sik as the main meals, when providing Han-sik meals in 70 overweight or obese persons in Australia during 12 weeks, a significant decrease in waist circumference and fasting glucose was observed in the intervention group [31]. Another study using a randomized trial design assessed the effect of Korean diet, the 2010 Dietary Guidelines for Americans (DGA), and a typical American diet on caridometabolic risk factors reported that significant decrease of total cholesterol and LDL cholesterol in Korean diet and 2010 DGA groups among 31 overweight or obese adults in US [11].

Our study has several limitations. First, our nutrition education was only for four months, which may not be long enough to determine the intervention's effectiveness. When comparing the intervention group (HG and EG) and the control group, the differences in changes in dietary intakes and metabolic syndrome-related factors were smaller than those of the self-assessed dietary behavior changes. Secondly, this study focused on macronutrients and food group intakes in the nutrition education, which limited our ability to evaluate the effects of the nutrition education on the intakes of micronutrients such as vitamin D and folate. Third, this study was conducted using a selected sample living in a metropolitan area, and thus, the results may not be generalized to the Korean population as a whole. Nevertheless, the tailored nutrition education program for middle aged Korean adults showed beneficial effects on improving dietary behaviors and metabolic risk factors. Further studies are needed to assess the long-term effects of nutrition education programs on metabolic syndrome risks. Nutrition educations for various age groups are also required.

CONCLUSIONS

This study found that tailored nutrition education programs for middle-aged Korean adults showed beneficial effects on improving dietary behaviors and metabolic syndrome risk factors. Further studies are needed to assess the long-term effects of nutrition education programs on metabolic syndrome risks.

CONFLICT OF INTEREST

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

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DATA AVAILABILITY

Data sharing is not applicable.

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Research Article

The relationship between smartphone usage and eating behavior for elementary school students in Gangneung, South Korea: cross-sectional study

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Objectives: This study investigates the relationship between smartphone usage and eating behavior among elementary school students.
Methods: This survey was conducted on 4th- to 6th-grade students at elementary schools in Gangneung from September 6th to September 15th, 2023. Of the 129 copies of the questionnaire that were distributed to 5 schools, 66 copies (51.2%) were returned.
Results: Compared to the nationwide statistics, the smartphone ownership rate of elementary school students in Gangneung was lower, but the rate of smartphone overdependence was higher. Smartphone dependence was 21.12 points for study subjects and 26.00 points for the overdependence risk group (Org). Compared to national statistics, the self-control failure factor was higher, so study participants in Gangneung City are thought to have great difficulty with self-control. The Org's weekend smartphone use time of 7.54 hours was significantly more than the general user group (Gug)'s 4.06 hours. The number of days in which the Org consumed late-night snacks per week was 2.92 days, and the Gug had 2.15 days, but the difference was not significant. Eating fast food showed a positive correlation with eating sweet food, eating fatty food, and eating heavily seasoned food. It was found that frequent consumption of fast food is closely correlated with unhealthy eating behavior. Weekend smartphone use time showed a significant positive correlation with smartphone dependence and the number of days late-night snacks consumed per week.
Conclusions: Study participants in Gangneung are more dependent on smartphones than national statistics. Smartphone dependence had a negative correlation with healthy eating behavior and a correlation with average unhealthy eating behavior.

Keywords: smartphone; eating behavior; schools

INTRODUCTION

In 2022, the smartphone ownership rate of elementary school students nationwide was 93.9%, up from 24.1% in 2012 [1]. The smartphone is an intelligent terminal that adds several computer support functions to the mobile phone and is characterized by the user's ability to install an application desired by the user [2]. Because smartphones can be used immediately without time and space con-

straints, smartphones are preferred over the Internet [3]. Smartphone addiction causes maladjustment in school, home, and daily life. The maladjustment occurs because they are too immersed in the use of smartphones and cannot control themselves [4]. Overdependence has replaced addiction, a word that can give negative perceptions [5].

According to National Information Society Agency (NIA), overdependence on smartphones is a state in which the prominence of smartphones increases, and the self-control power decreases due to excessive use of smartphones, resulting in serious consequences. Among the three factors that cause dependence on smartphones, the first self-control failure is the user's poor ability to self-regulate smartphone use compared to their personal goals. Second, salience is when smartphone use becomes the most critical activity in an individual's life above anything else. Third, serious consequences are defined by continued smartphone use despite various negative consequences to the user because of smartphone use [6].

According to a survey conducted by the Ministry of Gender Equality and Family in 2021, 129,543, or 10.4% of 1.25 million adolescents, were overdependent on smartphones. The overdependence on the Internet and smartphones also increased in 2020 for both boys and girls in the fourth grade of elementary school [7]. In a 2022 survey by NIA, middle school students were the most at-risk group for smartphone overdependence: kindergarten (24.7%), elementary school students (33.6%), middle school students (44.5%), high school students (40.0%), and college students (34.1%) [6]. The excessive use and dependence of these smart devices has become a new social problem in the health and psychology of infants and adolescents who find it difficult to self-regulate [8].

In 2014, the access to dietary information through smartphones in high school students in Incheon increased compared to the past when using computers [9]. In 2018, middle school students in Seoul mainly used social network service and smartphone as mass media to obtain dietary nutrition information [10]. According to previous studies on the influence of the Internet and various media on eating habits of 4th- to 6th-grade elementary school students, the number of snacks consumed, preference for processed food snacks, and frequency of consumption were high in groups with more than two hours of television viewing in Gyeongsangnam-do in 2013 [11]. In 2014, elementary school students in Ansan showed a negative correlation between weekend smartphone usage time and good eating habits scores. As smartphone usage time increased, they tended to consume excessive snacks [12]. In 2016, the group who used smartphones for more than two hours in Cheongju had a higher frequency of eating ice cream, snacks, and soda compared to the group who used smartphones for less than two hours; furthermore, those who used a smartphone for less than two hours had generally desirable eating behavior [13].

In 2011, among middle school students in Gyeonggi-do, the Internet-using group reported that eating speed increased and snacks increased, and the higher the degree of Internet use, the more negatively affected dietary attitudes [14]. In 2014, among high school students in Incheon, male students had increasingly poor eating habits, reflected by lower scores on eating behavior, as the degree of addiction to smartphones was higher [9]. In 2018, high school students in the Gyeonggi area and Seoul had negative effects on their eating habits if they watched food content [15]. In 2022, young people in their 20s and 30s across the country primarily viewed social media on their smartphones, and the average daily social media usage time was longer in groups with high levels of food content use. When the level of food content use was high, some poor eating habits were higher [16]. These studies demonstrate that excessive use of the Internet or smartphones negatively affects snack and eating habits.

According to the Ministry of Education's elementary school student health test conducted in 2022, the rate of fast-food consumption more than once a week increased from 68.6% in 2019 to 77.8%, and the rate of beverage consumption more than once a week also increased from 80.9% in 2019 to 85.8%, increasing negative eating habits [17], indicating the need for improvement in dietary behavior [18]. The prevalence of obesity among elementary school students has also increased [17]. In a 2020 study of elementary school students in Busan, the overweight and obese groups had a higher intake of snacks with higher sugar content [19]. There-

fore, the eating habits of elementary school students in Korea are deteriorating, and the prevalence of obesity is also increasing.

An increase in the body mass index (BMI) in childhood can be an important predictor of obesity in adolescence and adulthood [20], hence it is necessary to form eating habits properly at a young age [21]. In middle and high school students, the higher the score of obesity-related eating attitude and the shorter the eating time, the higher the BMI [22]. The ratio of overweight and obesity combined (OOC) middle school students in Gangwon-do was 42.1% (male students 43.1%, female students 40.9%) [23], which was higher than the national rate of 32.8% (male students 37.3%, female students 27.6%), and the proportion of OOC female middle school students in Gangwon-do was especially high. However, the proportion of OOC elementary school students is 27.0% in Gangwon-do, which is lower than the national rate of 29.8% [17,23], so elementary school students in Gangwon-do must form proper eating habits in the process of growing into middle school students.

Therefore, we investigated whether the use of smartphones is related to eating behavior for 4th- to 6th-graders of elementary schools in Gangneung via survey.

METHODS

Ethics statement

The informed written consent was obtained from each participant. The study was approved by the Institutional Review Board of Gangneung-Wonju National University (approval number: GWNUIRB-2023-21).

1. Study subject and duration

In the Gangneung Office of Education data on April 1, 2023, the number of elementary school students in the 4th- to 6th grades in Gangneung was 4,832. As a result of calculating the number of study subjects with a power of 0.8 and a significance level of 0.05 using G*Power, the minimum number of samples was 84, and considering the 20% dropout rate, it was 100. 66 copies (51.2%) were returned after distributing 129 copies of the questionnaire for 10 days, from September 6th to September 15th, 2023, for students from the 4th- to 6th grades of five elementary schools in Gangneung.

2. Study content and methods

The questionnaire used in this study included the questions related to general characteristics, eating behaviors, snacks [11-13,24,25] and smartphone dependence [6] and it was revised and supplemented to suit elementary school students. The 'Youth, Adult, and Elderly (Self-report) Scale' among the 'Smartphone Overdependence Integrated Scale' developed by NIA [6] consists of 11 questions, consisting of 3 questions for self-control failure, 3 for salience, and 4 for serious consequences. It was measured on a Likert 4-point scale (strongly disagree: 1 point, disagree: 2 points, agree: 3 points, strongly agree: 4 points). Subjects with a score of 31 or more were divided into the high-risk group, subjects with scores of 23 to 30 were divided into the potential risk group, and subjects with a score of less than 23 were divided into the general user group (Gug) [6]. The questionnaire was completed by supplementing it after conducting a preliminary survey of elementary school students.

3. Statistical analysis

For statistical processing, IBM SPSS Statistics 28 (IBM Corp.) was used, and the significance level was based on $P < 0.05$. When the group size was small, with less than 30 people, the Shapiro-Wilk test was performed, and statistical analysis of the nonparametric method was performed because it was not a normal distribution. In the case of questions scored on a continuous variable and a scale, the mean and standard deviation were obtained, and the difference between the two groups was verified by the Mann-Whitney *U* test. For categorical variables, after the frequency and percentage were obtained, the difference in distribution was verified by Fisher's exact test. Pearson correlation analysis was performed to find out the relationship between eating behavior questions and smartphone-related variables.

RESULTS

1. Smartphone ownership and dependence

In Table 1, the smartphone ownership rate was 86.4% (57 students) of the study subjects, 84.6% (33 students) of male students, and 88.9% (24 students) of female students, and there was found to have no significant dif-

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Table 1. General characteristics of subjects according to smartphone ownership and smartphone dependence

Variable	Smartphone ownership				Smartphone dependence			
	Total	Yes	No	*P*-value[1)]	Total	Org	Gug	*P*-value[1)]
Total	66 (100)	57 (86.4)	9 (13.6)	-	57 (100)	24 (42.1)	33 (57.9)	-
Sex				0.727				0.596
Male	39 (100)	33 (84.6)	6 (15.4)		33 (100)	15 (45.5)	18 (54.5)	
Female	27 (100)	24 (88.9)	3 (11.1)		24 (100)	9 (37.5)	15 (62.5)	
Academic year				0.018				0.878
4th-grade	21 (100)	15 (71.4)	6 (28.6)		15 (100)	6 (40.0)	9 (60.0)	
5th-grade	14 (100)	12 (85.7)	2 (14.3)		12 (100)	6 (50.0)	6 (50.0)	
6th-grade	31 (100)	30 (96.8)	1 (3.2)		30 (100)	12 (40.0)	18 (60.0)	

n (%).
Org, overdependence risk group; Gug, general user group.
[1)]*P*-value was determined by Fisher's exact test.

ference according to gender ($P = 0.727$). The percentage of possession by grade was 71.4% (15 students) in the fourth grade, 85.7% (12 students) in the fifth grade, and 96.8% (30 students) in the sixth grade, which increased as the grade increased ($P = 0.018$). Among the subjects of the study, the high-risk group included one male and one female in the sixth grade, so the high-risk group and the potential risk group were combined and classified into the overdependence risk group (Org). The proportion of students in the Org was 42.1% (24 students); 45.5% male, and 37.5% female among the subjects of the study, and there was no significant difference in dependence on smartphones according to gender ($P = 0.596$). There was no significant difference in the proportion of the Org by grade ($P = 0.878$).

2. Comparison of factors of dependence on smartphone

In Table 2, the total score of smartphone dependence of the study subjects was 21.12 points. This was less than 23 points, the standard for classification of the general group. Among the factors of dependence on smartphones, the self-control failure factor was the highest at 2.49 points, the salience factor was 2.05 points, and the serious consequences factor was 1.87 points. The total score of smartphone dependence of the Org (26.00 points) was higher than that of the Gug, 17.58 points ($P < 0.001$). In Org, the self-control failure factor was the highest at 3.03 points, the salience factor was 2.67 points, and the serious consequences factor was 2.23 points, which were higher than the Gug ($P < 0.001$). The factor of self-control failure was the highest in both the Org and the Gug. Among the items on the smartphone dependence scale, the item with the highest score was that the Org always failed to reduce the smartphone use time, and for the Gug, it was difficult to limit to appropriate smartphone use time.

3. Smartphone usage time and eating behavior

In Table 3, the weekend smartphone use time of the study subjects was about 5.53 hours, and the 7.54 hours of the Org were significantly more than the 4.06 hours of the Gug ($P = 0.014$). The Gug used the most 1–4 hours at 69.7%, while the Org used the most 5–10 hours ($P = 0.043$).

In Table 4, the average healthy eating behavior of the study subjects was 2.35 points, and the average unhealthy eating behavior was 1.89 points. At 2.26 points, the average healthy eating behavior of the Org was lower than that of the Gug (2.42 points), but there was no significant difference. Among the questions for the healthy eating behavior survey, the Org regularly eats three meals a day (2.38 points), eats a variety of foods (2.21 points), and eats fruits and vegetables (2.29 points) were lower than those of the Gug, but there was no significant difference.

The average unhealthy eating behavior of the Org (2.02 points) was higher than that of the Gug (1.80 points), but there was no significant difference. In all four of the survey questions on unhealthy eating behavior, the Org was higher than that of the Gug, but the question that showed the significantly high in the Org was eating sweet food (2.33 points) ($P = 0.036$). The study subjects

Table 2. Analysis of smartphone dependence factors according to smartphone dependence

Factor	Total (n = 57)	Org (n = 24)	Gug (n = 33)	*P*-value[1)]
Self-control failure	2.49 ± 0.78	3.03 ± 0.49	2.10 ± 0.72	< 0.001
I always fail to reduce my smartphone use time	2.53 ± 0.93	3.13 ± 0.68	2.09 ± 0.84	< 0.001
I find it difficult to control my smartphone use time	2.49 ± 0.89	3.04 ± 0.75	2.09 ± 0.77	< 0.001
I find it difficult to limit myself to appropriate smartphone use time	2.46 ± 0.87	2.92 ± 0.78	2.12 ± 0.78	< 0.001
Salience	2.05 ± 0.75	2.67 ± 0.66	1.61 ± 0.43	< 0.001
It is hard to focus on other things if I have a smartphone next to you	2.14 ± 0.88	2.75 ± 0.85	1.70 ± 0.59	< 0.001
I am often thinking about my smartphone	2.02 ± 0.83	2.54 ± 0.88	1.64 ± 0.55	< 0.001
I strongly desire to use smartphone	2.00 ± 0.89	2.71 ± 0.75	1.48 ± 0.57	< 0.001
Serious consequences	1.87 ± 0.55	2.23 ± 0.48	1.61 ± 0.44	< 0.001
I have problems with my health because of smartphone use	1.75 ± 0.79	2.17 ± 0.82	1.45 ± 0.62	< 0.001
My smartphone use negatively affects my relationship with my family	1.95 ± 0.81	2.21 ± 0.83	1.76 ± 0.75	0.047
My smartphone use has led to severe conflicts with friends	1.84 ± 0.90	2.04 ± 0.81	1.70 ± 0.95	0.055
My smartphone use negatively affects my studying	1.95 ± 0.85	2.50 ± 0.83	1.55 ± 0.62	< 0.001
Total score	21.12 ± 5.38	26.00 ± 2.99	17.58 ± 3.66	< 0.001

Mean ± SD.
The responses were based on a 4-point Likert scale: 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree.
Org, overdependence risk group; Gug, general user group.
[1)]*P*-value was determined by Mann-Whitney *U* test.

Table 3. Weekend smartphone use time for subjects

Variable	Total (n = 57)	Org (n = 24)	Gug (n = 33)	*P*-value
Smartphone use time (hour)				0.043[1)]
1–4	32 (56.1)	9 (37.5)	23 (69.7)	
5–10	19 (33.3)	11 (45.8)	8 (24.2)	
11–34	6 (10.5)	4 (16.7)	2 (6.1)	
Average use time (hour)	5.53 ± 5.55	7.54 ± 7.31	4.06 ± 3.18	0.014[2)]

n (%) or Mean ± SD.
Org, overdependence risk group; Gug, general user group.
[1)]*P*-value was determined by Fisher's exact test.
[2)]*P*-value was determined by Mann-Whitney *U* test.

consumed snacks for more than five days, about 5.35 days per week, and the Org was 5.75 days, compared to the Gug, which consumed stacks 5.06 days out of the week. There was no significant difference according to smartphone dependence ($P = 0.190$). The study subjects consumed about 2.47 days of late-night snacks a week; the Org was 2.92 days, and the Gug was 2.15 days, but the difference was not significant ($P = 0.220$).

4. Correlation between eating behavior and smartphone-related variables

Table 5 shows the results of the correlation analysis between eating behavior and smartphone-related variables. Eating fruits and vegetables showed a positive correlation with eating a variety of foods (r = 0.372, $P < 0.01$). Eating fast food showed positive correlation with eating sweet food (r = 0.415, $P < 0.01$), eating fatty food (r = 0.708, $P < 0.01$), eating heavily seasoned food (r = 0.314, $P < 0.05$). Eating fatty foods showed a positive correlation with eating sweet foods (r = 0.439, $P < 0.01$)

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Table 4. Mean value of eating behavior factors according to smartphone dependence

Variable	Total (n = 57)	Org (n = 24)	Gug (n = 33)	*P*-value
Healthy eating behavior				
I regularly eat 3 meals	2.54 ± 0.60	2.38 ± 0.71	2.67 ± 0.48	0.122
I eat a variety of foods	2.42 ± 0.63	2.21 ± 0.72	2.58 ± 0.50	0.052
I eat milk or dairy foods (cheese or yogurt)	2.11 ± 0.75	2.17 ± 0.82	2.06 ± 0.70	0.555
I eat fruits and vegetables	2.33 ± 0.69	2.29 ± 0.75	2.36 ± 0.65	0.790
Average	2.35 ± 0.42	2.26 ± 0.50	2.42 ± 0.36	0.369
Unhealthy eating behavior				
I eat fast-food (hamburgers, pizza, fried chicken)	1.60 ± 0.65	1.67 ± 0.70	1.55 ± 0.62	0.547
I eat sweet food (ice cream, soda, chocolate)	2.14 ± 0.61	2.33 ± 0.64	2.00 ± 0.56	0.036
I eat fatty foods (fried foods or pork belly)	1.70 ± 0.63	1.79 ± 0.66	1.64 ± 0.60	0.380
I eat heavily seasoned food (sweet or salty or spicy food)	2.12 ± 0.68	2.29 ± 0.69	2.00 ± 0.66	0.105
Average	1.89 ± 0.48	2.02 ± 0.51	1.80 ± 0.44	0.098
No. of days of snacks consumed per week	5.35 ± 1.80	5.75 ± 1.99	5.06 ± 1.62	0.190
No. of days of late-night snacks consumed per week	2.47 ± 1.81	2.92 ± 2.17	2.15 ± 1.46	0.220

Mean ± SD.
Scores represent as follows, 1 = 0–1 times per week, 2 = 2–4 times per week, 3 = more than 5 times per week.
Org, overdependence risk group; Gug, general user group.

and eating heavily seasoned foods (r = 0.296, $P < 0.05$).

When looking at the correlation between smartphone dependence and eating behavior factors, smartphone dependence showed a negative correlation with eating three meals regularly (r = –0.276, $P < 0.05$), eating a variety of foods (r = –0.398, $P < 0.01$), the average of healthy eating behavior (r = –0.350, $P < 0.01$). On the other hand, smartphone dependence showed a positive correlation with the average of unhealthy eating behavior (r = 0.310, $P < 0.05$), eating sweet food (r = 0.272, $P < 0.05$), and eating heavily seasoned food (r = 0.341, $P < 0.01$).

Weekend smartphone usage time showed a negative correlation with eating three meals regularly (r = –0.270, $P < 0.05$). Also, it showed a negative correlation with other healthy eating behavior questions, but it was not significant. Weekend smartphone usage time showed a positive correlation with eating fast food (r = 0.307, $P < 0.05$), eating fatty foods (r = 0.329, $P < 0.05$), eating heavily seasoned food (r = 0.397, $P < 0.01$), and the average of unhealthy eating behavior (r = 0.419, $P < 0.01$).

Weekend smartphone usage time showed a positive correlation with smartphone dependence (r = 0.275, $P < 0.05$) and the number of late-night snacks consumed per week (r = 0.333, $P < 0.05$), but no significant correlation with the number of snacks consumed per week.

The number of snacks consumed per week was not significantly correlated with the eating behavior variables, but the number of late-night snacks consumed per week showed a significant positive correlation with all unhealthy eating behavior variables.

DISCUSSION

This study investigated whether the use of smartphones is related to eating behavior in the 4th- to 6th-grade elementary students in Gangneung. The 86.4% smartphone ownership rate of the study subjects was lower than the 89.3% ownership rate for people aged 3–19 living in small and medium-sized cities in 2022 [6] and was also lower than the 93.9% of elementary school students nationwide in 2022 [1]. The smartphone ownership rates were 84.6% of the boys and 88.9% of the girls, and there was no significant difference according to gender, and the higher the grade, the higher the smartphone ownership rate. The proportion of students in the Org was 42.1% (24 students), which is higher than the 33.6% of elementary school students nationwide in 2022 [6]. In previous studies of elementary school students, the proportion of the risk group of overdependence continued to increase to 10.1% in Ansan in 2014 [12], 2.7% in Cheongju in 2016 [13], and 18.2% in Siheung and Ansan in 2017 [26]. Despite the lower smartphone ownership

Table 5. Correlation coefficient (*r*) between eating behavior and smartphone-related variables (n = 57)

Var	Reg	Vari	Milk	Fru	H-eat	Fast	Sweet	Fat	Spi	U-eat	Spd	Time	Snack	Nsnack
Reg	1	0.140	0.109	0.201	0.538**	−0.068	0.032	0.059	−0.122	−0.037	−0.276*	−0.270*	−0.035	−0.192
Vari		1	0.247	0.372**	0.682**	−0.058	−0.158	−0.038	0.044	−0.067	−0.398**	−0.122	−0.197	−0.179
Milk			1	0.138	0.630**	0.125	0.123	0.183	−0.096	0.108	−0.119	−0.134	−0.121	−0.037
Fru				1	0.679**	−0.053	−0.198	−0.069	0.177	0.005	−0.127	0.121	−0.096	−0.057
H-eat					1	−0.012	−0.073	0.116	0.003	0.012	−0.350**	−0.151	−0.153	−0.174
Fast						1	0.415**	0.708**	0.314*	0.818**	0.193	0.307*	0.016	0.377**
Sweet							1	0.439**	0.258	0.697**	0.272*	0.199	0.198	0.278*
Fat								1	0.296*	0.815**	0.107	0.329*	0.142	0.410**
Spi									1	0.645**	0.341**	0.397**	−0.123	0.370**
U-eat										1	0.310*	0.419**	0.072	0.484**
Spd											1	0.275*	0.237	0.151
Time												1	0.155	0.333*
Snack													1	0.381**
Nsnack														1

Pearson's correlation coefficient was used.
Var, variable; Reg, I regularly eat 3 meals; Vari, I eat a variety of foods; Milk, I eat milk or dairy foods (cheese or yogurt); Fru, I eat fruits and vegetables; H-eat, average healthy eating behavior; Fast, I eat fast foods (hamburgers; pizza; fried chicken); Sweet, I eat sweet food (ice cream; soda; chocolate); Fat, I eat fatty foods (fried foods or pork belly); Spi, I eat heavily seasoned food (sweet or salty or spicy food); U-eat, average unhealthy eating behavior; Spd, smartphone dependence; Time, weekend smartphone use time; Snack, number of days of snacks consumed per week; Nsnack, number of days of late-night snack consumed per week.
*$P < 0.05$, **$P < 0.01$.

rates for elementary school students in Gangenung, the proportion of the Org was higher.

In terms of smartphone dependence, 45.5% of boys and 37.5% of girls were at risk of overdependence, and there was no significant difference according to gender [12]. In the 2018 survey, male students in elementary school were more dependent on smartphones than female students [27]. In the 2022 survey, the rate of dependence on smartphones for kids between the ages of 10 and 19 was higher in girls than boys [6]. As such, previous studies showed differences in the rate of dependence on smartphones according to gender, but this study does not demonstrate a significant difference due to the small number of study subjects. Looking at the dependence on smartphones according to grade, the difference was not significant in the number of students in the Org.

Compared to the control failure (2.88 points), salience (2.75 points), and serious consequences (2.75 points) of the 2022 survey's the risk group of overdependence on elementary school students [6], the control failure factor (3.03 points) of the Org was higher and the salience factor (2.67 points) and serious consequences (2.23 points) were lower. So the Org in Gangneung are considered to have a great difficulty in the self-control failure. The study subjects' weekend smartphone use time was about 5.53 hours, the Org was 7.54 hours, and the Gug was 4.06 hours, which was more than the 3.86 hours for 4th-grade elementary school students nationwide reported in 2018 [27]. The use time of the Org was significantly higher than that of the Gug, and the Gug used 1–4 hours the most at 69.7%, while the Org used more than 5–10 hours the most at 45.8%.

The average healthy eating behavior of the study subjects was 2.35 points, and the average unhealthy eating behavior was 1.89 points. The average healthy eating behavior of the Org (2.26 points) was lower than the Gug (2.42 points), but the difference was not significant. The average unhealthy eating behavior (2.02 points) of the Org was higher than that (1.80 points) of the Gug, but the difference was not significant.

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According to previous studies on the eating habits of elementary school students, a 2006 study [28] showed that the longer the computer use time, the lower the eating habits score. In the 2014 study [12], the smartphone addiction group had lower scores on good eating habits than the general group and higher scores on bad eating habits. In the 2017 study [26], the food behavior score of the risk group of overdependence was lower than that of the general group. As such, in previous studies, the eating habits of the risk group of overdependence were not more desirable than those of the general group. The Org in this study tended to have fewer healthy eating behaviors and more unhealthy eating behaviors than the Gug, but the reason why there was no significant difference is considered to be due to the small number of study subjects. In this study, eating sweet food of the Org (2.33 points) was higher than that of the Gug (2.00 points). In the 2016 study of 5th- to 6th-grade elementary school students, the group who used the smartphone for more than 2 hours had a higher frequency of eating ice cream, snacks, and soda than the group who used it for less than 2 hours [13]. In a 2020 study of 4th- to 6th-grade elementary school students in Busan, the overweight and obese groups had a higher intake of snacks with higher sugar content than the normal weight group [19], so it is considered necessary to control the intake of snacks with high sugar content in the risk group of overdependence.

The number of days of snack consumed per week of the study subjects was about 5.35 days, the Org was 5.75 days, and the Gug was 5.06 days, and there was no significant difference, as they all were eating snacks more than five days of the week. In 2021, the percentage of elementary school students in Gyeonggi-do who ate snacks more than twice a day was the highest at 37.6% [25]. The number of days of late-night snacks consumed per week of the study subjects was 2.47 days, the Org was 2.92 days, and the Gug consumed late-night snacks 2.15 days, and there was no significant difference. In the 2021 Gyeonggi-do study of 4th- to 6th-grade elementary school students, 55.9% of them rarely eat late-night snacks during the week and 28.3% of them eat once or twice a week [25], so it is considered that elementary school students in Gangneung eat late-night snacks more often.

As a result of analyzing the subject's eating behavior, consumption of fast food had a positive correlation with eating fatty foods, sweet foods, and heavily seasoned foods, indicating that frequently eating fast food is closely related to unhealthy eating behavior. The number of days of snack consumed per week was not significantly related to the eating behavior variable, but in Kim & Kim's study [12], the number of snacks consumed was positively correlated with the bad eating habits score, resulting in different results. The number of days of late-night snacks consumed per week showed a significant positive correlation with all variables of unhealthy eating behavior, so it is considered that the number of days of late-night snacks consumed per week should be treated as an important factor when investigating eating behavior.

Smartphone dependence showed a negative correlation with the average healthy eating behaviors, eating three regular meals, and eating a variety of foods, as well as showed a positive correlation with the average unhealthy eating behavior, eating sweet food, and eating heavily seasoned food.

Weekend smartphone usage time showed a significant negative correlation with eating three regular meals, and a negative correlation with other healthy eating behavior questions was found but was not significant. In Kim & Kim's study [12], weekend smartphone usage time and good eating habits scores showed a negative correlation. And the group using smartphones for less than 2 hours had more desirable eating behavior than the group who used phones for more than 2 hours [13]. Weekend smartphone usage time was positively correlated with the average unhealthy eating behavior, eating fatty food, heavily seasoned food, and eating healthy. However, in Kim & Kim's study [12], weekend smartphone usage time was not significantly correlated with bad eating habits.

Weekend smartphone usage time showed a positive correlation with smartphone dependence and the number of days of late-night snacks consumed per week, but in both this study and Kim & Kim's study [12], weekend smartphone usage time was not significantly correlated with the number of days of snack consumption. This study recruited survey subjects through the convenience sampling method, and the number of respon-

dents is small, so it is difficult to generalize.

CONCLUSIONS

As a result of investigating the relationship between smartphone usage in elementary school students in Gangneung region, the percentage of smartphone ownership was lower than the nationwide statistics, but the rate of smartphone overdependence was higher. Smartphone dependence had a negative correlation with healthy eating behavior and a positive correlation with unhealthy eating behavior.

CONFLICT OF INTEREST

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

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DATA AVAILABILITY

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

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Research Article

북한 주민의 영양실태 및 남한 성인의 관련 인식

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Nutritional status of North Koreans and related perceptions among South Korean adults

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Objectives: North Koreans have been facing chronic food shortages and malnutrition. This study examined the nutritional status of North Koreans and the perceptions of South Korean adults regarding their nutritional status.

Methods: The nutritional status was examined using nutritional indicators for the general population, children, and reproductive-aged women in North Korea. An online survey was conducted among 1,000 South Korean adults aged 19–69 years to investigate their perceptions regarding the nutritional status of North Koreans.

Results: Although the nutritional status of children in North Korea has consistently improved, significant progress in the general population and reproductive-aged women in the country remains elusive. The prevalence of malnutrition among North Korean children has decreased to a level that is not considered severe based on international standards, although it shows a substantial difference from that among South Korean children. The prevalence of undernourishment and food insecurity in North Korea remains over 40%. South Korean adults perceive the nutritional status of North Koreans as being more severe than it is in reality. Notably, a significant inconsistency exists between the perceived and actual nutritional status of North Korean children, with over 95% of South Korean adults perceiving North Korean children's malnutrition as being more severe than it actually is. Moreover, South Korean adults in their 20s to 40s tended to perceive the nutritional status of North Koreans as being more severe than those in their 50s to 60s did.

Conclusions: The nutritional status of North Koreans is a matter of concern. The disparity between South Koreans' perceptions of the nutritional status of North Koreans and the actual status highlights the need for accurate information dissemination to effectively address malnutrition in North Korea. These efforts could be instrumental in enhancing public awareness and fostering social consensus on food aid and nutritional support programs for North Korea.

Keywords: Democratic People's Republic of Korea; Republic of Korea; malnutrition; nutritional indicators; surveys and questionnaires

INTRODUCTION

오랜 기간 지속된 북한의 식량부족 문제는 주민들의 만성적인 영양불량 상태로 이어졌다. 1990년대 중반 이후 북한이 겪은 대규모의 식량난은 '고난의 행군' [1]으로 널리 알려져 있으며, 오늘날에도 북한은 식량부족과 이에 따른 영양불량 문제에서 자유롭지 못하다. Food and Agriculture Organization (FAO)에 따르면 2020–2022년 평균, 북한 인구 중 45.5%가 에너지섭취부족 상태, 즉 활력 있고 건강한 삶을 위해 필요한 에너지보다 적은 양의 에너지를 섭취하고 있는 상태인 것으로 추정된다[2]. 북한의 2023년 세계기아지수(Global Hunger Index, GHI)는 27.8점으로 산출 대상 125개국 중 20번째로 높은 심각한 수준으로 발표되었다[3].

그러나 정보의 한계로 인해 북한 주민의 영양실태를 정확히 파악하는 것은 쉽지 않은 상황이다. 북한 주민의 영양실태에 대한 정보는 제한적이기 때문에 연구자들은 주로 FAO, World Food Programme (WFP), World Health Organization (WHO), United Nations International Children's Emergency Fund (UNICEF)와 같은 United Nations (UN)의 산하기구 및 전문기구로부터 발간되는 보고서와 통계 등에 의존하고 있다[2-6].

영양정책의 수립을 위해서는 정책 대상의 영양실태에 대한 파악이 선행되어야 한다. 따라서 신뢰성과 시의성을 갖춘 영양실태 지표를 이용하여 북한 주민의 영양실태를 파악하는 것은 식량지원정책을 포함한 대북 영양정책의 수립을 위해 필수적이다. 이에 지표 정보를 바탕으로 북한 주민의 영양실태를 파악하기 위한 노력과 논의가 꾸준히 이루어져 왔다. 그러나 그동안의 연구들은 영양실태의 현황만을 단편적으로 다루었다는 한계가 있다[7-9]. 따라서 장기적인 영양부족은 전 생애주기 또는 세대에 걸쳐 영향을 미침을 고려할 때, 시간의 흐름에 따른 영양실태의 변화 또한 파악할 필요가 있다.

우리나라에서 대북 및 통일정책은 국민의 이해와 지지가 특히 중요한 분야이지만[10], 대북 식량지원에 대한 사회적 합의는 충분히 이루어지지 않은 실정이다[11-13]. 식량지원정책을 포함한 대북 영양정책에 대한 국민의 지지를 높이기 위해서는 북한 주민의 영양실태에 대한 우리 국민의 인식을 파악해야 한다. 도움이 필요한 상황을 심각하게 받아들일수록 국제구호 캠페인에서의 지원 동기가 높아짐을 고려할 때[14], 북한 주민의 영양실태에 대한 인식은 대북 식량지원과 영양개선 프로그램의 필요성에 대한 공감으로 연결될 수 있다. 그러므로 북한 주민의 영양실태를 정확히 파악하는 것만큼 우리 국민이 인식하는 북한 주민의 영양실태를 살펴보는 것 또한 중요하다.

이에 본 연구에서는 북한주민의 영양실태와 이와 관련된 우리 국민의 인식을 살펴보았다. 다양한 영양실태 지표를 활용하여 북한 주민의 영양실태 현황뿐 아니라 시간의 흐름에 따른 변화를 함께 파악하였으며, 남한 성인을 대상으로 북한 주민의 영양실태에 대한 인식을 조사·분석하였다.

METHODS

Ethics statement

The survey for this study was approved by the Seoul National University Institutional Review Board (approval number: 1908/003-001).

1. 매크로데이터 수집 및 분석

북한 주민의 영양실태에 대한 원시데이터(raw data) 또는 마이크로데이터(microdata)를 이용할 수 없으므로, 매크로데이터(macrodata)인 영양실태 지표 정보를 여러 국제기구의 자료원으로부터 수집하여 분석하였다.

1) 영양실태 지표 선정

여러 국제기구에서는 세계 각국의 건강상태를 파악할 수 있는 다양한 지표를 발표하고 있다. 본 연구에서는 FAO, WHO 등의 국제기구에서 제공하는 정보 중에서 북한의 주민 전반, 영유아, 가임기 여성에 대한 영양실태 지표들을 다음과 같이 선정하였다.

북한 주민 전반의 영양실태를 파악하기 위한 지표로 에너지섭취부족 인구비율(prevalence of undernourishment), 식품불안정 인구비율(prevalence of food insecurity), 식품섭취불량 가구비율(prevalence of households with poor food consumption), 세계기아지수의 네 가지를 선정하였다. 에너지섭취부족 인구비율[15]은 기아수준을 측정하기 위한 FAO의 전통적인 지표로, '에너지섭취부족(undernourishment)'이란, 활력있고 건강한 삶을 위해 필요한 에너지보다 적은 양을 섭취하는 상태를 의미한다. 식품불안정 인구비율[16]은 식품에 대한 접근성을 측정하는 지표로, '식품불안정'이란, 정상적인 성장 및 발달과 활동적이고 건강한 삶을 위해 안전하고 영양가 있는 음식에 정기적으로 접근하지 못하는 상태로 정의된다. 식품불안정성은 식품불안정경험척도(Food Insecurity Experience Scale, FIES)를 근거로 한 FAO의 식품불안정 측정 방법론에 의해 낮은(mild), 보통(moderate), 심각한(severe) 수준의 세 단계로 구분되며, 일반적으로 '보통 또는 심각한 수준의 식품불안정 인구비율(prevalence of moderate or severe food insecurity)'과 '심각한 수준의 식품불안정 인구비율(prevalence of severe food insecurity)' 각각에 대하여 3년 평균값으로 보고된다[2].

식품섭취불량 가구비율[17]은 식품섭취점수(Food Consumption Score, FCS)가 불량 수준에 해당하는 가구의 비율이다. 식품섭취점수는 식품군별 지난 일주일 동안의 식품섭취 빈도에 근거하여 총 114점 만점으로 산출되며, 불량(0–21점), 경계(21.5–35점), 적정(> 35점)의 3등급으로 분류된다. 세계기아지

수[3]는 기아를 측정하기 위한 종합지표로, 에너지섭취부족 인구비율, 영유아 급성 및 만성 영양실조율, 5세 미만 사망률을 이용하여 산출된다. 세계기아지수는 100점 만점으로 산출되는데, 낮음(≤ 9.9점), 보통(10.0–19.9점), 심각(20.0–34.9점), 위험(35.0–49.9점), 극히 위험(≥ 50.0점)으로 기아수준의 심각도를 구분하고 있다.

북한 영유아의 영양실태를 파악하기 위한 지표로, 만성 영양실조율(prevalence of stunting), 급성 영양실조율(prevalence of wasting), 저체중률(prevalence of underweight), 과체중률(prevalence of overweight), 빈혈유병률(prevalence of anemia)의 다섯 가지 지표를 선정하였다. 영유아 만성 영양실조는 나이에 비해 키가 작은 상태로, 만성적이고 반복적인 영양실조의 결과이다. 급성 영양실조는 키에 비해 너무 마른 상태로, 단기간의 영양부족으로 인한 근육과 체지방 손실로부터 유발된다. 저체중은 나이에 비해 체중이 가벼운 상태로, 급성과 만성 영양실조의 특성을 모두 포함할 수 있다. 과체중은 키에 비해 체중이 무거운 상태로, 영양과잉으로 유발된다. 이 네 지표는 WHO의 아동 성장 표준을 기준으로 각 상태에 해당하는 5세 미만 영유아의 비율로 정의된다[18]. 영유아 빈혈유병률은 헤모글로빈 농도가 110 g/L 미만인 6–59개월 영유아의 비율이다[19].

북한 15–49세 가임기 여성의 영양실태를 파악하기 위한 지표로, 빈혈유병률과 단백질에너지 영양실조율(prevalence of maternal protein-energy malnutrition)의 두 가지 지표를 선정하였다. 가임기 여성의 빈혈유병률과 단백질에너지 영양실조는 특히 저소득 및 중간소득국가에서 심각한 영양문제이다[20,21]. 비임신 여성의 경우 혈중 헤모글로빈 농도가 120 g/L 미만, 임신부의 경우 110 g/L 미만일 때 빈혈로 진단된다[20]. 가임기 여성 단백질에너지 영양실조율은 팔의 상완위 둘레(Mid Upper Arm Circumference, MUAC)가 22.5 cm 미만인 가임기 여성의 비율이다[9].

2) 매크로데이터 수집

국제기구의 웹사이트와 보고서에 공개된 영양실태 지표 정보를 2024년 1월에 수집하였다. 지표별로 이용 가능한 모든 시기의 북한 정보를 수집하였으며, 이렇게 수집된 지표별 북한의 최신 정보의 시기에 해당하는 남한, 저소득국가 평균 및 세계 평균의 정보도 수집하였다.

영양실태 지표별 북한의 최신 정보는 다음과 같은 자료원으로부터 수집하였다. 에너지섭취부족 인구비율(2020–2022년 평균), 영유아 만성 영양실조율(2022년), 영유아 급성 영양실조율(2022년), 영유아 과체중률(2022년), 가임기 여성 빈혈유병률(2019년)의 경우, FAOSTAT [2]으로부터 정보를 수집하였다. 식품불안정 인구비율(2019년)은 2019년 FAO와 WFP 합동 '북한 긴급 식량안보 평가' 보고서[4]를, 식품섭취불량 가구비율(2021년)은 2021년 US Round Table의 WFP 발표자료[17]를 자료원으로 하였다. 세계기아지수(2023년)는 '2023년 세계기아지수' 보고서[3]를, 영유아 저체중률(2017년)은 북한중앙통계국과 UNICEF가 발표한 'DPRK Multiple Indicator Cluster Survey 2017' 보고서[22]를 자료원으로 하였다. 영유아 빈혈유병률(2019년)은 World Bank Open Data [5]로부터 정보를 수집하였다. 가임기 여성 단백질에너지 영양실조율(2012년)은 북한중앙통계국과 UNICEF가 발표한 'National Nutrition Survey 2012' 보고서[23]를 자료원으로 하였다.

이외에도 시간의 흐름에 따른 북한 주민의 영양실태 변화를 파악하기 위하여 에너지섭취부족 인구비율, 세계기아지수, 영유아 만성 영양실조율, 급성 영양실조율, 저체중률, 과체중률, 빈혈유병률, 가임기 여성 빈혈유병률, 단백질에너지 영양실조율에 대하여 이용 가능한 모든 연도의 북한 정보를 수집하였다. 지표별 그리고 연도별로 다양한 자료원으로부터 수집하였는데, FAOSTAT [2], World Bank Open Data [5] 등의 국제기구 웹사이트와 1998년부터 약 2년마다 UNICEF 등의 국제기구와 북한 당국이 합동으로 발표한 국가영양조사(National Nutrition Survey, NNS) [23–27]와 다중지표군집조사(Multiple Indicator Cluster Survey, MICS) 결과 보고서[22,28,29]가 주요 자료원이다.

남한, 저소득국가 평균 및 세계 평균의 지표 정보는 다음과 같은 자료원으로부터 수집하였다. 에너지섭취부족 인구비율, 식품불안정 인구비율, 가임기 여성 빈혈유병률은 FAOSTAT [2]으로부터 정보를 수집하였다. 세계 평균의 세계기아지수는 2023년 세계기아지수 보고서[3]를 자료원으로 하였다. 영유아 급성 영양실조율, 만성 영양실조율, 과체중률의 경우, 남한과 세계 평균 정보는 FAOSTAT [2]으로부터, 저소득국가 평균 정보는 FAO 등이 발표한 'The State of Food Security and Nutrition in the World 2023' 보고서[6]로부터 수집하였다. 영유아 저체중률과 빈혈유병률의 경우, World Bank Open Data [5]를 자료원으로 하였다.

3) 분석 방법

북한의 인구집단별(주민 전반, 영유아, 가임기 여성) 영양실태의 현황과 변화를 살펴보았다. 영양실태 지표별 북한의 최신 정보와 동일하거나 가장 가까운 시기의 남한, 저소득국가 평균, 세계 평균의 정보를 비교하였다. 또한 지표별 추이를 그래프로 제시함으로써 시간의 흐름에 따른 북한 주민의 영양실태 변화를 파악하였다.

World Bank Group에서는 매년 7월에 직전년도의 1인당 국민총소득(Gross National Income, GNI)에 따라 대상 국가를 저소득(low income), 중하위소득(low-middle income), 중상위소득(upper-middle income), 고소득(high income) 국가로 분류하여 발표한다[30,31]. 북한은 1990–1997년 동안 중하위소득국가로 분류되었으나, 1998년 이후부터는 줄곧 저소득국가로 분류되었다. 따라서 북한의 영양실태를 저소득국가 평균과 비교하였다.

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2. 온라인 설문조사

남한 성인의 북한 주민의 영양실태 관련 인식을 조사하기 위하여 온라인 설문조사를 실시하였다.

1) 조사 대상 및 방법

만 19세 이상 69세 미만의 남한 성인 1,000명을 대상으로 설문조사를 실시하였다. 응답자의 특성이 남한 성인을 대표할 수 있도록 행정안전부의 주민등록 인구통계현황(2019년 8월 기준)을 근거로[32] 성·연령·지역에 따라 표본 수를 비례 할당하여 추출하였다. 조사는 2019년 9월에 조사 전문업체를 통해 온라인으로 실시하였다.

2) 조사 내용

본 연구에서는 서울대학교 통일평화연구원 통일기반구축사업의 일부로 수행된 북한의 식량 및 영양실태와 대북식량지원에 대한 우리 국민의 인식을 조사한 설문조사의 일부를 이용하였다. 전체 조사 내용 중, 대북식량지원에 대한 태도 관련 요인을 분석한 결과는 선행연구[11]로 이미 발표하였고, 본 연구에서는 다음과 같은 조사 내용을 분석에 이용하였다.

응답자의 일반적 특성으로 성별 및 연령과 함께 만 15세 이전까지 가장 오래 거주한 지역, 정치성향을 조사하였다. 북한의 영양실태 관련 인식의 경우, 에너지섭취부족 인구비율, 식품불안정 인구비율, 영유아 급성 영양실조율, 영유아 만성 영양실조율의 네 가지 지표에 대하여 인식하는 북한의 수준을 조사하였다. 영양실태 지표에 대한 응답자의 이해를 돕기 위해 지표별 개념을 알기 쉽게 풀어서 설명하였으며, 지표별 수치에 따른 국제 기준이 존재하는 경우 해당 기준으로 보기로 구성하고 문항에도 가장 높은 수치의 기준값을 명시하였다. 예를 들어 에너지섭취부족 인구비율 문항의 경우, '평소에 섭취하는 에너지가 필요량보다 부족한 사람이 북한 전체 인구의 몇 % 수준이라고 생각하십니까? 일반적으로 35% 이상이면 매우 높은 수준으로 간주합니다'와 같이 기술하였다.

북한의 기아수준에 대한 인식은 세계기아지수를 활용하여 조사하였다. 우선 세계기아지수의 개념을 설명하고 기아수준의 심각성에 따른 5단계 척도(낮음: ≤ 9.9점, 보통: 10.0–19.9점, 심각: 20.0–34.9점, 위험: 35.0–49.9점, 극히 위험: ≥ 50.0점) [33]를 그림으로 제시하였다. 그림에는 척도와 함께 설문지 개발 당시 최신인 2019년 세계기아지수의 대상 국가 전체 평균과 기아지수가 가장 높은 중앙아프리카공화국의 점수를 표시하였다. 이를 근거로 북한의 기아수준 및 다른 나라(중국, 필리핀, 아프가니스탄)와 비교한 북한의 기아수준에 대한 인식을 조사하였다. 또한 남한과의 비교를 위해 현재 북한의 기아수준과 비슷한 과거 남한의 시기가 언제인지를 1950년대 이전부터 2000년대 이후까지 보기로 구성하여 질문하였다. 한편, 북한의 식량부족 및 영양불량에 대한 관심과 심각성에 대한 인식은 리커트식 5점 척도(1 = 매우 그렇지 않다, 2 = 그렇지 않다, 3 = 반반이다, 4 = 그렇다, 5 = 매우 그렇다)를 이용하여 조사하였다.

3) 분석 방법

에너지섭취부족 인구비율, 식품불안정 인구비율, 영유아 급성 영양실조율, 영유아 만성 영양실조율의 네 가지 지표 각각에 대하여, 보기에 따른 응답 비율과 분포를 살펴봄으로써 실제 지표 값과 비교하였을 때 남한 성인이 북한 주민의 영양실태를 제대로, 더욱 심각하게 또는 덜 심각하게 인식하고 있는지 파악하였다.

응답자를 연령에 따라 20–40대의 청장년층, 50–60대의 중노년층 두 집단으로 나누어 집단 간 응답을 비교하였다. 북한의 영양실태와 기아수준에 대한 인식의 경우, 연령대에 따른 두 집단 간 응답 분포 차이의 유의성을 검정하기 위하여 카이제곱 검정을 실시하였다. 북한의 식량부족 및 영양불량에 대한 관심과 심각성에 대한 인식은 5점 만점의 평균과 표준편차로 제시하였으며, 독립표본 t-검정을 실시하여 연령대에 따른 두 집단 간 평균의 차이를 검정하였다.

자료의 분석에는 통계분석 프로그램인 IBM SPSS Statistics 23.0 (IBM Co.)을 이용하였다. 통계의 유의성은 $\alpha = 0.05$ 수준에서 검정하였다.

RESULTS

1. 북한 주민의 영양실태

1) 북한 주민 전반의 영양실태

북한 주민 전반의 영양실태 현황과 변화를 Table 1 [2–6,17,22,23]과 Figure 1 [2,3]에 각각 제시하였다. 에너지섭취부족 인구비율의 2020–2022년 3개년 평균값은 북한의 경우 45.5%로, 저소득국가 평균인 28.1%보다 1.6배 이상, 세계 평균인 9.2%보다 5배 가까이 높은 수준이다[2]. 반면, 남한의 경우 2.5% 미만으로 보고되어 북한과 상당한 격차를 보인다. 북한의 에너지섭취부족 인구비율은 2000년대 중반부터 지속적으로 증가하여 2007–2009년에는 40%를 넘어선 이후, 2020–2022년에는 가장 높은 45.5%로 보고되었다.

북한의 식품불안정 인구비율은 2019년의 FAO와 WFP 합동 '북한 긴급 식량안보 평가' 보고서[4]에서 40%로 처음 보고되었다. 식품불안정성은 '보통 또는 심각한 수준의 식품불안정 인구비율'과 '심각한 수준의 식품불안정 인구비율' 각각에 대하여 3년 평균값으로 보고되며 '보통 또는 심각한 수준의 식품불안정 인구비율'이 일반적으로 사용된다[2]. 그러나 2019년 북한의 식품불안정 인구비율은 이러한 두 가지 비율 중 어느 쪽에 해당하는지에 대한 설명없이 40%로 제시되고 있다[4]. '보통 또는 심각한 수준의 식품불안정 인구비율'의 2018–2020년 3개년 평균값은 저소득국가 평균이 60.4%, 세계 평균이 26.6%, 남한이

Table 1. Nutritional indicators of North Korea, South Korea, low-income countries, and the world

Nutritional indicators	North Korea	South Korea	Low-income country average[1]	World average
General population				
Prevalence of undernourishment	45.5 (2020–2022)[5]	< 2.5 (2020–2022)[5]	28.1 (2020–2022)[5]	9.2 (2020–2022)[5]
Prevalence of food insecurity[2]	40.0 (2019)[6]	5.1 (2018–2020)[5]	60.4 (2018–2020)[5]	26.6 (2018–2020)[5]
Prevalence of households with poor food consumption	69.6 (2021)[7]	-	-	-
Global hunger index[3]	27.8 (2023)[8]	-	-	18.3 (2023)[8]
Children under 5 years				
Prevalence of stunting	16.8 (2022)[5]	1.7 (2022)[5]	33.5 (2022)[9]	22.3 (2022)[5]
Prevalence of wasting	2.5 (2022)[5]	0.2 (2022)[5]	6.6 (2022)[9]	6.8 (2022)[5]
Prevalence of underweight	9.3 (2017)[10]	0.9 (2017)[11]	20.0 (2017)[11]	13.5 (2017)[11]
Prevalence of overweight	2.8 (2022)[5]	5.4 (2022)[5]	3.4 (2022)[9]	5.6 (2022)[5]
Prevalence of anemia[4]	31.6 (2019)[11]	15.0 (2019)[11]	58.9 (2019)[11]	39.8 (2019)[11]
Reproductive-aged women (15–49 years)				
Prevalence of anemia	33.9 (2019)[5]	13.5 (2019)[5]	38.8 (2019)[5]	29.9 (2019)[5]
Prevalence of protein-energy malnutrition	23.2 (2012)[12]	-	-	-

% (year) or point (year).
For the range of years, the values represent a three-year average.
[1]For the current 2024 fiscal year, low-income economies are defined as those with a gross national income (GNI) per capita, calculated using the World Bank Atlas method, of $1,135 or less in 2022 by the World Bank.
[2]In the case of South Korea, low-income countries, and the world, the prevalence of food insecurity is the prevalence of moderate or severe food insecurity in the total population.
[3]100-point scale: a value of 100 signifies that a country's undernourishment, child wasting, child stunting, and child mortality levels each exactly meet the thresholds set slightly above the highest levels observed worldwide in recent decades. For the 2023 Global Hunger Index, data were assessed for 125 countries.
[4]Children ages 6–59 months.
[5]Data from Food and Agriculture Organization of the United Nations (http://www.fao.org/faostat) [2].
[6]Data from Food and Agriculture Organization of the United Nations and World Food Programme (https://www.wfp.org/publications/democratic-peoples-republic-korea-dprk-faowfp-joint-rapid-food-security-assessment) [4].
[7]Data from World Food Programme (chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://uploads.mwp.mprod.getusinfo.com/uploads/sites/67/2022/03/3.-WFPs-Update-on-Food-and-Nutrition-Security-Situation-in-DPR-Korea-by-Mr.-Aylieff.pdf) [17].
[8]Data from Welthungerhilfe and Concern Worldwide (https://www.globalhungerindex.org/pdf/en/2023.pdf) [3].
[9]Data from Food and Agriculture Organization of the United Nations *et al.* (https://docs.wfp.org/api/documents/WFP-0000151116/download/?_ga=2.107116868.71777565.1724027384-299261806.1724027384) [6].
[10]Data from Central Bureau of Statistics of the DPR Korea and United Nations Children's Emergency Fund (https://www.unicef.org/dprk/media/156/file/MICS.pdf) [22].
[11]Data from World Bank Group (https://data.worldbank.org/) [5].
[12]Data from United Nations Children's Fund *et al.* (https://www.ncnk.org/sites/default/files/content/resources/publications/DPRK_NNS%20Final%20Report_%202013.pdf) [23].

5.1%로 보고되었다[2]. 북한의 식품불안정 인구비율은 세계 평균 및 남한보다는 높지만 저소득국가 평균보다는 낮은 수준으로 파악된다.

북한의 식품섭취불량 가구비율은 WFP의 'Household Food Security in the DPRK' 발표자료[17]에서 2021년 69.6%로 보고되었다. 해당 발표자료에 따르면, 북한의 식품섭취불량 가구비율은 2019년 11%, 2020년 38%, 2021년 70%로 급격히 증가하였다.

북한의 세계기아지수는 2023년 27.8점으로, 기아수준의 심각도에 따른 5단계(낮음: ≤ 9.9점, 보통: 10.0–19.9점, 심각: 20.0–34.9점, 위험: 35.0–49.9점, 극히 위험: ≥ 50.0점) 중 '심각'에 해당한다[3]. 이는 산출 대상 125개국의 전체 평균인 18.3점보다 10점 가까이 높은 수준이다. 세계기아지수는 대상 국가들의 데이터를 이용하여 산출되는 상대적인 지표로, 매년 대상 국가에 변화가 있을 수 있어 연도별 수치를 직접적으로 비교할 수 없다. 대신 매년 발간되는 보고서에 해당 연도의 세계기아지수와 직접적으로 비교 가능하도록 수치를 조정한 과거 2–3개 기준연도의 세계기아지수를 함께 제시하고 있으므로[3], 이를 통해 연도별 수치를 비교할 수 있다. 2023년의 세계기아지수와 비교 가능한 기준연도는 2000년, 2008년, 2015년으로, 북한의 세계기아지수는 2000년에 39.5점, 2008년에 30.4점, 2015년

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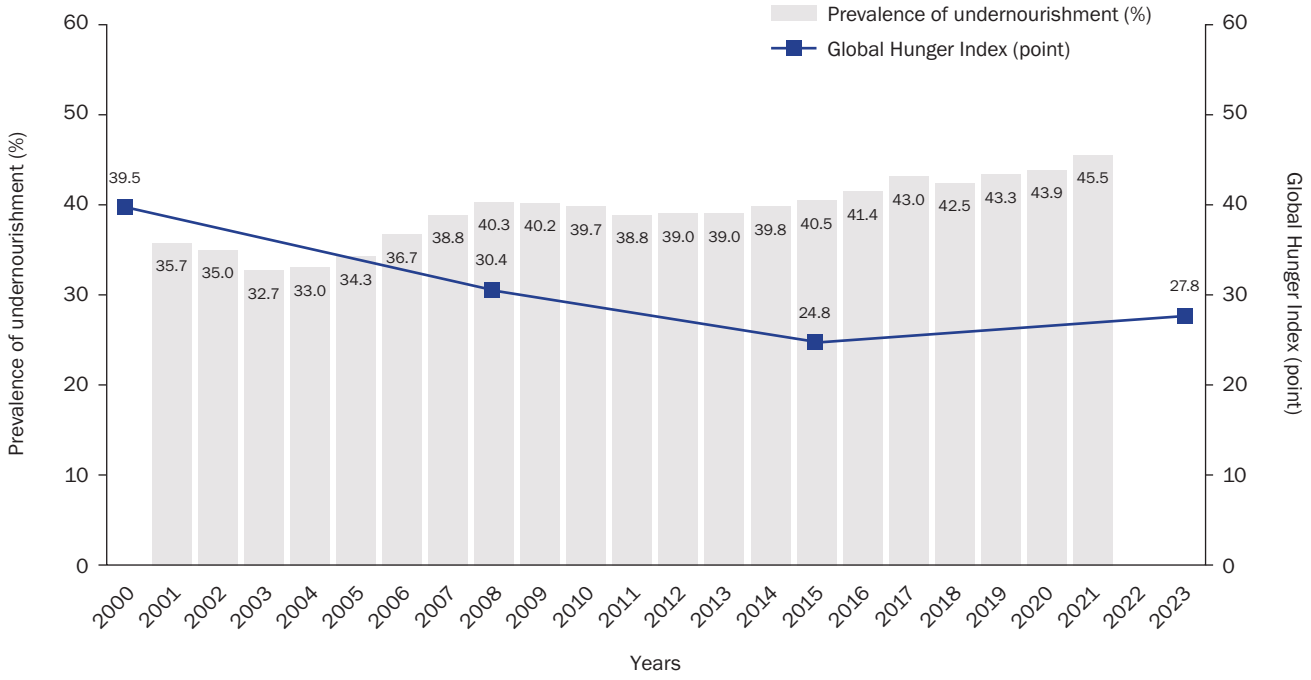

Fig. 1. Changes in the prevalence of undernourishment and the Global Hunger Index (GHI) among the general population of North Korea from 2000 to 2023.
Prevalence of undernourishment is the three-year average before and after the reference year. The 2023 GHI scores can be directly compared with the GHI scores provided for three reference years—2000, 2008, and 2015.
Data from Food and Agriculture Organization of the United Nations (http://www.fao.org/faostat) [2]. Data from Welthungerhilfe and Concern Worldwide (https://www.globalhungerindex.org/pdf/en/2023.pdf) [3].

에 24.8점으로 감소 추세에 있었으나 2023년(27.8점)에 다시 증가하였다[3].

2) 북한 영유아의 영양실태

북한 영유아의 영양실태 현황과 변화를 Table 1 [2-6,17,22,23]과 Figure 2 [2,5,22-29]에 각각 제시하였다. 북한의 영유아 만성 영양실조율은 2022년 16.8%로, 저소득국가 평균(33.5%) 및 세계 평균(22.3%)과 비교하였을 때에는 양호한 수준이다[2,6]. 그러나 2022년 남한의 영유아 만성 영양실조율(1.7%)과는 매우 큰 격차를 보인다[2]. 북한의 영유아 급성 영양실조율 또한 2022년 2.5%로, 저소득국가 평균(6.6%) 및 세계 평균(6.8%)에 비해서는 양호하나[2,6], 남한(0.2%)과 비교하였을 때에는 높은 수준이다[2]. 1998년 처음 보고된 북한의 영유아 만성(62.3%) 및 급성(15.6%) 영양실조율[24]은 꾸준히 감소하여, 2017년 UNICEF의 다중지표군집조사(MICS) 결과[22] 각각 19.1%, 2.5%로 보고되었다. 이후 가장 최근인 2022년에는 각각 16.8%, 2.5%로 감소하였다[2].

2017년 북한의 영유아 저체중률은 9.3%로[22], 저소득국가 평균인 20.0%와 세계 평균 인 13.5%에 비해 낮은 수준이지만, 0.9%인 남한보다는 10배 이상 높다[5]. 1998년 60% 수준(60.6%)이던 북한의 영유아 저체중률[24]은 2017년 9.3%로 크게 감소하였다[22]. 북한의 영유아 과체중률의 경우 2022년 2.8%로, 저소득국가 평균인 3.4%보다도 낮으며 세계 평균인 5.6%와 남한의 5.4%보다는 2배 가까이 낮다[2,6]. 북한의 영유아 과체중률은 꾸준한 감소를 보이는 다른 영유아 영양실태 지표와는 달리 증가하는 경향을 보이는데, 2009년 0.0% [29]로 처음 보고된 이후, 2017년 2.3% [22], 2022년 2.8% [2]로 소폭 증가하였다.

북한의 영유아 빈혈유병률은 2019년 31.6%로 보고되었다[5]. 이는 저소득국가 평균(58.9%)의 절반 수준이며, 세계 평균(39.8%)보다도 다소 낮은 수준이다. 그러나 남한의 15.0%와 비교하면 2배 이상 높은 수준이다[5]. 북한의 영유아 빈혈유병률은 2010년 중반까지 꾸준히 감소하였는데, 2000년에 42.9%로 시작하여 2015년에 30.9%로 가장 낮았으나 2019년에 31.6%로 다시 조금씩 증가하는 추세에 있다[5].

3) 북한 가임기 여성의 영양실태

북한 가임기 여성의 영양실태 현황과 변화를 Table 1 [2-6,17,

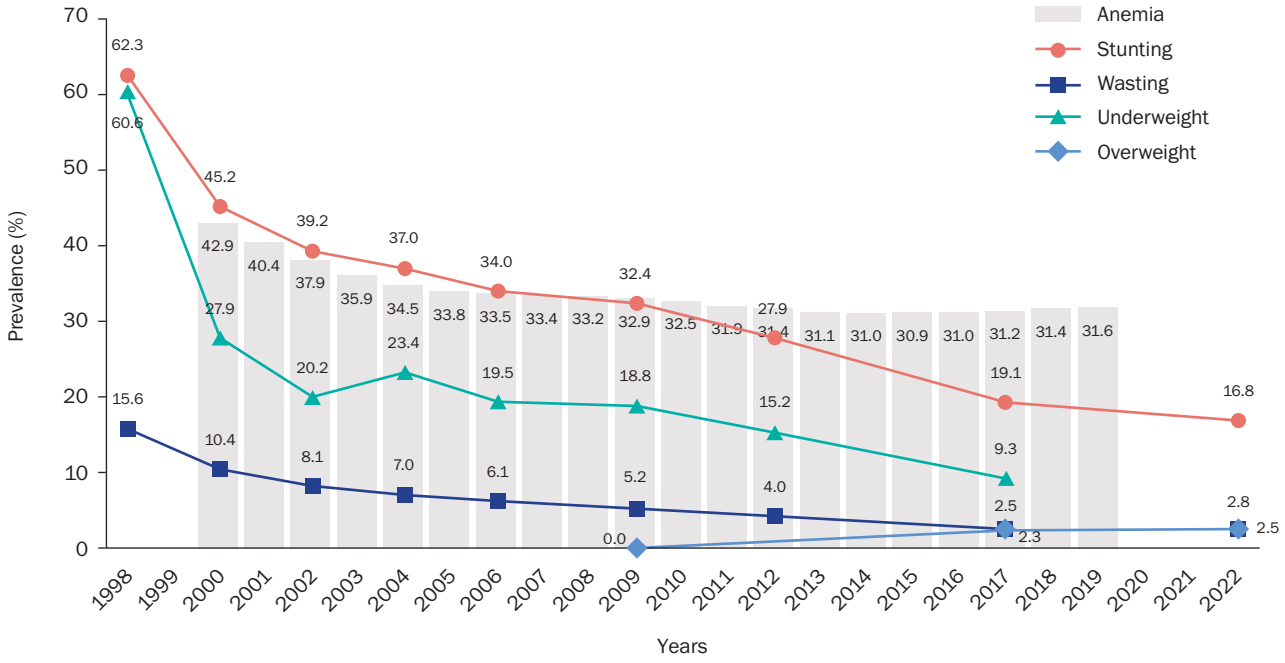

Fig. 2. Changes in the prevalence of anemia, stunting, wasting, underweight, and overweight among children under 5 years of North Korea from 1998 to 2022.
In the case of stunting, wasting, underweight, and overweight, there are differences in the area, number of samples, and sampling methods by survey year. In particular, the target age of children is different (2000, 2006, 2009, 2012, 2017: < 5 years; 2004: < 6 years; 1998, 2002: < 7 years). The prevalence of anemia refers to the percentage of children aged 6–59 months.
Data from Food and Agriculture Organization of the United Nations (http://www.fao.org/faostat) [2]. Data from World Bank Group (https://data.worldbank.org/) [5]. Data from Central Bureau of Statistics of the DPR Korea and United Nations Children's Emergency Fund (https://www.unicef.org/dprk/media/156/file/MICS.pdf) [22]. Data from United Nations Children's Fund *et al.* (https://www.ncnk.org/sites/default/files/content/resources/publications/DPRK_NNS%20Final%20Report_%202013.pdf) [23]. European Union *et al.* (https://reliefweb.int/report/democratic-peoples-republic-korea/nutrition-survey-democratic-peoples-republic-korea) [24]. Central Bureau of Statistics of the DPR Korea *et al.* (https://reliefweb.int/report/democratic-peoples-republic-korea/dpr-korea-nutrition-assessment-2002) [25]. Central Bureau of Statistics of the DPR Korea *et al.* (https://reliefweb.int/report/democratic-peoples-republic-korea/dprk-2004-nutrition-assessment-report-survey-results) [26]. United Nations Children's Emergency Fund [27]. Central Bureau of Statistics of the DPR Korea (https://www.rhsupplies.org/uploads/tx_rhscpublications/Korea_2000_MICS_English.pdf) [28]. Central Bureau of Statistics of the DPR Korea and United Nations Children's Emergency Fund (https://www.aidsdatahub.org/sites/default/files/resource/dprk-mics-2009.pdf) [29].

22,23]과 Figure 3 [2,23,25–27,29]에 각각 제시하였다. 북한의 가임기 여성 빈혈유병률은 2019년 33.9%로 저소득국가 평균(38.8%)과 비슷하였다[2]. 그러나 세계 평균(29.9%)보다 10% 이상 높으며, 특히 남한의 13.5%보다 2.5배 이상 높은 수준이다[2]. 북한의 가임기 여성 빈혈유병률은 2000년 이후부터 큰 변화없이 30%–35% 수준을 유지하고 있다. 2000년에 35.0%에서 2010년과 2011년에 31.6%로 감소하였으나, 이후부터는 다시 증가하여 2019년에는 33.9%로 보고되었다[2].

북한의 가임기 여성 단백질에너지 영양실조율은 2012년 23.2%로 가장 마지막으로 보고되었다[23]. 이는 2002년과 2004년에 각각 32.0%와 32.4%에서[25,26] 10년 후인 2012년에 약 10% 감소한 수치이다. 2012년 기준 북한의 가임기 여성 단백질에너지 영양실조율은 20대는 25.2%, 30대는 21.4%, 40대는 21.8%로, 남한(2010년 기준 20대: 9.9%, 30대: 3.4%, 40대: 1% 미만)보다 연령대별 최소 2.5배에서 20배가 넘는 큰 격차를 보인다[9].

2. 남한 성인의 북한 주민 영양실태 관련 인식

설문조사 응답자의 일반적 특성은 Table 2 [32]와 같다. 전체 응답자의 남녀 비율은 비슷하였고 연령대 또한 20대와 30대는 각각 20%, 40대와 50대는 각각 23%, 60대는 16% 수준으로 비교적 고르게 분포하였다. 만 15세 이전까지 가장 오래 거주한

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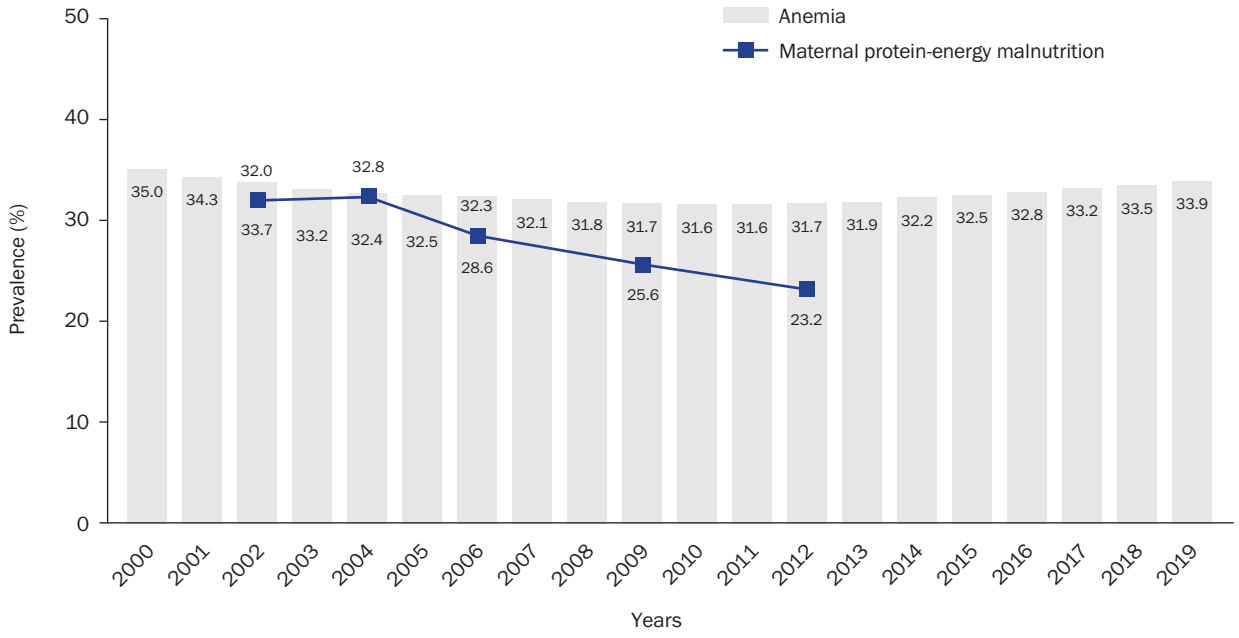

Fig. 3. Changes in the prevalence of anemia and protein-energy malnutrition among reproductive-aged women of North Korea from 2000 to 2019.
The target age of protein-energy malnutrition is different by survey year (2002: ≤ 20 years; 2004: 20–44 years; 2006: not available; 2009, 2012: 15–49 years).
Data from Food and Agriculture Organization of the United Nations (http://www.fao.org/faostat) [2]. Data from United Nations Children's Fund *et al.* (https://www.ncnk.org/sites/default/files/content/resources/publications/DPRK_NNS%20Final%20Report_%202013.pdf) [23]. Central Bureau of Statistics of the DPR Korea *et al.* (https://reliefweb.int/report/democratic-peoples-republic-korea/dpr-korea-nutrition-assessment-2002) [25]. Central Bureau of Statistics of the DPR Korea *et al.* (https://reliefweb.int/report/democratic-peoples-republic-korea/dprk-2004-nutrition-assessment-report-survey-results) [26]. United Nations Children's Emergency Fund [27]. Central Bureau of Statistics of the DPR Korea and United Nations Children's Emergency Fund (https://www.aidsdatahub.org/sites/default/files/resource/dprk-mics-2009.pdf) [29].

지역은 서울 및 수도권이 과반(51.7%)을 차지하였고 이외 영남(25.7%), 충청(10.0%) 등의 순으로 조사되었다. 청장년층(20–40대)과 중노년층(50–60대)의 두 그룹 간 성별과 거주지역에 유의한 차이는 없었으나, 정치성향에는 유의한 차이가 있었다(P = 0.002). 보수 성향의 응답자 비율은 중노년층(28.7%)에서 청장년층(19.3%)보다 높았고, 중도 및 진보 성향의 응답자 비율은 청장년층(중도 45.7%, 진보 35.0%)에서 중노년층(중도 38.9%, 진보 32.3%)보다 높았다.

조사 당시의 행정안전부 주민등록 인구통계현황(2019년 12월 기준) [32]의 전체 남한 성인 인구와 조사 응답자의 성·연령·지역별 인구 비율을 비교하였다. 전체 남한 성인과 조사 응답자의 남녀 비율은 유사하였으며, 40, 50대가 각각 약 23%로 다른 연령대에 비해 다소 높아 연령대의 구성비율 또한 유사하였다. 전체 남한 성인의 절반(50.0%)이 수도권에 거주한 것과 유사하게 응답자의 51.7%가 만 15세까지 가장 오랜 기간 거주한 지역도 수도권으로 조사되었다.

북한 주민의 영양실태에 대한 남한 성인의 인식을 연령대에 따라 Table 3 [2,4,22]에 제시하였다. 에너지섭취부족 인구비율의 경우, 약 70% (69.3%)의 응답자가 2019년 북한 현황인 47.6% [2]가 포함된 '35% 이상'을 선택하였다. 응답 분포에는 연령대에 따른 유의한 차이가 있었는데(P = 0.003), '35% 이상'에 대한 응답률은 청장년층에서 73.6%로, 중노년층(62.4%)에 비해 10% 이상 높았다. 식품불안정 인구비율의 경우, 2019년 북한 현황인 40% [4]가 포함된 '40% 이상 60% 미만'에 대한 응답률은 26.9%로, 이보다 더 많은 30% 이상(31.4%)의 응답자가 '60% 이상 80% 미만'을 선택하였다. '60% 이상 80% 미만' 또는 '80% 이상'에 대한 응답률은 청장년층에서 56.4%로 중노년층(44.1%)보다 높아 젊은 층에서 북한의 식품불안정 수준을 더욱 심각하게 인식하는 경향을 보였다(P = 0.003).

영유아 만성 및 급성 영양실조율의 경우, 각각 95.6%와 97.9%의 응답자가 북한의 현황보다 심각한 수준의 보기를 선택하여 현황과 인식에 큰 괴리를 보였다. 두 지표 모두 높은 수

Table 2. General characteristics of the survey respondents by age group

Characteristic	South Korean adults [1]	Respondent			*P*-value[2]
		Total (n = 1,000)	20s–40s (n = 617)	50s–60s (n = 383)	
Gender					0.643
Men	49.9	508 (50.8)	317 (51.4)	191 (49.9)	
Women	50.1	492 (49.2)	300 (48.6)	192 (50.1)	
Age (year)					< 0.001
19–29	18.3	196 (19.6)	196 (31.8)	0 (0.0)	
30–39	19.0	194 (19.4)	194 (31.4)	0 (0.0)	
40–49	22.5	227 (22.7)	227 (36.8)	0 (0.0)	
50–59	23.3	228 (22.8)	0 (0.0)	228 (59.5)	
60–69	16.9	155 (15.5)	0 (0.0)	155 (40.5)	
Region with the longest residency before age 15					0.379
Seoul & metropolitan area	50.0	517 (51.7)	333 (54.0)	184 (48.0)	
Yeongnam	25.1	257 (25.7)	150 (24.3)	107 (27.9)	
Chungcheong	11.2	100 (10.0)	61 (9.9)	39 (10.2)	
Honam	10.7	97 (9.7)	58 (9.4)	39 (10.2)	
Gangwon	3.0	29 (2.9)	15 (2.4)	14 (3.7)	
Political orientation					0.002
Conservative	-	229 (22.9)	119 (19.3)	110 (28.7)	
Moderate	-	431 (43.1)	282 (45.7)	149 (38.9)	
Progressive	-	340 (34.0)	216 (35.0)	124 (32.3)	

% or n (%)
[1]Data from Ministry of the Interior and Safety (https://jumin.mois.go.kr) [32].
[2]Chi-square test between age groups.

치의 보기일수록 높은 응답률을 보였다. 만성 영양실조율은 53.7%의 응답자가 '40% 이상'을 선택하였고 급성 영양실조율은 71.7%의 응답자가 '15% 이상'을 선택하였다. 그러나 북한 영유아의 만성 및 급성 영양실조율은 2017년 기준으로 각각 19.1%와 2.5%로[22], 이 수치가 포함된 보기에 대한 응답률은 5% 미만으로 매우 낮았다. 한편, 만성 영양실조율의 경우 연령대에 따른 응답 분포에 유의한 차이를 보여($P < 0.001$) '40% 이상'에 대한 응답률이 청장년층에서 중노년층보다 더 높았다.

북한의 기아수준에 대한 남한 성인의 인식을 연령대에 따라 Table 4 [33]에 제시하였다. 조사 당시인 2019년 북한의 세계기아지수는 27.7점으로 '심각' 단계에 해당하였다[33]. 이러한 현황이 포함된 보기인 '심각(20점 이상 35점 미만)'을 선택한 응답자는 31.8%였으며, 55% 이상의 응답자가 그보다 높은 단계의 보기를 선택하였다(위험 32.7%, 매우 위험 22.7%). 한편, '위험' 또는 '매우 위험'에 대한 응답률은 청장년층에서 60%에 가까운 수준이었으나(59.3%) 중노년층에서는 50%에 미치지 못해(49.1%) 젊은 층이 북한의 기아수준을 더욱 심각하게 인식하는 경향을 보였다($P = 0.009$).

세계기아지수를 근거로 북한과 다른 나라의 기아수준에 대한 인식을 비교한 결과, 80% 이상의 응답자가 북한과 중국, 북한과 필리핀 중 기아수준이 더 심각한 나라로 북한을 선택하였다(각각 88.0%, 81.3%). 반면, 북한과 아프가니스탄 중에서는 아프가니스탄의 기아수준이 더 심각하거나(42.1%) 두 나라가 비슷하다는(40.2%) 응답이 각각 40% 수준으로 주를 이루었다. 북한과 중국을 비교한 문항에서만 연령대에 따른 응답 분포에 유의한 차이가 있었는데($P = 0.016$), 중노년층에서 북한의 기아수준이 더 심각하다는 응답이 많았으며(청장년층 85.7%, 중노년층 91.6%), 두 나라의 기아수준이 비슷하다는 응답은 청장년층에서 더 많았다(청장년층 10.4%, 중노년층 5.5%).

현재 북한의 기아수준과 비슷한 과거 남한의 시기를 조사한 결과, 1960년대와 1970년대에 대한 응답률이 가장 높았다. 45.6%의 응답자가 1960년대를, 28.5%의 응답자가 1970년대를 선택하였으며, 1980년대 이후의 보기를 선택한 응답자는 모두 합해 10% 수준에 불과하였다(1980년대 7.3%, 1990년대 2.1%, 2000년 이후 0.8%). 연령대에 따른 응답 분포에는 통계적으로 유의한 차이는 없었다.

북한의 식량부족 및 영양불량에 대한 남한 성인의 관심과 심각성에 대한 인식을 Table 5에 제시하였다. '평소에 북한의 식량부족 및 영양불량에 대하여 관심이 있다'는 문항에 대한 응답자 전체의 평균 점수는 각각 2.87점과 2.85점으로 높지 않은 수

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Table 3. South Korean adults' perception regarding the nutritional status of North Koreans by age group

Item	Total (n = 1,000)	20s–40s (n = 617)	50s–60s (n = 383)	*P*-value[1]
Prevalence of undernourishment				0.003
< 5%	13 (1.3)	7 (1.1)	6 (1.6)	
≥ 5% and < 15%	45 (4.5)	28 (4.5)	17 (4.4)	
≥ 15% and < 25%	73 (7.3)	38 (6.2)	35 (9.1)	
≥ 25% and < 35%	176 (17.6)	90 (14.6)	86 (22.5)	
≥ 35% [47.6%][2),3)]	693 (69.3)	454 (73.6)	239 (62.4)	
Prevalence of food insecurity				0.003
< 20%	38 (3.8)	20 (3.2)	18 (4.7)	
≥ 20% and < 40%	176 (17.6)	93 (15.1)	83 (21.7)	
≥ 40% and < 60% [40%][2),4)]	269 (26.9)	156 (25.3)	113 (29.5)	
≥ 60% and < 80%	314 (31.4)	207 (33.5)	107 (27.9)	
≥ 80%	203 (20.3)	141 (22.9)	62 (16.2)	
Prevalence of stunting (in children under 5 years)				< 0.001
< 20% [19.1%][2),5)]	44 (4.4)	24 (3.9)	20 (5.2)	
≥ 20% and < 30%	163 (16.3)	95 (15.4)	68 (17.8)	
≥ 30% and < 40%	256 (25.6)	134 (21.7)	122 (31.9)	
≥ 40%	537 (53.7)	364 (59.0)	173 (45.2)	
Prevalence of wasting (in children under 5 years)				0.113
< 5% [2.5%][2),5)]	21 (2.1)	12 (1.9)	9 (2.3)	
≥ 5% and < 10%	83 (8.3)	50 (8.1)	33 (8.6)	
≥ 10% and < 15%	179 (17.9)	97 (15.7)	82 (21.4)	
≥ 15%	717 (71.7)	458 (74.2)	259 (67.6)	

n (%).
[1)]Chi-square test between age groups.
[2)]Correct answers. Numbers in square brackets represent the reported values of each nutritional indicator.
[3)]Data from Food and Agriculture Organization of the United Nations (http://www.fao.org/faostat) [2].
[4)]Data from Food and Agriculture Organization of the United Nations and World Food Programme (https://www.wfp.org/publications/democratic-peoples-republic-korea-dprk-faowfp-joint-rapid-food-security-assessment) [4].
[5)]Data from Central Bureau of Statistics of the DPR Korea and United Nations Children's Emergency Fund (https://www.unicef.org/dprk/media/156/file/MICS.pdf) [22].

준이었다. 중노년층은 청장년층보다 북한의 식량부족과 영양불량에 대하여 더 큰 관심을 보였다. 식량부족과 영양불량에 대한 관심은 중노년층에서 약 3.1점(식량부족: 3.08점, 영양불량 3.05점), 청장년층에서 약 2.7점(식량부족: 2.75점, 영양불량: 2.73점)으로 중노년층에서 유의하게 높았다($P < 0.001$).

'북한의 식량부족 및 영양불량은 다른 나라의 지원을 받아야 할 정도로 심각하다'는 문항에 대한 응답자 전체의 평균 점수는 각각 3.63점과 3.67점으로 나타났다. 식량부족($P = 0.042$)과 영양불량($P = 0.045$)의 심각성에 대한 인식 또한 연령대에 따른 평균 점수에 유의한 차이가 있어 중노년층은 청장년층보다 북한의 식량부족과 영양불량에 대하여 더 심각하다고 인식하였다. 식량부족과 영양불량의 심각성에 대한 인식은 중노년층에서 약 3.7점(식량부족: 3.71점, 영양불량 3.75점), 청장년층에서 약 3.6점(식량부족: 3.58점, 영양불량: 3.63점)으로 중노년층에서 높았다.

DISCUSSION

본 연구에서는 북한 주민의 영양실태를 파악하고 이와 관련된 남한 성인의 인식을 조사하였다. 영양실태 지표를 통해 살펴본 북한 주민의 영양실태는 영유아를 중심으로 크게 개선되었으나 북한 주민 전반 및 가임기 여성의 영양실태는 개선되지 않고 있어 여전히 우려할만한 수준으로 파악된다.

에너지섭취부족 인구비율은 일반적으로 3년 동안의 평균값으로 보고되는데, 북한의 경우 2020–2022년 3개년 평균 45.5%로[2], 절반에 가까운 북한 주민이 필요한 만큼의 에너지를 섭취하지 못하는 것으로 해석할 수 있다. 식품불안정 인구비율의 경우, 일반적으로 '보통 또는 심각한 수준의 식품불안정 인구

Table 4. South Korean adults' perception regarding the hunger level of North Korea by age group

Item	Total (n = 1,000)	20s–40s (n = 617)	50s–60s (n = 383)	*P*-value[1]
Hunger level[2] in North Korea				0.009
Low (< 10)	27 (2.7)	11 (1.8)	16 (4.2)	
Moderate (≥ 10 and < 20)	101 (10.1)	61 (9.9)	40 (10.4)	
Serious (≥ 20 and < 35) [27.7][3]	318 (31.8)	179 (29.0)	139 (36.3)	
Alarming (≥ 35 and < 50)	327 (32.7)	214 (34.7)	113 (29.5)	
Extremely alarming (≥ 50)	227 (22.7)	152 (24.6)	75 (19.6)	
Comparison of hunger level[2]				
North Korea vs. China				0.016
North Korea is more severe[3]	880 (88.0)	529 (85.7)	351 (91.6)	
China is more severe	35 (3.5)	24 (3.9)	11 (2.9)	
Both are similar	85 (8.5)	64 (10.4)	21 (5.5)	
North Korea vs. Philippines				0.644
North Korea is more severe[3]	813 (81.3)	496 (80.4)	317 (82.8)	
Philippines is more severe	48 (4.8)	31 (5.0)	17 (4.4)	
Both are similar	139 (13.9)	90 (14.6)	49 (12.8)	
North Korea vs. Afghanistan				0.439
North Korea is more severe	177 (17.7)	103 (16.7)	74 (19.3)	
Afghanistan is more severe[3]	421 (42.1)	268 (43.4)	153 (39.9)	
Both are similar	402 (40.2)	246 (39.9)	156 (40.7)	
A past period in South Korea with hunger levels similar to present-day North Korea				0.163
Before 1950s	157 (15.7)	95 (15.4)	62 (16.2)	
1960s[3]	456 (45.6)	272 (44.1)	184 (48.0)	
1970s	285 (28.5)	176 (28.5)	109 (28.5)	
1980s	73 (7.3)	50 (8.1)	23 (6.0)	
1990s	21 (2.1)	17 (2.8)	4 (1.0)	
After 2000s	8 (0.8)	7 (1.1)	1 (0.3)	

n (%).
[1]Chi-square test between age groups.
[2]The question included the description of the Global Hunger Index (GHI) and the GHI severity scale.
[3]Correct answers. Numbers in square brackets represent the Global Hunger Index. Data from Welthungerhilfe and Concern Worldwide (https://www.globalhungerindex.org/pdf/en/2019.pdf) [33].

비율'과 '심각한 수준의 식품불안정 인구비율'의 각각에 대하여 3년 평균값으로 보고되는 것과 달리[16], 북한은 2019년에 40%로 처음 보고되었다[4]. 때문에 해석에 조심스러운 부분이 있음에도 불구하고 식품불안정 인구비율은 북한에 대한 국제사회의 인도적 식량지원의 필요성을 호소하는 근거로 널리 활용되고 있다. 북한의 식품섭취불량 가구비율은 2019년에 11%, 2020년에 38%, 2021년에 70%로 급격히 증가하였다[17]. 이는 북한 주민의 식이 다양성이 매우 낮아졌음을 의미하며, 2020년 1월 코로나19로 인한 국경폐쇄 조치를 고려할 때 팬데믹으로 인한 부정적 영향도 예상할 수 있다. 2023년 북한의 세계기아지수는 27.8점으로 '심각' 단계에 해당하며, 산출 대상 125개국 중 20위를 차지하였다[3]. 이는 북한의 기아수준이 세계적으로 심각한 수준임을 의미한다.

2022년 북한의 영유아 만성 및 급성 영양실조율은 각각 16.8%, 2.5%로 보고되었다[2]. 북한의 영유아 저체중률은 2017년에 9.3% [22], 과체중률은 2022년에 2.8% [2], 빈혈유병률은 2019년에 31.6% [5]이다. 만성적이고 반복적인 영양실조의 결과인 만성 영양실조율과 급성과 만성 영양실조의 특성을 모두 포함하는 저체중률이 상대적으로 높음을 고려할 때, 북한 영유아의 영양불량은 만성적이고 복합적인 특징을 갖는다고 할 수 있겠다. 더욱이 영유아 빈혈은 철분 결핍뿐 아니라 조산, 저체중 출생, 비타민 및 무기질 부족, 질병 등의 다양한 원인으로 유발되기 때문에[34], 식생활을 포함하여 전반적으로 취약한 북한의 양육 환경이 영향을 미친 것으로 보인다.

한편 WHO는 'Global Nutrition Target 2025' [35]에서 가임기 여성의 빈혈유병률을 2025년까지 15.2% 이하로 감소시키는

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Table 5. South Korean adults' concern and perception regarding the food shortages and malnutrition of North Korea by age group

Item	Total (n = 1,000)	20s–40s (n = 617)	50s–60s (n = 383)	*P*-value[1)]
Concern about food shortages and malnutrition in North Korea				
I am generally concerned about food shortages in North Korea	2.87 ± 0.91	2.75 ± 0.92	3.08 ± 0.84	< 0.001
I am generally concerned about malnutrition in North Korea	2.85 ± 0.95	2.73 ± 0.97	3.05 ± 0.90	< 0.001
Severity of food shortages and malnutrition in North Korea				
Food shortages in North Korea are so severe that the country requires food aid from other nations	3.63 ± 0.95	3.58 ± 0.96	3.71 ± 0.93	0.042
Malnutrition in North Korea is so severe that the country requires food aid from other nations	3.67 ± 0.94	3.63 ± 0.97	3.75 ± 0.87	0.045

Mean ± SD.
Values were measured on a 5-point Likert scale (1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; 5 = strongly agree).
[1)]Independent samples t-test between age groups.

것을 목표로 설정하였다. 그러나 북한의 2019년 가임기 여성 빈혈유병률은 목표치의 2배 이상인 33.9%로 높은 수준이다[2]. 오래된 정보이기는 하나 북한의 가임기 여성 단백질에너지 영양실조율은 2012년 23.2%로 마지막으로 보고되었는데[23], 북한의 가임기 여성의 빈혈유병률이 2010년대 이후 다시 조금씩 증가하고 있는 것으로 보아 단백질에너지 영양실조율 또한 개선되지는 않았을 것으로 보인다. 가임기 여성의 영양문제는 자신뿐 아니라 자녀에게도 영향을 미칠 수 있음을 고려할 때[21], 이러한 수치는 더욱 우려스러운 상황이다.

전반적으로 북한의 영유아 관련 영양불량률은 과거에 비해 크게 감소하여 최신의 현황은 저소득국가 평균 및 세계 평균과 비교하였을 때에도 양호한 수준이다. 그럼에도 불구하고 남한과의 격차는 여전히 좁혀지지 않고 있는데, 남북 비교가 가능한 지표 중 영유아 과체중률을 제외한 모든 영유아 영양실태 지표에서 북한은 남한보다 최소 2배에서 최대 18배 이상 높은 영양불량률을 보인다. 북한 주민 전반의 영양실태 지표에 대한 유병률은 오히려 증가 추세에 있으며, 북한의 에너지섭취부족 인구비율과 식품불안정 인구비율은 모두 40% 이상으로 매우 높은 수준이다. 특히 에너지섭취부족 인구비율의 경우 저소득국가 평균과 비교하더라도 1.6배 이상 높다. 또한 빈혈유병률이 2010년 이후 다시 증가하는 등 북한 가임기 여성의 영양실태도 개선되었다고 보기에는 무리가 있다.

본 연구에서는 성·연령·지역에 따라 표본 수를 비례 할당하여 설문조사를 실시함으로써 모집단인 남한 성인에 대한 응답자의 대표성을 확보하고자 하였다. 조사 당시인 2019년 12월 우리나라 인구통계현황[32]을 근거로 본 연구의 응답자와 전체 남한 성인을 비교하였을 때, 성·연령·지역의 비율이 모두 유사하였다. 정치성향의 경우 공식적인 국가통계는 보고된 바 없으나, 조사 당시 한국갤럽에서 실시한 여론조사에 따르면, 진보(33.8%), 중도(28.0%), 보수(23.3%), 모름(14.9%) 순으로 보고되어[36], 진보와 보수의 비율이 본 연구와 유사하였다. 이러한 내용을 종합할 때, 본 연구의 응답자는 남한 성인에 대한 대표성을 어느 정도 확보한 것으로 생각된다.

본 연구 결과, 남한 성인은 전반적으로 북한 주민의 영양실태와 기아수준을 실제보다 심각한 수준으로 인식하였다. 영양실태에 대한 인식과 현황의 괴리는 특히 영유아 영양실태에서 두드러졌다. 영유아 만성 및 급성 영양실조율의 경우 95% 이상의 응답자가 북한의 현황보다 심각한 수준의 보기를 선택하였으며, 가장 높은 수치의 보기에서 응답률이 가장 높았다. 세계기아지수를 근거로 북한에 기아수준의 심각성에 대한 인식을 조사한 결과, 대부분의 응답자(87.2%)가 북한의 기아수준을 '심각', '위험', '극히 위험' 단계로 인식하였다. 또한 실제 북한의 현황인 '심각' (31.8%)보다 높은 수준인 '위험' (32.7%) 또는 '매우 위험' (22.7%)의 응답률이 높았다.

이러한 결과는 북한 주민의 영양실태와 기아수준이 과거에 비해 개선된 반면, 남한 성인의 인식은 이를 따라가지 못하고 있기 때문으로 생각된다. 특히 영유아 만성 영양실조율과 저체중률은 1998년 60% 이상의 높은 수준[24]에서 각각 16.8% (2022년) [2]와 9.3% (2017년) [22]로 크게 개선되었다. 일반 국민들은 북한에 대한 정확한 정보를 얻기 어려우며 TV 등의 매체에 큰 영향을 받는데, 특히 탈북자 출연 프로그램이나 뉴스 등에서는 북한에 대한 비판적 논조가 강한 것으로 알려져 있다[37]. 이러한 매체에서는 북한 주민의 굶주림과 경제적 어려움을 강조하기 때문에, 우리 국민이 인식하는 북한 주민의 영양실태는 심각했던 과거의 수준에 머물러 있는 것으로 해석할 수 있다.

또한 청장년층은 중노년층보다 북한 주민의 영양실태와 기

아수준을 더욱 심각한 수준으로 인식하였다. 인식을 조사한 네 가지 영양실태 지표 중 에너지섭취부족 인구비율, 식품불안정 인구비율, 영유아 만성 영양실조율에서 연령대에 따른 응답 분포에 유의한 차이가 있었으며, 세 지표 모두 가장 높은 수치의 보기에서 청장년층의 응답률이 중노년층보다 높았다. 특히 영유아 만성 영양실조율의 경우, '40% 이상'에 대한 응답률은 청장년층에서 59%, 중노년층에서 45% 수준으로 가장 큰 격차를 보였다. 기아수준 또한 영양실태와 마찬가지로 청장년층이 중노년층보다 더욱 심각하게 인식하였다. 남한 성인의 연령대에 따른 북한 주민의 영양실태와 기아수준의 심각성에 대한 인식을 조사한 선행연구는 보고된 바 없어 이와 같은 연구 결과를 고찰하기에는 한계가 있으나, 세대별 북한에 대한 견해 차이와 정치성향의 관점에서 대북지원에 대한 인식과 연결지어 다음과 같이 해석할 수 있다.

서울대학교 통일평화연구원에서 수행한 2021년 통일의식조사에서 세대별 북한에 대한 견해를 조사한 결과[38], MZ세대의 11.2%가 북한을 '지원대상'이라고 응답하여, X세대(8.8%)와 2차 베이비부머 세대(9.1%)보다 높은 응답률을 보였다. 이러한 결과를 본 연구 결과와 연결하면, 북한 주민의 영양실태를 보다 심각하게 인식하는 젊은 층에서 북한을 지원대상으로 인식하는 것으로 생각할 수 있다. 한편, 본 연구에서 응답자의 정치성향은 연령대에 따라 유의한 차이가 있었는데, 청장년층에서 중도 및 진보 성향의 응답자 비율이 높았고, 중노년층에서 보수 성향의 응답자 비율이 높았다. 일반적으로 정치성향이 진보적인 경우 북한[37] 및 대북지원[11,39-41]에 긍정적인 것으로 알려져 있다. 국제구호 캠페인에서 도움이 필요한 상황을 심각하게 인식할수록 돕고자 하는 동기가 높아짐을 고려할 때[14], 북한 주민의 영양실태와 기아수준을 심각하게 인식하는 청장년층에서 대북지원에 긍정적인 진보 성향의 비율이 높은 것으로 해석할 수도 있겠다.

본 연구에서 북한과 기아수준을 비교한 나라들(중국, 필리핀, 아프가니스탄)의 세계기아지수는 조사 시점인 2019년을 기준으로 북한은 27.7점, 중국은 6.5점, 필리핀은 20.1점, 아프가니스탄은 33.8점이였다[33]. 80% 이상의 응답자가 북한과 중국, 북한과 필리핀 중 기아수준이 더 심각한 나라로 북한을 선택하였는데, 실제로 북한과 필리핀의 기아수준은 비슷한 수준이다. 또한 북한과 아프가니스탄 중에서는 두 나라가 비슷하다는 응답이 40% 수준으로 조사되었다. 이는 국가 간 비교 시에도 남한 성인이 북한의 기아수준에 대하여 보다 심각하게 인식하고 있음을 보여준다.

한편 북한 주민의 식량부족과 영양불량에 대한 관심은 중노년층에서 청장년층보다 더 높았다. 또한 중노년층은 청장년층보다 북한의 식량부족 및 영양불량이 다른 나라의 지원을 받아야할 정도로 심각하다고 인식하였다. 이는 청장년층이 중노년층보다 북한 주민의 영양실태를 심각한 수준으로 인식하였던 본 연구의 앞선 결과와는 다소 차이가 있다. 청장년층이 인식하는 북한 주민의 영양실태는 지표 유병률의 수치적인 관점에서는 중노년층보다 높으나, 그 수치가 의미하는 북한의 영양실태가 지원이 필요한 정도로 심각하다고는 인식하지 않았다. 즉, 북한의 영양실태에 대하여 수치적으로 높은 수준으로 인식하고 있으나 그 수치의 심각성에 대한 인식은 낮은 것으로 해석할 수 있다. 또한 중노년층은 과거의 배고픔과 국제사회의 도움을 기억하는 세대로 이에 대한 관심이 청장년층보다 클 수밖에 없으며, 식량부족과 영양불량의 심각성을 국제사회의 지원 필요성과 연결지어 인식하는 경향이 있는 것으로 생각된다.

본 연구에서는 남한 성인의 북한 주민의 영양실태에 대한 인식을 조사하기 위하여 영양실태 지표를 이용하였다. 응답자에게 영양실태 지표는 생소한 개념이므로 응답에 어려움을 겪었을 가능성이 있으나, 해당 문항에 지표의 개념과 수치에 대한 설명을 포함하여 이러한 상황에서 발생할 수 있는 측정오차를 최소화하기 위해 노력하였다.

또한 본 연구에서 북한 주민의 영양실태와 관련된 이용 가능한 대부분의 정보를 최대한 활용하였음에도 불구하고, 북한의 국가적 특수성으로 인한 정보의 한계를 언급하지 않을 수 없다. 1990년대 후반부터 UNICEF 등의 국제기구에서 비정기적으로 북한 주민들을 대상으로 계측 및 조사한 국가영양조사(NNS)와 다중지표군집조사(MICS) 결과의 보고서들[22-29]은 신뢰도 높은 자료원으로 널리 활용되고 있으나 8년 전인 2017년의 다중지표군집조사(MICS) 보고서를 마지막으로 더 이상 보고된 바 없다[22]. 이후의 북한의 영양실태 정보는 지표의 조사 내용이나 산출 방법에 대한 별도의 보고없이 추정된 지표만이 공개되고 있다. 이러한 상황에서 신뢰도 높은 정보의 선별과 정확한 해석의 중요성은 나날이 강조되고 있다. 그러나 북한 주민의 영양실태를 다루는 대부분의 논의에서 지표에 대한 충분한 이해를 바탕으로 한 해석은 찾아보기 어려운 실정이다. 본 연구에서는 한정된 정보를 최대한 활용하여 지표의 정의, 개념, 산출방법 등에 대한 심도있는 이해를 기반으로 북한 주민의 영양실태를 정확하게 파악하고자 하였다.

북한 주민의 영양실태에 대한 이해는 식량지원을 포함한 우리나라의 대북 지원 및 정책에 있어 중요한 기반이다. 본 연구 결과, 남한 성인은 북한 주민의 영양실태를 실제보다 심각한 수준으로 인식하였으며, 이러한 경향은 젊은 연령대에서 더욱 크게 나타났다. 영양실태에 대한 심각성을 인식하는 것이 지원의 필요성과 연결될 수 있다는 점에서, 이러한 결과는 식량지원을 포함한 대북지원에 대한 국민의 지지를 이끌어 내는데 유리한 방향으로 해석될 수 있다.

그러나 북한 주민의 영양실태에 대한 남한 성인의 인식과 실제의 괴리를 긍정적으로만 바라보는 것은 바람직하지 않다. 사회적 합의를 기반으로 한 효과적인 대북지원 및 정책을 수립하기 위해서는 정확한 현황 파악과 이에 대한 국민의 이해가 필

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수적이기 때문이다. 그러므로 우리 국민에게 북한 주민의 영양실태와 관련된 정확한 정보를 제공하기 위한 노력이 필요하다. 뉴스를 포함한 대중매체에서는 극단적인 탈북스토리와 같은 감정적 호소가 아닌 국민의 알권리 보장을 위한 중립적이고 정확한 정보를 제공할 필요가 있다. 본 연구에서 특히 청장년층의 젊은 세대가 북한 주민의 영양실태를 실제보다 심각하게 인식하고 있음을 고려할 때, TV 등의 전통적인 대중매체뿐 아니라 젊은 세대가 많이 이용하는 인터넷 및 모바일을 통해서도 관련 정보를 접할 수 있도록 해야 한다.

이와 더불어 북한 주민의 영양실태에 대한 국민의 이해를 돕기 위해서는 정보 제공 시 알기 쉽게 내용을 전달할 필요가 있다. 북한 주민의 영양실태에 대한 대부분의 보도와 논의들은 관련 지표의 수치를 강조하고 있지만, 정작 지표에 대한 이해는 부족한 실정이다. 그러나 영양실태 지표 자체에 대한 이해가 바탕이 되어야만 그 수치를 올바르게 해석할 수 있으며, 나아가 단순한 수치 너머 북한 주민의 영양실태를 정확히 파악할 수 있다. 그러므로 지표에 대한 이해를 바탕으로 관련 내용을 알기 쉽게 전달한다면, 북한 주민의 영양실태에 대한 우리 국민의 인식 또한 제고할 수 있을 것으로 생각된다. 특히 젊은 세대를 대상으로 한 통일교육 등에 이러한 내용을 포함한다면 북한 주민의 영양실태에 대한 우리 국민의 인식과 현황의 괴리를 줄이는데 더욱 효과적일 것으로 기대된다.

CONCLUSIONS

본 연구에서는 영양실태 지표를 이용하여 북한 주민의 영양실태의 현황 및 변화를 파악하고 남한 성인을 대상으로 이와 관련된 인식을 조사하였다. 전반적으로 북한 주민의 영양실태는 영유아를 중심으로 크게 개선되었으나 북한 주민 전반 및 가임기 여성의 영양실태는 개선되었다고 보기에는 무리가 있다. 큰 개선을 보인 영유아 영양불량률의 경우에도 남한과의 격차는 여전히 좁혀지지 않고 있다. 연령대와 상관없이 남한 성인이 인식하는 북한 주민의 영양실태는 실제보다 심각한 것으로 조사되었다. 특히 영유아 영양실태에 대하여 인식과 현황의 괴리가 크게 나타났으며, 청장년층은 중노년층보다 북한 주민의 영양실태를 더욱 심각하게 인식하는 경향을 보였다. 이러한 연구 결과는 영양실태 지표에 대한 이해를 기반으로 북한 주민의 영양실태를 정확히 파악해야 하며, 북한 주민의 영양실태에 대한 우리 국민의 인식을 제고해야함을 강조한다. 이를 통해 국민의 이해를 바탕으로 대북 지원 및 정책에 대한 사회적 합의를 이끌어낼 수 있을 것으로 기대된다.

CONFLICT OF INTEREST

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

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DATA AVAILABILITY

The survey data is not available since the researchers did not receive the written consent for the data to be shared publicly from the participants of this study.

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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

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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

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.

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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[1)]
Childcare centers				
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
Cooks				
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.
[1)]χ-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[1)]	FS group (n = 68)	Non-FS group (n = 245)	Total (n = 313)	*P*-value[2)]
I eat soup, stew, or noodle soup without leaving any broth[3)]	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[3)]	4.16 ± 0.84	4.29 ± 0.74	4.26 ± 0.76	0.237
I think side dishes should be strongly seasoned[3)]	4.15 ± 0.80	4.24 ± 0.72	4.22 ± 0.74	0.335
When stressed, I crave spicy and salty food[3)]	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.
[1)]Five-point Likert scale (5 as never to 1 as always).
[2)]Student's t-test or Welch's t-test.
[3)]Reverse coding.

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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[1)]	Before	After	*P*-value[1)]	Before	After	*P*-value[1)]
Total average	4.06 ± 0.40[2)]	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
Purchase									
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
Cooking									
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
Serving									
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.

[1)]Paired t-test.

[2)]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[1)]	Before	After	*P*-value[1)]	Before	After	*P*-value[1)]
Total average	3.63 ± 0.38[2)]	4.26 ± 0.51	< 0.001	3.77 ± 0.45	4.33 ± 0.50	< 0.001	3.74 ± 0.44	4.31 ± 0.50	< 0.001
Purchase									
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	3.75 ± 0.84	4.00 ± 0.82	< 0.001
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	3.79 ± 0.80	3.96 ± 0.82	0.003
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	4.09 ± 0.75	4.19 ± 0.74	0.057
Average	3.65 ± 0.63	4.00 ± 0.75	0.003	3.94 ± 0.63	4.06 ± 0.65	0.008	3.88 ± 0.64	4.05 ± 0.67	< 0.001
Cooking									
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	4.57 ± 0.69	4.61 ± 0.60	0.441
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	4.45 ± 0.71	4.45 ± 0.65	0.895
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	3.95 ± 0.82	4.08 ± 0.81	0.014
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	4.41 ± 0.74	4.56 ± 0.60	0.003
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	4.43 ± 0.77	4.50 ± 0.69	0.237
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	3.17 ± 1.36	4.55 ± 0.68	< 0.001
Average	4.11 ± 0.49	4.41 ± 0.49	< 0.001	4.18 ± 0.54	4.47 ± 0.51	< 0.001	4.17 ± 0.53	4.46 ± 0.50	< 0.001
Serving									
Seasonings are served separately	4.40 ± 0.88	4.47 ± 0.70	0.587	4.34 ± 0.91	4.53 ± 0.78	0.003	4.35 ± 0.91	4.52 ± 0.76	0.004
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	4.05 ± 0.85	4.25 ± 0.75	< 0.001
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	3.03 ± 1.29	4.12 ± 0.99	< 0.001
Average	3.75 ± 0.63	4.22 ± 0.60	< 0.001	3.82 ± 0.70	4.32 ± 0.68	< 0.001	3.81 ± 0.69	4.29 ± 0.67	< 0.001

Mean ± SD.

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

[1)]Paired t-test.

[2)]Five-point Likert scale (1 as never to 5 as always).

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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[1)]	Importance (n = 68)	Performance (n = 68)	*P*-value[1)]
Total average	4.06 ± 0.40[2)]	3.63 ± 0.38[3)]	< 0.001	4.27 ± 0.45	4.26 ± 0.51	0.853
Purchase						
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
Cooking						
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
Serving						
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.
[1)]Paired t-test.
[2)]Five-point Likert scale (1 as very unimportant to 5 as very important).
[3)]Five-point Likert scale (1 as never to 5 as always).

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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[1)]	Importance (n = 245)	Performance (n = 245)	*P*-value[1)]
Total average	4.28 ± 0.50[2)]	3.77 ± 0.45[3)]	< 0.001	4.37 ± 0.49	4.33 ± 0.50	0.072
Purchase						
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
Cooking						
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
Serving						
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.
[1)]Paired t-test.
[2)]Five-point Likert scale (1 as very unimportant to 5 as very important).
[3)]Five-point Likert scale (1 as never to 5 as always).

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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

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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.

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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.

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Research Article

Exploring the customer perceived value of online grocery shopping: a cross-sectional study of Korean and Chinese consumers using Means-End Chain theory

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Objectives: Despite the growing market share of online grocery shopping, there is a need to understand customer perceived value due to the ongoing advancements in information technology. This study explores the connections between attributes, consequences, and values. Additionally, it conducts a cross-country comparison of consumers' online grocery shopping behaviors to gain a deeper understanding of consumer market segments and any potential variations among them.

Methods: Data was collected through an online questionnaire survey conducted from May 1 to 15, 2024, targeting 400 consumers in Seoul, Korea, and Shanghai, China, who have experience with online grocery shopping. The survey utilized the Means-End Chain theory and association pattern technique hard laddering. Data collation and analysis were conducted using the IBM SPSS Statistics 28.0 program. The LadderUX software was employed to analyze the links between attributes, consequences, and values and create the consumer purchasing process's implication matrix and hierarchical value map (HVM).

Results: The study identified key attributes that influence online grocery shopping decisions, including delivery service, price, freshness, and quality. Korean consumers demonstrated a higher sensitivity to price (19.0%) and delivery service (17.0%). In contrast, Chinese consumers prioritized delivery service (15.0%) and after-sales service (14.8%). Commonly cited consequences included time saving (12.6% for Koreans, 11.3% for Chinese), whereas prevalent values encompassed convenience (36.8% for Koreans, 19.6% for Chinese) and economic value (26.6% for Koreans, 14.7% for Chinese). The HVM underscored these insights, highlighting diverse consumer preferences and country-specific nuances.

Conclusions: The findings highlight the current state of online food consumption and consumers' value systems, revealing variations among countries. These findings offer empirical insights that can be used to create customized global marketing strategies that resonate with various consumer preferences and market dynamics.

Keywords: consumer behavior; food preferences; perception; online systems; surveys and questionnaires

INTRODUCTION

The Internet's continuous innovation has significantly integrated e-commerce into daily life and consumption habits [1,2]. In 2023, global retail e-commerce

sales were estimated to have reached $5.8 trillion, with projections suggesting they will surpass $8.0 trillion by 2027 [3]. The rise of online sales channels is also transforming how brands sell products to consumers [4]. Online grocery shopping, a form of e-commerce, allows individuals and businesses to purchase food and various household supplies through e-commerce websites or mobile applications [5]. In South Korea, one of the pioneers of online grocery shopping with a well-developed Internet infrastructure [5], food and beverage transactions in online shopping malls increased from 13.4 trillion won in 2019 to 29.8 trillion won in 2023 [6]. Considering that the growth rate of the total online shopping transaction amount over the past five years was 67.5%, the growth rate of food and beverage online transactions was even more significant at 122.4%. In contrast, the Chinese online market started late and is still in the emerging stage, with insufficient industry regulation. China's online retail market grew from 10.6 trillion yuan in 2019 to 15.4 trillion yuan in 2023, a growth rate of 45.2% over the past five years. Among them, the online grocery market is growing rapidly, increasing from 279.6 billion yuan to 642.4 billion yuan, a 129.8% increase [7,8].

As the potential of online grocery shopping is explored, early research has begun to focus on consumer behavior. For instance, perceived risks, trust, satisfaction, and attitudes have been identified as effective predictors of consumers' willingness to use online grocery shopping again, while social norms, compatibility, and relative attitudes played a key role in explaining consumers' acceptance of online grocery shopping [9-11]. However, the underlying reasons why consumers adopt these behavioral factors have been largely neglected. Hsiao *et al*. [12] posited that customer evaluations of quality attributes and usage consequences can be encapsulated as customer perceived value (CPV). A service or product positively influences corresponding behaviors and beliefs when it is perceived as valuable [13]. Despite its acknowledged significance in shaping behavioral intentions, CPV remains inconsistently defined. This study utilizes the definitions provided by Zeithaml [14] and Monroe & Chapman [15] definitions to define CPV as an overall evaluation of online grocery shopping, considering the trade-off between cost and benefit. Additionally, certain values manifest differently depending on specific behaviors or across various populations [16]. Previous discussions on CPV measurement have largely been context-dependent; for instance, Mohd-Any *et al*. [17] argued that CPV in online environments should be distinct from that in physical stores, while Dastane *et al*. [18] further validate these differences in mobile versus general online contexts. Existing research in this area may overlook key details, as most value scales were not originally designed to measure consumers in the context of online grocery shopping [19]. In addition, most studies on online grocery shopping have been conducted in relatively developed markets or in countries outside Asia. Few studies have been conducted in major Asian markets, particularly those comparing online grocery shopping behaviors between developed and developing countries. Therefore, this study selects South Korea, a representative developed market, and China, a developing market, to explore the CPV of online grocery shopping in two major Asian markets.

In two representative Asian markets, Korean consumers exhibit a notable inclination toward online grocery shopping [5], whereas urbanization, climate changes, supply chain issues, and the impact of COVID-19 drive China's market growth. Beyond reaching market maturity, consumer behaviors and preferences vary significantly between Korean and Chinese contexts. Choi *et al*. [20] discovered that Korean consumers' online grocery shopping channel choices are influenced by demographic factors such as residential population density, household composition, education level, and price sensitivity, with ease of use and delivery services also playing a role. Customer preferences in China are influenced by various factors, including product attributes, retailer reputation, and socio-demographic factors [21]. Other key factors include origin, food safety, green perceptions, sensory characteristics, and online reviews [22]. Thus, conducting a cross-country comparison between Korea and China is essential to comprehend consumer perspectives on online grocery shopping across different levels of market maturity.

Although prior research has validated the importance of CPV in explaining consumer behavioral decisions, to further explore and explain the process of CPV formation, the Means-End Chain (MEC) theory, which is

a common method for exploring cognitive processes through hierarchical analyses, provides theoretical support by revealing the abstract cognition that may result from the attributes of a product or service, thus being widely applied [23]. It achieves this by examining the cognitive processes involved in the hierarchical links between product/service attributes, consequences, and values. Based on Reynolds & Olson's [24] three cognitive levels, MEC theory offers a robust framework for understanding consumer decision-making. MEC has been extensively used to assess consumer preferences for various products and services [13,23]. Examples include online shopping and mobile payments [13,25]. Beyond the online context, applying MEC theory extends to various fields, such as education, tourism, and healthcare [26-28]. Hard laddering techniques are commonly employed to obtain hierarchical information. Hard laddering, which involves selecting from predetermined conceptual codes, mitigates researcher bias and supports a large sample. However, it limits the correlation among specific factors, which may result in superficial conclusions [29]. The association pattern technique (APT), which is an advanced technique in hard laddering, tackles this issue by permitting forked answers, capturing results akin to qualitative studies [30]. APT's utility, particularly in food sector research, has been consistently validated [31].

Therefore, this study employs the MEC and APT laddering techniques to elicit attributes, consequences, and values associated with online grocery shopping. Most research on online grocery shopping has been conducted in relatively developed markets or countries. To bridge this gap and advance the digital market transformation of groceries, we identify the main attribute-consequence-value (ACV) pathways. Moreover, we explore and discuss consumers' CPV regarding online grocery shopping, focusing on differences across countries by constructing a comprehensive implication matrix and hierarchical value map (HVM). By gaining a better understanding of consumers' online grocery shopping behavior and identifying the factors that consumers value most when making purchase decisions, this research aims to adapt to the rapidly developing environment of cross-border shopping, thereby expanding the scope of online shopping applications. Additionally, this study will contribute to the development of the strategies for entering international markets and invigorating the domestic online grocery sector. It will also provide insights for e-suppliers to refine their business strategies in the highly competitive online retail market, ultimately protecting consumers. Furthermore, the findings will serve as a reference for online market policy formulation.

METHODS

Ethics statement

The informed written consent was obtained from each participant. The Institutional Review Board of Kookmin University approved this study (approval number: KMU-202403-HR-401). All participants were required to read a description of the content and purpose of the study before the beginning of the survey and to provide an online consent form.

1. Research subject and period

This study utilized online questionnaires to survey online grocery shopping consumers in Seoul, Korea, and Shanghai, China. Data was collected from May 1 to 15, 2024, through an online recruitment notice. The quota sampling method was applied based on age and gender. The sample included 400 consumers (200 in Korea and 200 in China) who had experienced online grocery shopping within the last year. All responses were analyzed, with an equal number of 200 responses from each country.

2. Content of the survey

The survey questions were formulated based on a context analysis of previous research [13,18,31-35]. The survey investigated consumers' demographic characteristics, online grocery shopping behaviors, and hierarchy of attributes, consequences, and values. Regarding consumers' demographic characteristics, it examined consumers' gender, age, education, occupation, monthly income, and household composition. Furthermore, it investigated their online grocery shopping behaviors, including purchaser, purchasing frequency, frequency increase, and online shopping channel. Finally, the MEC hierarchy of attributes, consequences, and values was explored using the APT laddering technique. To identify the ACV associated with online grocery

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shopping, a systematic review of the literature was conducted. A pre-survey study identified 23 online grocery shopping attributes, which were categorized into four dimensions: service factors, food factors, surroundings, and antecedent states [32-34]. Several prior studies were referenced to derive consequence variables for the second stage in the MEC, identifying 21 consequence variables used in this study [32-34]. Since CPV can be an abstract personal factor, it may be difficult to express directly in words. Previous research has suggested providing an a priori value scale to give subjects some reference [31]. Ultimately, the value scale proposed by Dastane *et al.* [18] and other previous studies were used as the basis for this study, utilizing the 10 values as the scope of measurement.

3. Data analysis methods

Data was collated and analyzed using IBM SPSS Statistics 28.0 (IBM Co.). The analysis included frequency analysis, descriptive analysis, chi-square or Fisher's exact test, and cross-country comparisons of demographic characteristics and online grocery shopping consumption patterns. The LadderUX software [36] was utilized to analyze and establish relationships between attributes, consequences, and values and construct the implication matrix and HVM. When plotting the HVM, a cut-off value was used to avoid loss of results and reduce complexity [37]. The cut-off characterizes the minimum number of total links (direct and indirect) between the elements to be depicted in the HVM. After iterative debugging based on the number of samples and rules of thumb, this study consistently validated the establishment of a cut-off value of 7, indicating that links occurring less than 7 times are not displayed. Each line represents the perceived association of online grocery shopping consumers, and the five lines with the highest number of associations are bolded to demonstrate key connections.

RESULTS

1. Demographic characteristics

Table 1 presents the demographic characteristics of Korean and Chinese consumers. For both Korea and China, the proportion of men (n = 100, 50.0%) and women (n = 100, 50.0%) was equal. In Korea, 20.0% of respondents (n = 40) were distributed across age groups of 20–29, 30–39, 40–49, 50–59, and 60 years and older. More than 50.0% of the Korean respondents were university graduates (n = 144, 72.0%), while 47.0% were office workers (n = 94). The highest proportion of Korean respondents reported a monthly income of 3,000,000–4,999,999 Korean Won (KRW) (n = 66, 33.0%). The most prevalent household composition was four-person households (n = 53, 26.5%). The largest groups in China comprised respondents aged 50–59 and 60 years and older (n = 42, 21.0% each). Seventy-five percent of Chinese respondents were university graduates (n = 150), and 59.5% were employed in office settings (n = 119). Among the Chinese respondents, the largest proportion reported a monthly income of over 10,000 Chinese Yuan (CNY) (n = 67, 33.5%). Three-person households were the most common (n = 83, 41.5%).

2. Online grocery shopping behaviors

Table 2 compares online grocery shopping behaviors between Korean and Chinese consumers. When purchasing groceries online, most respondents from both Korea and China typically make the purchases themselves (Korean: n = 179, 89.5%; Chinese: n = 185, 92.5%). In both countries, most respondents reported an increase in online grocery shopping frequency in the current year compared to the previous one, with the highest proportion answering "maybe yes" (Korean: n = 91, 45.5%; Chinese: n = 90, 45.0%). Regarding the frequency of online grocery shopping, Korean consumers predominantly shopped once a week (n = 64, 32.0%), whereas Chinese consumers indicated a higher frequency of shopping once every 2–3 days (n = 95, 47.5%). A significant percentage of respondents from both groups expressed a preference for using both online and offline shopping channels equally (Korean: n = 67, 33.5%; Chinese: n = 72, 36.0%). However, Korean consumers demonstrated a preference for physical shops more than Chinese consumers, who preferred online grocery shopping. Most Korean consumers primarily utilized online shopping platforms (n = 162, 36.4%) for their purchases, typically spending between 30,000–50,000 KRW per transaction (n = 76, 38.0%). They most frequently purchased ready-to-cook processed food (n

Table 1. Demographic characteristics

Characteristic	Total (n = 400)	Korean (n = 200)	Chinese (n = 200)	χ^2
Gender				0.000
Man	200 (50.0)	100 (50.0)	100 (50.0)	
Woman	200 (50.0)	100 (50.0)	100 (50.0)	
Age (year)				0.200
20–29	80 (20.0)	40 (20.0)	40 (20.0)	
30–39	78 (19.5)	40 (20.0)	38 (19.0)	
40–49	78 (19.5)	40 (20.0)	38 (19.0)	
50–59	82 (20.5)	40 (20.0)	42 (21.0)	
≥ 60	82 (20.5)	40 (20.0)	42 (21.0)	
Education				4.315
Junior high school	6 (1.5)	1 (0.5)	5 (2.5)	
High school	44 (11.0)	26 (13.0)	18 (9.0)	
Bachelor's	294 (73.5)	144 (72.0)	150 (75.0)	
Master's or above	56 (14.0)	29 (14.5)	27 (13.5)	
Occupation				43.899***
Office worker	213 (53.3)	94 (47.0)	119 (59.5)	
Student	34 (8.5)	12 (6.0)	22 (11.0)	
Homemaker	33 (8.3)	28 (14.0)	5 (2.5)	
Self-employed	26 (6.5)	15 (7.5)	11 (5.5)	
Specialized worker	25 (6.3)	22 (11.0)	3 (1.5)	
Service industrial	23 (5.8)	11 (5.5)	12 (6.0)	
Public official	11 (2.8)	2 (1.0)	9 (4.5)	
Production worker	11 (2.8)	3 (1.5)	8 (4.0)	
Others	24 (6.0)	13 (6.5)	11 (5.5)	
Monthly income				-
Below 1,000,000 KRW or 4,000 CNY	34 (8.5)	15 (7.5)	19 (9.5)	
1,000,000-2,999,999 KRW or 4,000–5,999 CNY	84 (21.0)	57 (28.5)	27 (13.5)	
3,000,000–4,999,999 KRW or 6,000–7,999 CNY	107 (26.8)	66 (33.0)	41 (20.5)	
5,000,000–6,999,999 KRW or 8,000–9,999 CNY	70 (17.5)	29 (14.5)	41 (20.5)	
More than 7,000,000 KRW or 10,000 CNY	93 (23.3)	26 (13.0)	67 (33.5)	
No regular income	12 (3.0)	7 (3.5)	5 (2.5)	
Composition of a family				45.836***
1	50 (12.5)	41 (20.5)	9 (4.5)	
2	66 (16.5)	44 (22.0)	22 (11.0)	
3	134 (33.5)	51 (25.5)	83 (41.5)	
4	110 (27.5)	53 (26.5)	57 (28.5)	
5	34 (8.5)	11 (5.5)	23 (11.5)	
More than 6	6 (1.5)	0 (0.0)	6 (3.0)	

n (%).
KRW, Korean Won; CNY, Chinese Yuan.
***P < 0.001 by chi-square test.

= 143, 11.8%), followed by milk and dairy products (n = 126, 10.4%). In contrast, Chinese consumers preferred online supermarket malls (n = 133, 26.5%). Among the various categories, fruits were the most frequently purchased (n = 167, 13.7%), followed by milk and dairy products (n = 143, 11.7%). The average expenditure per transaction among Chinese consumers ranged from 50–99 CNY (n = 74, 37.0%).

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Table 2. Online grocery shopping behaviors

Dimension	Total (n = 400)	Korean (n = 200)	Chinese (n = 200)	χ^2
Online purchaser				2.670
Self	364 (91.0)	179 (89.5)	185 (92.5)	
Parents	22 (5.5)	11 (5.5)	11 (5.5)	
Others	14 (3.5)	10 (5.0)	4 (2.0)	
Online frequency increase				12.676*
Absolutely not	8 (2.0)	3 (1.5)	5 (2.5)	
Maybe not	29 (7.3)	10 (5.0)	19 (9.5)	
Ordinary	135 (33.8)	80 (40.0)	55 (27.5)	
Maybe yes	181 (45.3)	91 (45.5)	90 (45.0)	
Absolutely yes	47 (11.8)	16 (8.0)	31 (15.5)	
Online frequency				50.609***
Daily	23 (5.8)	2 (1.0)	21 (10.5)	
Once every 2–3 days	149 (37.3)	54 (27.0)	95 (47.5)	
Once every week	115 (28.8)	64 (32.0)	51 (25.5)	
2–3 times a month	83 (20.8)	57 (28.5)	26 (13.0)	
Once every month	20 (5.0)	16 (8.0)	4 (2.0)	
Once every 2–3 months	10 (2.5)	7 (3.5)	3 (1.5)	
Shopping channel				15.403**
Almost all through physical stores	25 (6.3)	19 (9.5)	6 (3.0)	
Physical stores more than online	82 (20.5)	50 (25.0)	32 (16.0)	
Half and half	139 (34.8)	67 (33.5)	72 (36.0)	
Online more than physical stores	113 (28.3)	46 (23.0)	67 (33.5)	
Almost all through online	41 (10.3)	18 (9.0)	23 (11.5)	
Single spending amount (KRW)				-
Below 10,000	2 (0.5)	2 (1.0)	-	
10,000–20,000	22 (5.5)	22 (11.0)	-	
20,000–30,000	34 (8.5)	34 (17.0)	-	
30,000–50,000	76 (19.0)	76 (38.0)	-	
50,000–70,000	48 (12.0)	48 (24.0)	-	
70,000–100,000	15 (3.8)	15 (7.5)	-	
More than 100,000	3 (0.8)	3 (1.5)	-	
Single spending amount (CNY)				-
Below 50	31 (7.8)	-	31 (15.5)	
50–99	74 (18.5)	-	74 (37.0)	
100–199	59 (14.8)	-	59 (29.5)	
200–299	25 (6.3)	-	25 (12.5)	
300–399	5 (1.3)	-	5 (2.5)	
More than 400	6 (1.5)	-	6 (3.0)	
Online grocery shopping channels[1)]				-
Online shopping platforms (Coupang, Meituan maicai, etc.)	283 (29.9)	162 (36.4)	121 (24.2)	
Online supermarket mall (E-mart mall, Rt-mart mall, etc.)	231 (24.4)	98 (22.0)	133 (26.5)	
Food specializing mall (Oasis, Womai, etc.)	142 (15.0)	83 (18.7)	59 (11.8)	
Home shopping (CJ O-shopping, CNRmall, etc.)	117 (12.4)	35 (7.9)	82 (16.4)	
Quick commerce (B-mart, Dingdong [Cayman] limited, etc.)	102 (10.8)	25 (5.6)	77 (15.4)	
Online department store mall (SSG.com, Jd.com, etc.)	51 (5.4)	27 (6.1)	24 (4.8)	
Others	20 (2.1)	15 (3.4)	5 (1.0)	
Total	946 (100.0)	445 (100.0)	501 (100.0)	

(Continued on the next page)

Table 2. (Continued)

Dimension	Total (n = 400)	Korean (n = 200)	Chinese (n = 200)	χ^2
Online grocery shopping types[1)]	946 (100.0)	445 (100.0)	501 (100.0)	-
Fruits	259 (10.6)	92 (7.6)	167 (13.7)	
Vegetables	223 (9.2)	93 (7.7)	130 (10.6)	
Meat	230 (9.4)	112 (9.2)	118 (9.7)	
Eggs	209 (8.6)	95 (7.8)	114 (9.3)	
Aquatic products	140 (5.7)	69 (5.7)	71 (5.8)	
Grains and their products	184 (7.6)	101 (8.3)	83 (6.8)	
Milk and dairy products	269 (11.0)	126 (10.4)	143 (11.7)	
Ready-to-cook processed foods	231 (9.5)	143 (11.8)	88 (7.2)	
Ready-to-eat processed foods	216 (8.9)	117 (9.6)	99 (8.1)	
Processed meat products	183 (7.5)	95 (7.8)	88 (7.2)	
Processed seafood products	120 (4.9)	77 (6.3)	43 (3.5)	
Other processed foods	172 (7.1)	94 (7.7)	78 (6.4)	
Total	2,436 (100.0)	1,214 (100.0)	1,222 (100.0)	

n (%).
KRW, Korean Won; CNY, Chinese Yuan.
[1)]Multiple responses.
*P < 0.05, **P < 0.01, ***P < 0.001 by chi-square or Fishers' exact test.

3. Means-End Chain analysis of consumers

We conducted MEC analysis to understand the values associated with online grocery shopping. The results are presented in Table 3.

Regarding attributes, Korean consumers prioritize price (n = 114, 19.0%) as the most important factor, followed by delivery service (n = 102, 17.0%), freshness (n = 73, 12.2%), quality (n = 67, 11.2%), and marketing promotions (n = 50, 8.3%). Conversely, Chinese consumers prioritize delivery service (n = 90, 15.0%), followed by after-sales service (n = 89, 14.8%), reviews (n = 49, 8.2%), price (n = 43, 7.2%), and quality (n = 43, 7.2%).

Regarding consequences, save time (n = 227, 12.6%) is the most frequently cited benefit among Korean consumers, followed by price comparison (n = 163, 9.1%), financial savings (n = 158, 8.8%), fast shipping (n = 154, 8.6%) and delivery on time (n = 139, 7.7). Similarly, Chinese consumers also prioritize save time (n = 203, 11.3%), followed by problem-solving (n = 177, 9.8%), service guarantee (n = 164, 9.1%), fast shipping (n = 152, 8.4%) and delivery on time (n = 146, 8.1%).

Regarding values, Korean consumers predominantly prioritize convenience (n = 663, 36.8%), followed by economic (n = 479, 26.6%) and trust (n = 204, 11.3%). In contrast, Chinese consumers, prioritize convenience (n = 353, 19.6%), followed by economic (n = 265, 14.7%) and superiority (n = 233, 12.9%).

4. Implication matrix

Based on the hard laddering analysis results, the data collected was used to create the implication matrix, which illustrates the overall connections among the elements. The rows and columns show the relationships between ACV. Tables 4-7 depict the number of links between attributes (1–23) and consequences (24–44) and between consequences (24–44) and values (45–54), respectively. As shown in Tables 4-7, each cell of the implication matrix contains two numbers separated by a decimal point. The number to the left of the decimal point signifies the count of direct links, whereas the number to the right denotes the count of indirect links.

In the implication matrix of Korea, A13 (price) is most prominently connected to C32 (price comparison) in the attributes-consequences implication matrix (Table 4). The number 62|0 between A13 (price) and C32 (price comparison) indicates that A13 (price) directly leads to C32 (price comparison) 62 times, while A13 (price) indirectly leads to C32 (price comparison) 0 times through other mediating structures. In Table 5, the consequences-values implication matrix, C37 (financial savings) is

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Table 3. Attribute-consequence-value coding content

Category[1)]	Total (n = 400)	Korean (n = 200)	Chinese (n = 200)
Attributes			
1. Cross-platform service	21 (1.8)	7 (1.2)	14 (2.3)
2. Delivery service	192 (16.0)	102 (17.0)	90 (15.0)
3. After-sales service	105 (8.8)	16 (2.7)	89 (14.8)
4. Search service	44 (3.7)	13 (2.2)	31 (5.2)
5. Internet homepage and application	57 (4.8)	35 (5.8)	22 (3.6)
6. Technology innovation	15 (1.3)	3 (0.5)	12 (2.0)
7. Review	85 (7.1)	36 (6.0)	49 (8.2)
8. Platform reputation	38 (3.2)	7 (1.2)	31 (5.2)
9. Marketing promotions	79 (6.6)	50 (8.3)	29 (4.8)
10. Safety	31 (2.6)	11 (1.8)	20 (3.3)
11. Packaging	25 (2.1)	14 (2.3)	11 (1.8)
12. Brand	24 (2.0)	11 (1.8)	13 (2.2)
13. Price	157 (13.1)	114 (19.0)	43 (7.2)
14. Type	56 (4.7)	25 (4.2)	31 (5.2)
15. Freshness	111 (9.3)	73 (12.2)	38 (6.3)
16. Quality	110 (9.2)	67 (11.2)	43 (7.2)
17. Distance perception	4 (0.3)	3 (0.5)	1 (0.2)
18. Weather factor	5 (0.4)	0 (0.0)	5 (0.8)
19. Transmission of disease	0 (0.0)	0 (0.0)	0 (0.0)
20. Work factor	5 (0.4)	1 (0.2)	4 (0.7)
21. Home factor	5 (0.4)	0 (0.0)	5 (0.8)
22. Living status	10 (0.8)	1 (0.2)	9 (1.5)
23. Consumption burden	21 (1.8)	11 (1.8)	10 (1.7)
Total	1,200 (100.0)	600 (100.0)	600 (100.0)
Consequence			
24. Convenient access	262 (7.3)	131 (7.3)	131 (7.3)
25. Delivery on time	285 (7.9)	139 (7.7)	146 (8.1)
26. Save time	430 (11.9)	227 (12.6)	203 (11.3)
27. Stay on budget	221 (6.1)	82 (4.6)	139 (7.7)
28. Stress decrease	173 (4.8)	44 (2.4)	129 (7.2)
29. Problem solving	220 (6.1)	43 (2.4)	177 (9.8)
30. Service guarantee	209 (5.8)	45 (2.5)	164 (9.1)
31. Product comparison	165 (4.6)	73 (4.1)	92 (5.1)
32. Price comparison	248 (6.9)	163 (9.1)	85 (4.7)
33. Grocery supplies	132 (3.7)	80 (4.4)	52 (2.9)
34. No need to go out	180 (5.0)	127 (7.1)	53 (2.9)
35. Sensory quality	90 (2.5)	48 (2.7)	42 (2.3)
36. Food security	180 (5.0)	121 (6.7)	59 (3.3)
37. Financial savings	185 (5.1)	158 (8.8)	27 (1.5)
38. Free choice	89 (2.5)	39 (2.2)	50 (2.8)
39. Can do other things	58 (1.6)	35 (1.9)	23 (1.3)
40. Making a difference	20 (0.6)	6 (0.3)	14 (0.8)
41. Avoid for health	32 (0.9)	18 (1.0)	14 (0.8)
42. Bulk purchase	45 (1.3)	23 (1.3)	22 (1.2)
43. Fast shipping	306 (8.5)	154 (8.6)	152 (8.4)
44. Consumption promotion	70 (1.9)	44 (2.4)	26 (1.4)
Total	3,600 (100.0)	1,800 (100.0)	1,800 (100.0)

(Continued on the next page)

Table 3. (Continued)

Category[1)]	Total (n = 400)	Korean (n = 200)	Chinese (n = 200)
Values			
45. Universal	210 (5.8)	84 (4.7)	126 (7.0)
46. Convenience	1,015 (28.2)	663 (36.8)	352 (19.6)
47. Economic	743 (20.6)	479 (26.6)	264 (14.7)
48. Hedonic	195 (5.4)	39 (2.2)	156 (8.7)
49. Superiority	303 (8.4)	70 (3.9)	233 (12.9)
50. Ease of use	222 (6.2)	82 (4.6)	140 (7.8)
51. Compatible	164 (4.6)	37 (2.1)	127 (7.0)
52. Normative	159 (4.4)	10 (0.6)	149 (8.3)
53. Stability	254 (7.1)	132 (7.3)	122 (6.8)
54. Trust	335 (9.3)	204 (11.3)	131 (7.3)
Total	3,600 (100.0)	1,800 (100.0)	1,800 (100.0)

n (%).
[1)]Multiple responses.

most prominently connected to V47 (economic). C37 (financial savings) directly leads to V47 (economic) 118 times, while C37 (financial savings) indirectly leads to V47 (economic) 0 times through other intermediary structures. Similarly, the results of Chinese implication matrix show that A2 (delivery service) is most prominently connected to C25 (delivery on time) in the attributes-consequences implication matrix (Table 6). The number 55|0 between A2 (delivery service) and C25 (delivery on time) indicates that A2 (delivery service) directly leads to C25 (delivery on time) 55 times, while A2 (delivery service) indirectly leads to C25 (delivery on time) 0 times through other mediating structures. In the consequences-values implication matrix, C26 (save time) is most prominently connected to V46 (convenience) (Table 7). C26 (save time) directly leads to V46 (convenience) 80 times, while C26 (save time) indirectly leads to V46 (convenience) 0 times through other intermediary structures.

5. Hierarchical value map

Each link within the HVM is considered a motivational basis for consumer behavior. Thus, HVM provides insight into consumers' hierarchical cognitive structure and enables researchers to gain direct insight into consumer motivations. The HVM represents the main results of the study and is depicted in Figures 1 and 2 to increase the depth of information. All HVMs use a cut-off of 7 and retain the 5 most dominant paths.

Figure 1 shows the Korean results. Five major paths were found from attributes to consequences. The most salient links were A2 (delivery service) to C25 (delivery on time), A2 (delivery service) to C26 (save time), A2 (delivery service) to C43 (fast shipping), A13 (price) to C32 (price comparison) and A13 (price) to C37 (financial savings). Five major pathways were found from consequences to values, the most prominent links were C26 (save time) to V46 (convenience), C34 (no need to go out) to V46 (convenience), C43 (fast shipping) to V46 (convenience), C32 (price comparison) to V47 (economic), and C37 (financial savings) to V47 (economic). Finally, four major pathways were found from attributes to consequences to values. The most salient links were A2 (delivery service) to C26 (save time) to V46 (convenience), A2 (delivery service) to C43 (fast shipping) to V46 (convenience), A13 (price) to C32 (price comparison) to V47 (economic), and A13 (price) to C37 (financial savings) to V47 (economic).

Figure 2 shows the Chinese results. Five major paths were found from attributes to consequences. The most salient links were A2 (delivery service) to C25 (delivery on time), A2 (delivery service) to C26 (save time), A2 (delivery service) to C43 (fast shipping), A3 (after-sales service) to C29 (problem solving), and A3 (after-sales service) to C30 (service guarantee). Five main paths were found from consequences to values, the most prominent links were C25 (delivery on time) to V46 (convenience), C26 (save time) to V46 (convenience),

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Table 4. Implication matrix between attributes and consequences of Korean consumers (n = 200)

	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
1	4|0	4|0	4|0	2|0	-	1|0	1|0	-	2|0	1|0	-	-	-	-	-	1|0	-	-	-	-	1|0
2	27|0	49|0	48|0	7|0	3|0	9|0	3|0	4|0	20|0	12|0	34|0	4|0	12|0	14|0	4|0	6|0	1|0	-	4|0	47|0	1|0
3	4|0	7|0	7|0	-	2|0	5|0	4|0	2|0	2|0	-	2|0	1|0	2|0	3|0	1|0	2|0	-	-	-	3|0	1|0
4	5|0	4|0	6|0	2|0	3|0	-	1|0	1|0	2|0	2|0	3|0	-	2|0	4|0	1|0	1|0	-	-	-	2|0	-
5	20|0	15|0	19|0	1|0	1|0	2|0	1|0	3|0	8|0	2|0	7|0	1|0	4|0	4|0	3|0	1|0	-	-	-	12|0	1|0
6	1|0	-	1|0	1|0	-	-	-	-	1|0	-	-	-	1|0	2|0	1|0	-	-	-	1|0	-	-
7	6|0	7|0	16|0	6|0	3|0	3|0	7|0	15|0	9|0	1|0	5|0	2|0	8|0	6|0	2|0	-	1|0	2|0	-	4|0	3|0
8	2|0	1|0	4|0	-	-	1|0	1|0	-	1|0	1|0	1|0	-	-	1|0	2|0	2|0	-	-	-	3|0	1|0
9	8|0	9|0	21|0	11|0	8|0	6|0	3|0	3|0	21|0	4|0	6|0	4|0	3|0	23|0	-	3|0	2|0	1|0	2|0	7|0	5|0
10	3|0	1|0	3|0	1|0	-	1|0	2|0	-	4|0	3|0	6|0	-	3|0	2|0	-	1|0	-	1|0	-	1|0	1|0
11	2|0	3|0	4|0	-	1|0	1|0	2|0	3|0	1|0	1|0	4|0	-	6|0	2|0	-	4|0	-	1|0	-	6|0	1|0
12	2|0	1|0	4|0	-	-	1|0	-	3|0	4|0	2|0	3|0	1|0	2|0	4|0	1|0	1|0	1|0	-	-	1|0	2|0
13	20|0	13|0	35|0	33|0	8|0	5|0	5|0	14|0	62|0	8|0	17|0	6|0	13|0	48|0	7|0	4|0	-	2|0	6|0	22|0	12|0
14	5|0	3|0	8|0	4|0	-	2|0	-	8|0	5|0	8|0	6|0	3|0	4|0	6|0	6|0	2|0	1|0	-	1|0	2|0	3|0
15	13|0	10|0	24|0	4|0	7|0	3|0	4|0	9|0	10|0	16|0	18|0	15|0	30|0	17|0	4|0	3|0	-	4|0	3|0	21|0	4|0
16	7|0	8|0	16|0	9|0	6|0	2|0	10|0	7|0	9|0	19|0	10|0	10|0	30|0	16|0	6|0	2|0	-	7|0	3|0	18|0	6|0
17	2|0	3|0	2|0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1|0	1|0	-
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	1|0	-	-	-	-	-	-	-	-	-	1|0	-	-	1|0	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	1|0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1|0	1|0
23	-	1|0	3|0	2|0	1|0	1|0	1|0	2|0	3|0	2|0	4|0	1|0	1|0	4|0	1|0	1|0	-	-	1|0	3|0	1|0

0|0, direct linkages; |, indirect linkages; 1–23, attributes; 24–44, consequences.

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Table 5. Implication matrix between consequences and values of Korean consumers (n = 200)

	45	46	47	48	49	50	51	52	53	54
24	13|0	61|0	18|0	1|0	5|0	8|0	-	1|0	8|0	16|0
25	8|0	72|0	22|0	3|0	8|0	3|0	2|0	1|0	5|0	15|0
26	6|0	134|0	48|0	1|0	6|0	8|0	3|0	2|0	6|0	12|0
27	3|0	13|0	58|0	2|0	1|0	1|0	-	-	3|0	2|0
28	2|0	6|0	5|0	7|0	4|0	2|0	1|0	1|0	7|0	9|0
29	3|0	8|0	4|0	1|0	2|0	8|0	1|0	-	6|0	10|0
30	4|0	7|0	5|0	-	2|0	2|0	3|0	2|0	2|0	18|0
31	9|0	14|0	14|0	2|0	8|0	8|0	2|0	-	5|0	12|0
32	9|0	26|0	99|0	2|0	5|0	3|0	4|0	1|0	5|0	10|0
33	6|0	29|0	15|0	2|0	-	8|0	1|0	-	9|0	12|0
34	4|0	97|0	9|0	1|0	6|0	4|0	-	-	3|0	2|0
35	1|0	9|0	8|0	2|0	1|0	2|0	3|0	-	8|0	14|0
36	1|0	16|0	9|0	3|0	-	2|0	5|0	-	48|0	38|0
37	3|0	15|0	118|0	1|0	3|0	3|0	6|0	-	-	7|0
38	5|0	16|0	4|0	1|0	4|0	4|0	1|0	1|0	-	3|0
39	1|0	21|0	7|0	-	3|0	1|0	1|0	1|0	-	-
40	1|0	-	1|0	3|0	1|0	-	-	-	-	-
41	-	-	1|0	1|0	1|0	-	-	-	11|0	4|0
42	-	19|0	2|0	-	1|0	-	-	-	-	-
43	3|0	88|0	25|0	2|0	5|0	9|0	2|0	-	6|0	14|0
44	3|0	12|0	8|0	3|0	4|0	6|0	2|0	-	-	6|0
22	-	-	-	-	1|0	-	-	-	-	-
23	-	1|0	3|0	2|0	1|0	1|0	1|0	2|0	3|0	2|0

0|0, direct linkages; |, indirect linkages; 24–44, consequences; 45–54, values.

C43 (fast shipping) to V46 (convenience), C27 (stay on budget) to V47 (economic), and C24 (convenient access) to V46 (convenience). Ultimately, three major pathways were found from attributes to consequences to values. The most salient links were A2 (delivery service) to C25 (delivery on time) to V46 (convenience), A2 (delivery service) to C26 (save time) to V46 (convenience), and A2 (delivery service) to C43 (fast shipping) to V46 (convenience).

DISCUSSION

This study utilizes the MEC approach to reveal the CPV of online grocery shopping in Korea and China. The online channel has become increasingly innovative; thus, consumers have become more sophisticated and discerning because of the diminished constraints of shopping online and the increased diversity of products, services, information, technology, and purchasing channels [38]. Therefore, relying solely on offering variety and low prices may not always be an effective strategy for attracting consumers [39,40]. Thus this study aims to comprehend the CPV of online grocery shopping.

Both Korean and Chinese consumers surveyed actively engage in online grocery shopping. However, other findings exhibit significant cross-country differences. Compared with Korean consumers, Chinese consumers exhibit a more pronounced growth trend in online grocery shopping. Given the rapid expansion of the Chinese market, it is unsurprising that our survey could yield these results. Specifically, Korean consumers typically shop online once a week, whereas Chinese consumers shop online 2–3 times per week. Additionally, although Chinese consumers prefer online channels, Korean consumers show a greater inclination toward visiting physical stores. Chinese consumers predominantly utilize online supermarket malls and platforms for shopping, whereas Koreans prefer online shopping

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Table 6. Implication matrix between attributes and consequences of Chinese consumers (n = 200)

	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
1	8|0	5|0	7|0	5|0	1|0	2|0	2|0	1|0	1|0	-	2|0	1|0	-	-	-	-	-	-	1|0	6|0	-
2	30|0	55|0	47|0	11|0	16|0	19|0	14|0	8|0	4|0	3|0	8|0	-	3|0	2|0	1|0	2|0	-	-	1|0	45|0	1|0
3	18|0	19|0	30|0	21|0	30|0	39|0	35|0	10|0	5|0	7|0	5|0	4|0	6|0	3|0	4|0	4|0	-	2|0	1|0	24|0	1|0
4	8|0	10|0	14|0	6|0	5|0	7|0	8|0	8|0	6|0	2|0	2|0	1|0	-	1|0	3|0	-	1|0	-	-	8|0	3|0
5	11|0	6|0	4|0	4|0	2|0	8|0	7|0	5|0	3|0	-	1|0	-	3|0	1|0	3|0	1|0	2|0	-	-	5|0	-
6	1|0	1|0	1|0	3|0	8|0	5|0	5|0	3|0	3|0	1|0	1|0	-	1|0	-	-	-	1|0	1|0	-	1|0	-
7	5|0	8|0	16|0	12|0	13|0	17|0	15|0	12|0	8|0	7|0	1|0	5|0	4|0	-	6|0	-	2|0	3|0	1|0	10|0	2|0
8	3|0	7|0	15|0	6|0	8|0	11|0	15|0	4|0	4|0	2|0	2|0	2|0	2|0	-	-	1|0	1|0	-	1|0	9|0	-
9	5|0	8|0	8|0	10|0	6|0	9|0	5|0	5|0	8|0	1|0	6|0	-	-	3|0	-	2|0	1|0	1|0	1|0	6|0	2|0
10	6|0	10|0	2|0	5|0	7|0	2|0	4|0	3|0	3|0	-	2|0	-	2|0	2|0	4|0	2|0	1|0	1|0	1|0	-	3|0
11	3|0	2|0	2|0	2|0	1|0	3|0	3|0	1|0	-	3|0	2|0	1|0	1|0	1|0	4|0	-	-	1|0	2|0	1|0	-
12	1|0	1|0	5|0	11|0	2|0	1|0	3|0	3|0	3|0	-	3|0	-	1|0	-	1|0	1|0	-	-	-	2|0	1|0
13	5|0	4|0	17|0	20|0	8|0	8|0	5|0	5|0	14|0	1|0	3|0	2|0	7|0	7|0	6|0	1|0	-	-	5|0	9|0	2|0
14	7|0	3|0	7|0	5|0	3|0	5|0	9|0	4|0	6|0	6|0	5|0	7|0	5|0	2|0	2|0	3|0	-	1|0	2|0	8|0	3|0
15	1|0	8|0	7|0	7|0	5|0	16|0	10|0	6|0	3|0	7|0	1|0	9|0	10|0	2|0	8|0	2|0	-	2|0	1|0	7|0	2|0
16	10|0	9|0	13|0	6|0	4|0	12|0	15|0	8|0	7|0	8|0	4|0	7|0	6|0	-	3|0	-	2|0	3|0	1|0	10|0	2|0
17	-	1|0	2|0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	1|0	3|0	1|0	2|0	1|0	-	1|0	1|0	-	3|0	-	-	-	-	1|0	-	-	-	-	1|0
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	1|0	-	2|0	2|0	1|0	1|0	-	1|0	-	-	1|0	-	2|0	-	-	-	-	1|0	-
21	2|0	2|0	2|0	-	-	2|0	2|0	-	-	1|0	-	-	1|0	1|0	-	1|0	-	-	-	1|0	-
22	-	1|0	5|0	2|0	2|0	3|0	1|0	1|0	2|0	-	1|0	1|0	1|0	1|0	2|0	-	2|0	-	-	1|0	1|0
23	5|0	2|0	4|0	2|0	1|0	-	2|0	1|0	2|0	-	1|0	-	-	2|0	1|0	3|0	-	-	3|0	1|0	-

0|0, direct linkages; |, indirect linkages; 1–23, attributes; 24–44, consequences.

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Table 7. Implication matrix between consequences and values of Chinese consumers (n = 200)

	45	46	47	48	49	50	51	52	53	54
24	36|0	40|0	13|0	10|0	11|0	7|0	6|0	4|0	-	3|0
25	23|0	69|0	27|0	12|0	14|0	6|0	1|0	6|0	3|0	3|0
26	11|0	80|0	35|0	25|0	28|0	15|0	10|0	9|0	2|0	1|0
27	5|0	10|0	56|0	12|0	26|0	6|0	11|0	5|0	5|0	3|0
28	2|0	7|0	10|0	17|0	17|0	21|0	17|0	23|0	7|0	5|0
29	12|0	31|0	6|0	15|0	20|0	24|0	17|0	23|0	12|0	15|0
30	11|0	6|0	10|0	16|0	32|0	11|0	15|0	27|0	16|0	20|0
31	3|0	13|0	8|0	6|0	13|0	15|0	5|0	9|0	9|0	10|0
32	1|0	8|0	35|0	1|0	16|0	1|0	7|0	4|0	3|0	9|0
33	4|0	7|0	5|0	2|0	7|0	-	3|0	5|0	7|0	10|0
34	2|0	16|0	5|0	4|0	9|0	5|0	5|0	1|0	3|0	3|0
35	1|0	4|0	-	3|0	8|0	3|0	2|0	7|0	6|0	6|0
36	3|0	4|0	3|0	1|0	4|0	-	-	6|0	27|0	7|0
37	-	3|0	13|0	1|0	2|0	-	3|0	-	2|0	4|0
38	-	5|0	2|0	5|0	8|0	9|0	6|0	2|0	5|0	8|0
39	2|0	8|0	1|0	1|0	3|0	3|0	1|0	1|0	2|0	2|0
40	1|0	-	2|0	-	1|0	1|0	1|0	4|0	-	3|0
41	1|0	-	-	1|0	2|0	1|0	1|0	-	3|0	6|0
42	-	5|0	3|0	4|0	4|0	1|0	-	-	-	4|0
43	11|0	52|0	33|0	18|0	10|0	7|0	9|0	6|0	7|0	3|0
44	2|0	1|0	-	2|0	2|0	5|0	2|0	2|0	2|0	6|0

0|0, direct linkages; |, indirect linkages; 24–44, consequences; 45–54, values.

platforms. Additionally, the study found that Chinese consumers exhibit a higher frequency of using quick commerce and home shopping than their Korean counterparts. Concerning grocery preferences, Korean consumers prefer processed foods, whereas their Chinese counterparts prefer fresh foods.

In analyzing the ACV coding content of Korean and Chinese consumers, significant disparities were observed in terms of attributes, consequences, and values. Korean consumers exhibit greater price sensitivity and prioritize the quality and freshness of food. In contrast, Chinese consumers emphasize more the services provided by suppliers, such as after-sales service. Korean consumers prioritize price comparison and financial savings in online grocery shopping, whereas Chinese consumers prioritize enhancing their online grocery shopping experience by reducing stress and the time cost of problem-solving.

Regarding CPV, Korean consumers prioritize convenience, economic, and trust. In contrast, Chinese consumers exhibit more hedonistic tendencies, valuing superiority, ease of use, compatibility, and normative factors. These results are consistent with Singh's [41] definition of online grocery shopping consumers. Utilitarian consumers prioritize maximizing their returns on investment, saving more time, and increasing convenience to enhance their shopping experience. Hedonistic consumers prioritize the aspects of fun and emotional awareness when it comes to online grocery shopping.

Additional analysis using the HVM indicated that both Korean and Chinese consumers consider delivery service, reviews, price, freshness, and quality as selection criteria when shopping online. Similar to Choi *et al.*'s [20] findings, both groups regard delivery service as one of the most essential attributes. The findings from both countries indicate that, unlike other grocery shopping methods, the technological benefits of the online channel offer greater convenience to consumers. Home delivery is an indispensable service for achieving convenience. Given that groceries are daily necessities, suppliers must offer various delivery options and times because of the high frequency of consumer purchases.

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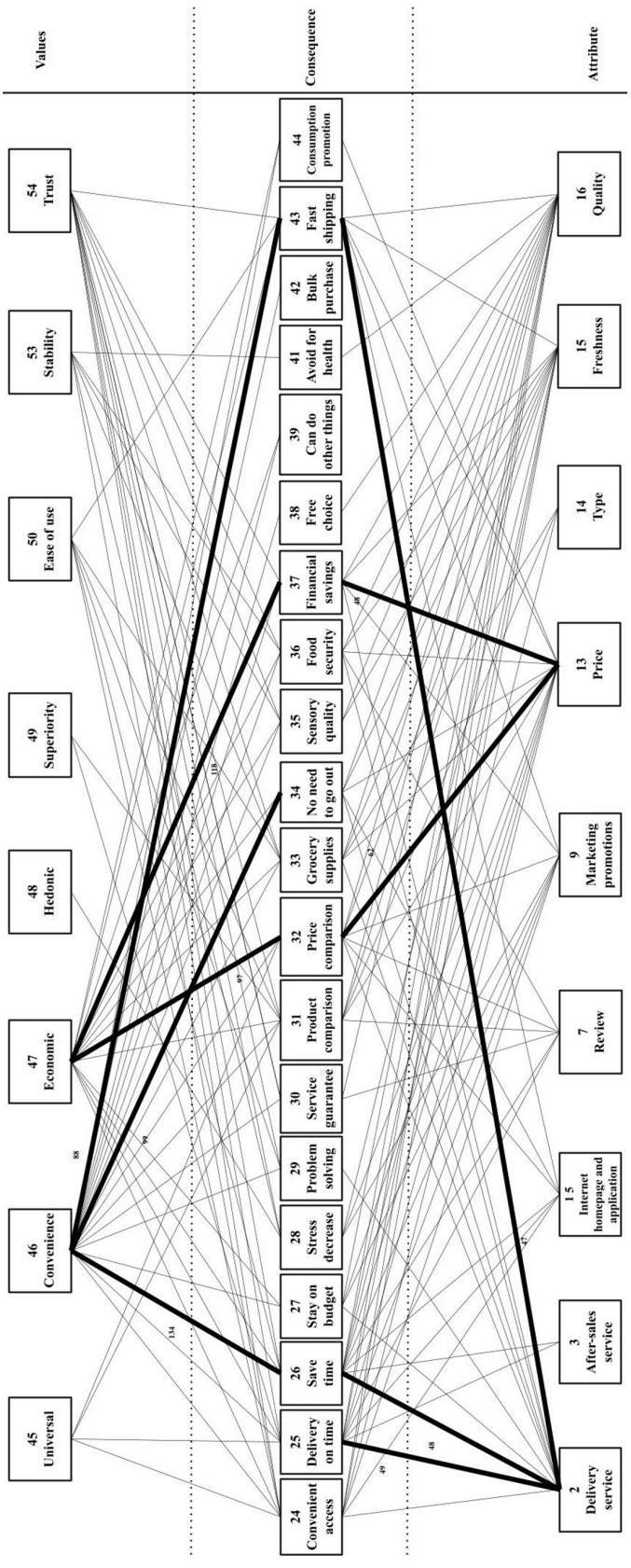

Fig. 1. Hierarchical value map of Korean consumers (cut-off = 7). Links that have less than 7 mentions are not displayed. Each line represents the perceived association of online grocery shopping consumers. The five lines with the highest number of associations are bolded, indicating more referenced associations.

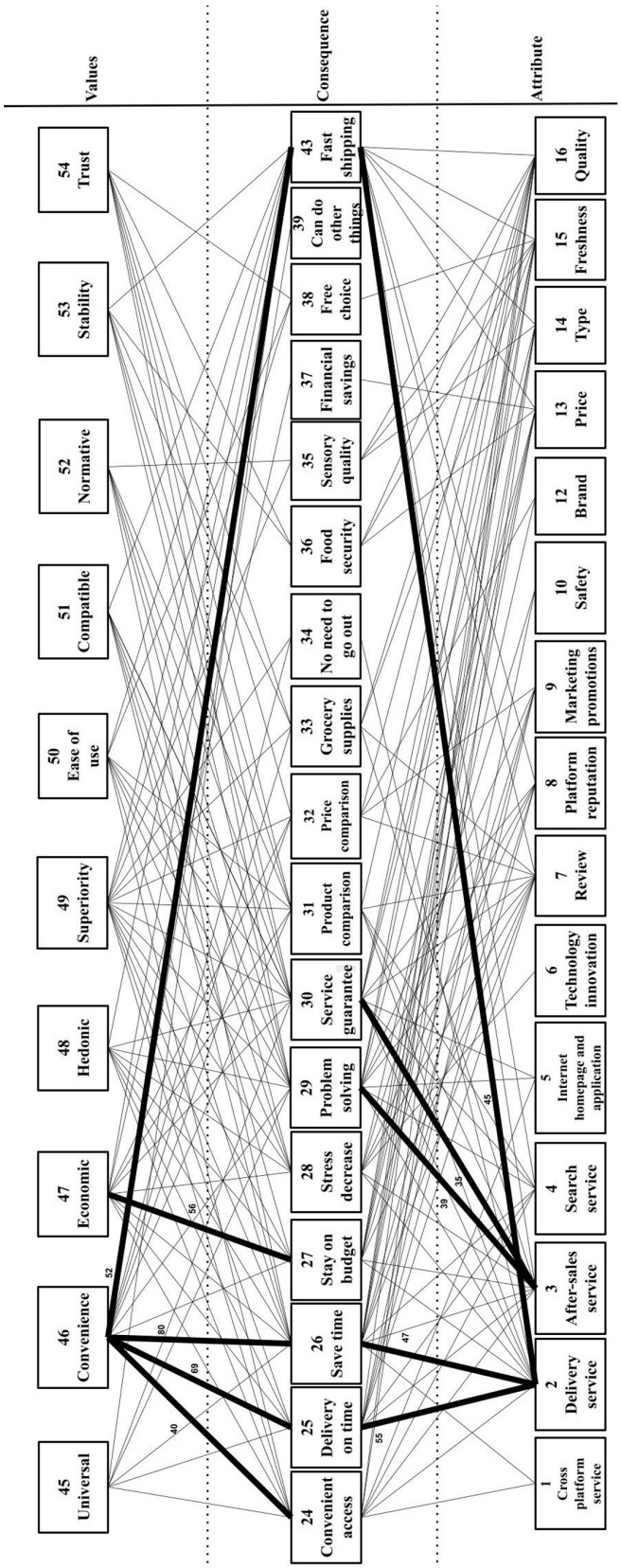

Fig. 2. Hierarchical value map of Chinese consumers (cut-off = 7). Links that have less than 7 mentions are not displayed. Each line represents the perceived association of online grocery shopping consumers. The five lines with the highest number of associations are bolded, indicating more referenced associations.

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Without a guaranteed delivery service of the online channel, it is challenging to reflect the convenience advantage of the online channel [41].

The price clearly indicates the economic value associated with online grocery shopping. Additionally, Korean consumers consider factors such as Internet homepages, applications, and marketing promotions. They seek simple and effective ways to compare product prices, so the marketing strategies provided by suppliers may increase consumer purchasing power [42]. Conversely, Chinese consumers prioritize the platform's reputation and after-sales service. This may be because consumers in developing markets are unfamiliar with online suppliers and want to ensure their rights and interests for a better shopping experience. Therefore, they focus on the supplier's after-sales service [21].

There are notable differences in the factors affecting Korean and Chinese consumers from the perspective of MEC as a whole. Korean consumers, being more familiar with online grocery shopping and in a relatively developed market, tend to purchase goods based on their experience. Conversely, since online shopping in China is still in its emerging stage, consumers are more likely to judge food safety and quality by referring to external factors. These cross-country differences can provide new perspectives on the future development of cross-border trade and promote positive consumer adoption through measures such as supplier improvements and service adjustments.

This study has certain limitations. First, it investigated two representative online grocery markets in Asia. Due to social, cultural, and consumer perception differences in other regions, there may be issues of generalizability and applicability when considering consumers in other regions, such as Europe or the Americas. Future research should replicate these online grocery shopping studies with consumers from other countries and perform additional cross-cultural studies to enhance the generalizability of the findings. Second, due to this study's exclusive use of a systematic literature review to confirm the scope of the study, the hard laddering technique may overlook certain factors. Future research should use a combination of soft and hard laddering to explore a more comprehensive hierarchical value structure of online grocery shopping consumers. This approach aims to extract more valuable and generalized insights into the CPV of online grocery shopping consumers.

CONCLUSIONS

This study applies the MEC approach to explore the cognitive structure of online grocery shopping and elucidates the impact of service, food, personal, and environmental attributes on CPV. Consumers in various countries consider delivery service, reviews, price, freshness, and quality when shopping online for groceries. However, differences in attribute choices were identified in the cross-country survey. The value proposition of online shopping was demonstrated through HVM. Convenience and economic value are the most important values Korean and Chinese consumers seek in online grocery shopping. Among them, convenience value is mainly driven by delivery services, and this relationship remains consistent across different countries. This study's results can provide more references for managers and researchers in formulating cross-border marketing strategies. In the Korean market, most consumers exhibit price sensitivity and seek a higher return on their investment. Managers can cultivate and maintain the consumer base by providing expedited or more guaranteed delivery services. In the Chinese market, where online grocery shopping is experiencing rapid development in its early to mid-stages, consumers prioritize the service guarantee provided by suppliers in case of any issues. To establish a more stable and loyal consumer base, managers should satisfy consumers' desire for affordable value. Overall, this cross-country study on the CPV of online grocery shopping addresses certain knowledge gaps, and the constructed MEC hierarchy enhances theoretical exploration and enriches the discourse in this field.

CONFLICT OF INTEREST

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

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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.

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Research Article

Sex differences in health-related quality of life among older Korean adults with type 2 diabetes mellitus: a cross-sectional study

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Objectives: This cross-sectional study examined sex differences in Health-Related Quality of Life (HRQoL) among seniors with Type 2 Diabetes Mellitus (T2DM).
Methods: Data from the Korea National Health and Nutrition Examination Survey (2008–2020) were analyzed. The EuroQol-5 Dimensions (EQ-5D), a measure of HRQoL, was used. It comprises five dimensions: mobility, self-care, usual activity, pain/discomfort, and anxiety/depression, each with three levels.
Results: Analysis of 3,826 older adults with T2DM showed a significant increasing trend in the EQ-5D Index from the 4th survey phase onwards (P for trend < 0.001 for both men and women). Men consistently reported higher EQ-5D levels than women across all survey years. Women's EQ-5D levels remained lower than men's, maintaining a decade-old disparity (P < 0.05). Men scored significantly higher (P < 0.05) in most EQ-5D domains, except for self-care and anxiety/depression, resulting in a higher total EQ-5D Index (P = 0.001). Increased comorbidities were strongly associated with lower EQ-5D levels in both sexes. Additionally, there was a negative correlation between the EQ-5D Index and refined grain intake for both sexes (P for trend < 0.001), with high-EQ-5D groups consuming fewer refined grains. Women in the high-EQ-5D group consumed more nuts, vegetables, and meat compared to men (P for trend < 0.05).
Conclusions: Our study highlights the sex disparities in HRQoL among older adults with T2DM. The findings suggest the need for tailored treatment guidelines aimed at improving the HRQoL of elderly T2DM patients, with a focus on their sex-specific characteristics. Implementing these tailored guidelines could enhance the HRQoL of older women with T2DM and promote more equitable healthcare outcomes. This underscores the importance of considering sex differences to comprehensively improve the well-being of this population.

Keywords: sex characteristics; quality of life; diabetes mellitus, type 2; Korea

INTRODUCTION

Health-Related Quality of Life (HRQoL) is closely related to an individual's health status [1] and represents a multidimensional assessment of the impact of illness and treatment on Quality of Life (QoL) [2]. HRQoL indicates how individuals perceive and experience health across the physical, psychological, and social dimensions [3]. In 2020, overall life expectancy in South Korea was 83.5 years, with

a healthy life expectancy of 66.3 years, indicating that people lived with illness for approximately 15 years [4]. The growing gap between life expectancy and healthy life expectancy underscores the increasing focus on disease management and QoL in the elderly population. This shift emphasizes the need for a qualitative approach to life in an aging society [1,2]. The growing emphasis on HRQoL in academic research [3] is reflected its use in healthcare policies, service evaluation, clinical research, and patient counseling [5], with recent studies stressing the importance of HRQoL measurements alongside clinical indicators for patients with chronic diseases [6].

Diabetes, a chronic condition with high global prevalence, requires long-term consistent management [7,8]. Patients must maintain blood sugar levels, adhere to a regular diet, engage in appropriate exercise, and undergo medication as needed [9]. For the elderly, the complexity of managing diabetes increases because of age-related cognitive and memory decline and directly affects their QoL [10,11]. HRQoL can vary according to individual characteristics including biological, psychological, and social factors, with sex playing a significant role. Differences in the symptoms, management needs, and psychological responses to diabetes between men and women are critical considerations in developing diabetes management and treatment strategies.

A meta-analysis of 18 cross-sectional studies involving 57,109 participants on the QoL of patients with Type 2 Diabetes Mellitus (T2DM) identified factors such as physical activity, frequency of blood sugar checks, and diabetes complications [12]. The QoL tends to decrease with age, and women with diabetes generally have a lower QoL than men [13-15]. This suggests that sex-specific factors should be considered in diabetes management and treatment strategies [16]. While prior research in Korea has focused on working adults aged 30–40 [17], the accelerating global aging of societies highlights the need for more in-depth research on elderly patients, considering both their age and sex. Such research is crucial in developing effective diabetes management strategies and policies in an aging society and ultimately improving the QoL of patients with diabetes. Therefore, further studies focusing on the elderly population with diabetes are necessary, particularly regarding sex-specific QoL factors.

In South Korea, among diabetes-related complications, women predominantly experience cardiovascular and ocular issues such as myocardial infarction, ischemic stroke, heart failure, and diabetic retinopathy [8]. In contrast, men are more prone to renal and oncological complications such as end-stage renal disease and most cancers (excluding breast and renal cancers) resulting from diabetes [8]. These sex-specific complications can diminish the QoL for individuals with diabetes [18]. The QoL for diabetes patients is influenced not only by these physical health issues but also by concerns about hypoglycemic episodes, as well as apprehension about lifestyle changes and long-term consequences [19]. Particularly, women may experience a higher prevalence of mental health issues such as anxiety and depression, further contributing to a decrease in QoL [20].

Proper blood sugar management is crucial in diabetes treatment to prevent complications and maintain a QoL comparable to individuals without diabetes [21]. Blood sugar management requires not only exercise and medication but also dietary therapy to be considered essential. According to randomized clinical trials, there are sex differences in food choices and adherence to nutritional recommendations among diabetes patients [22]. However, research findings suggest that the restrictions and burdens associated with dietary therapy can diminish the enjoyment of meals and decrease the QoL for diabetes patients [21]. Given these complexities, our study focused on comorbidities and dietary habits as they are significant, modifiable factors influencing HRQoL in diabetic populations. Understanding these factors can provide actionable insights for developing sex-specific management strategies.

Furthermore, exploring sex-specific diseases and their distinct impacts on HRQoL can offer deeper insights. Women with diabetes often face unique challenges related to hormonal changes and pregnancy management, while men may deal with complications such as end-stage renal disease and various cancers. Therefore, examining these differences can help in creating more targeted and effective interventions.

Herein, we aimed to analyze and compare HRQoL among elderly patients (≥ 65 years) with T2DM, based on sex, using data from the Korea National Health and

Nutrition Examination Survey (KNHANES). This research delved into understanding the specific impact of sex on the daily lives and HRQoL of elderly patients with T2DM, encompassing factors such as comorbidities and dietary habits. The primary hypothesis was that significant differences would be evident in HRQoL levels between elderly men and women with T2DM.

METHODS

Ethics statement

The data used in this study from the KNHANES for 2008–2020 were collected with the consent of all participants. For 2008–2014 and 2018–2020, the research was approved by the Institutional Review Board of Korea Centers for Disease Control and Prevention (approval numbers: 2008-04EXP-01-C, 2009-01CON-03-2C, 2010-02CON-21-C, 2011-02CON-06-C, 2012-01EXP-01-2C, 2013-07CON-03-4C, 2013-12EXP-03-5C, and 2014-12EXP-03-5C). Data for 2015–2017 were exempt from ethical review according to the opinion of the Research Ethics Review Committee of the Korea Disease Control and Prevention Agency [23].

1. Study participants

This study analyzed data from KNHANES [23]. The KNHANES, initiated in 1998 and conducted every 3–4 years, switched to an annual format from 2007 (4th phase, 1st year) for timely national statistics and continued to the 8th phase (2019–2021). The KNHANES includes household health examinations and nutrition surveys [24]. We analyzed integrated raw data from the KNHANES, focusing specifically on the years providing HRQoL information. This includes data from the 4th phase second years (2008) to the 8th phase second years (2020).

Our analysis, covering 2008–2020, involved 108,497 survey participants. The exclusion criteria were as follows: 1) < 65 years of age (87,549 participants); 2) nondiabetic or unaware of their T2DM (16,933); 3) diagnosed with diabetes before age 30 (15); and 4) nonrespondents to the EuroQol-5 Dimensions (EQ-5D) survey (174). Consequently, 3,826 individuals were included in the final analysis (Figure 1).

2. Demographic and lifestyle factors

Participant age, sex, education level, monthly household income, employment status, household type, physical activity level, smoking status, alcohol consumption, type of diabetes treatment, and duration of diabetes were surveyed using health questionnaires [23]. Health behaviors, such as smoking status and alcohol consumption were self-reported, and trained interviewers collected data on sex, age, education level, physical activity, EQ-5D questionnaires, and disease prevalence [23]. Education was categorized as elementary school or lower, middle school, or high school, or higher. Monthly household income levels were classified based on the tertile thresholds of KNHANES sample households. Employment status was divided into employed, unemployed, and economically inactive. Household types

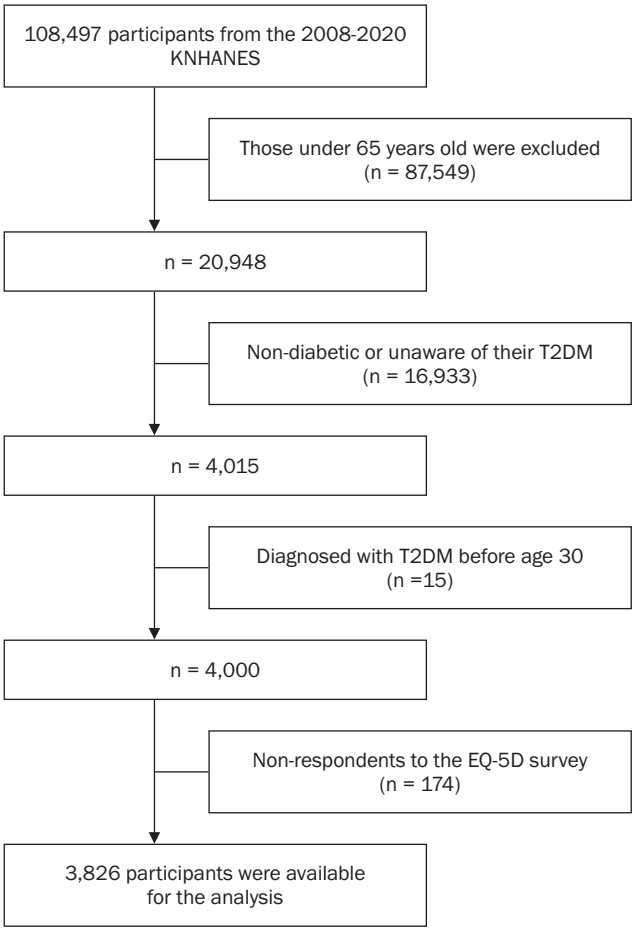

Fig. 1. Flow chart showing participant inclusion and exclusion steps.
KNHANES, Korea National Health and Nutrition Examination Survey; T2DM, Type 2 Diabetes Mellitus; EQ-5D, EuroQol-5 Dimensions.

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were categorized as living alone, with a spouse, or with relatives. Alcohol consumption was calculated by multiplying the number of serving per sitting and frequency of alcohol consumption in the past year. The body mass index (BMI) was calculated as weight (kg) divided by height (m^2). Physical activity levels were determined based on the frequency and duration of high-intensity, moderate-intensity, and walking activities by calculating the metabolic equivalents of tasks (METs-h, metabolic equivalent task-hours per week) [25]. Smoking status was classified as nonsmoker, former smoker, or current smoker.

Elderly patients with T2DM were defined as having comorbidities if they had chronic diseases (hypertension, dyslipidemia, stroke, myocardial infarction/angina, renal failure, or cancer) in addition to T2DM. These comorbidities were determined using health questionnaires based on: 1) a medical diagnosis, 2) recent or current suffering, or 3) ongoing treatment. Cancer was defined as any one or more types of gastric, liver, colon, breast, uterine, lung, or bronchial cancer. Using this information, patients were categorized based on the number of comorbid conditions: none, one, two, three or more.

3. Definition of patients with self-aware Type 2 Diabetes Mellitus

Most participants in this study were individuals with T2DM who were aware of their condition. They were defined as being aware of their T2DM if they met one or more of the following criteria: 1) reported receiving a medical diagnosis in the health survey; 2) acknowledged currently suffering from T2DM; or 3) indicated undergoing treatment for diabetes with oral hypoglycemic agents, insulin therapy, or through diet/exercise regimens.

4. Health-Related Quality of Life

The EQ-5D tool from the KNHANES was used to analyze HRQoL levels and their influencing factors among elderly patients with T2DM who were aware of their condition. The EQ-5D is a subjective self-assessment tool for current health status and comprises five dimensions: mobility, self-care, usual activity, pain/discomfort, and anxiety/depression [26]. Mobility assesses the ability to walk, while self-care focuses on the ability to perform personal hygiene and dressing. Usual activities measure the ability to carry out typical daily tasks such as work, study, housework, family, or leisure activities. Pain/discomfort evaluates the level of physical pain or discomfort, and anxiety/depression addresses mental health issues related to feelings of anxiety and depression. The EQ-5D Index, a composite score, applies specific QoL weights to the Korean population [27]. For ease of interpretation, we reclassified the response categories for each EQ-5D item provided by the KNHANES as 0 = severe problems; 0.5 = some problems; and 1 = no problems. The participants were then divided into tertiles based on their EQ-5D Index scores, with the lowest group labeled as Tertile 1 and the highest as Tertile 3.

5. Dietary assessment

The nutritional survey in the KNHANES involved trained interviewers conducting household interviews using the 24-hour recall method, in which respondents detailed their food intake from the previous day. The survey was conducted in principle through direct face-to-face interviews by trained interviewers, excluding the use of written records. When necessary, assistance from a proxy (guardian) was allowed [28]. The analysis used food group classifications from the KNHANES's individual 24-hour dietary recall data, covering grains (divided into refined and unrefined), potatoes and starches, legumes, eggs, meat, fish and seafood, seeds, fruits, vegetables (subdivided into vegetables and salted vegetables), mushrooms, dairy, and seaweeds.

6. Statistical analysis

In this study, we utilized a complex sample design method incorporating cluster sampling variables, variance estimation strata, and weights. To address potential errors arising from differences in the number of households and population between the sampling design stage and the survey stage, as well as issues such as unequal sampling rates and nonresponse errors from survey nonparticipants, we employed association analysis weights [23]. Specifically, we used health survey-examination survey weights and the nutrition survey weights. To analyze the general characteristics of the elderly patients with T2DM, categorical variables

were presented as frequencies and percentages using chi-square tests for significance. Continuous variables were expressed as means and standard errors with linear regression for significance testing. Multivariable linear regression was used to examine sex differences in EQ-5D scores, adjusting for factors such as age, BMI, physical activity, education level, monthly household income, smoking status, and alcohol consumption. Multivariable logistic regression was used to analyze the association between comorbidities and low HRQoL by sex, calculating odds ratios (OR) and 95% confidence intervals (95% CI). For the logistic regression analysis, the response categories for each EQ-5D item were reclassified. The original categories "some problems (0.5)" and "severe problems (0)" were merged into a single category labeled "Low HRQoL (1)," while the category "no problems (1)" was retained and relabeled as "High HRQoL (0)." The *P* for trend was calculated using the median value of each quartile as a continuous variable. Potential confounders, identified through literature review and preliminary analysis, were adjusted [12,29,30]. The confounding variables adjusted for include age (continuous), BMI (continuous), physical activity (continuous), education level (elementary school graduation or less, middle school graduation, and high school graduation or higher), monthly household income (< 1,000,000, 1,000,000–2,000,000, and ≥ 2,000,000), smoking status (nonsmoker, former smoker, and current smoker), and alcohol consumption (serving/day). Statistical processing was performed using SAS 9.4 (SAS Institute Inc.) and significance was tested at $\alpha = 0.05$.

RESULTS

1. General characteristics and lifestyle factors of elderly patients with Type 2 Diabetes Mellitus by sex

The general characteristics and lifestyle factors of the survey participants were analyzed by sex and are presented in Table 1. This analysis included 1,653 men and 2,173 women. The average age was 71.89 for men and 73.17 for women, indicating that women were older on average ($P < 0.001$). Men had higher education, monthly household income, and employment rates than women (all $P < 0.001$). More women lived alone than men ($P < 0.001$). Among women, 91.04% were non-smokers, whereas men had higher rates of current and past smoking ($P < 0.001$). Alcohol consumption was higher in men than in women ($P < 0.001$). The mean BMI was 24.16 and 25.06 kg/m^2 for men and women, respectively, while average physical activity was 26.78 and 17.25 METs-h/week for men and women, respectively (all $P < 0.001$).

2. Comparison of EuroQol-5 Dimensions domains and index scores by sex

Figure 2 compares the EQ-5D domains and index scores by sex in elderly patients with T2DM. After adjusting for age, BMI, physical activity, education level, monthly household income, smoking status, and alcohol consumption, women displayed lower EQ-5D levels in mobility, usual activities, pain/discomfort, and the overall EQ-5D Index than men. In detail, women and men respectively scored 0.81 and 0.75 in mobility ($P = 0.002$), 0.87 and 0.83 in usual activity ($P = 0.027$), and 0.81 and 0.71 in pain/discomfort ($P < 0.001$). The overall EQ-5D Index also revealed lower scores for women (0.84) relative to those of men (0.88, $P = 0.001$).

3. Trend analysis of EuroQol-5 Dimensions Index scores by sex

Figure 3 shows the sex-specific trends in the EQ-5D Index scores over different survey phases among elderly patients with T2DM. Both men and women showed a significant increasing trend in the EQ-5D Index scores from the 4th survey phase onwards (P for trend < 0.001). The EQ-5D Index scores for women increased until the 6th phase, significantly decreased in the 7th phase, and slightly increased in the 8th phase, whereas for men, this continued to increase until the 7th phase, with only a slight decrease in the 8th phase.

No significant differences were observed between men or women in the 4th or 6th phases. However, in the 7th and 8th phases, the EQ-5D Index scores in women was significantly lower than that in men. In the 7th phase, men scored 0.90 and women 0.83 ($P = 0.001$), and in the 8th phase, men scored 0.89 and women 0.85 ($P = 0.016$).

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Table 1. Demographic and lifestyle characteristics of participants by sex

KNHANES (2008–2020)	Men (n = 1,653)	Women (n = 2,173)	*P*-value
Age (years)	71.89 ± 0.12	73.17 ± 0.10	< 0.001
Education level			< 0.001
Elementary school graduation or less	646 (39.32)	217 (10.05)	
Middle school graduation	318 (19.35)	217 (80.78)	
High school graduation or higher	679 (41.33)	198 (9.17)	
Monthly household income (KRW)			< 0.001
< 1,000,000	616 (37.60)	1,130 (52.93)	
1,000,000 to < 2,000,000	407 (24.85)	392 (18.36)	
≥ 2,000,000	615 (37.55)	613 (28.71)	
Employed, yes	599 (36.39)	469 (21.70)	< 0.001
Living status, alone	194 (11.74)	690 (31.75)	< 0.001
Smoking status			< 0.001
Non-smoker	287 (17.46)	1,951 (91.04)	
Former smoker	998 (60.70)	111 (5.18)	
Current smoker	359 (21.84)	81 (3.78)	
Diabetes care			0.065
Non-care	136 (8.23)	154 (7.09)	
Oral hypoglycemic agents/insulin treatments	1,268 (76.71)	1,735 (79.84)	
Diet/exercise or oral agents/insulin treatments combination	249 (15.06)	284 (13.07)	
Diabetes duration (year)			0.836
< 5	489 (29.76)	650 (30.29)	
5–9	357 (21.73)	476 (22.18)	
≥ 10	797 (48.51)	1,020 (47.53)	
No. of comorbidities[1]			< 0.001
0	316 (19.12)	308 (14.17)	
1	666 (40.29)	863 (39.71)	
2	471 (28.49)	746 (34.33)	
≥ 3	200 (12.10)	256 (11.79)	
Alcohol consumption (serving/day)	0.92 ± 0.03	0.07 ± 0.02	< 0.001
Body mass index (kg/m^2)	24.16 ± 0.08	25.06 ± 0.07	< 0.001
Physical activity level (METs-h/week)	26.78 ± 0.93	17.25 ± 0.81	< 0.001

n (%) or Mean ± SE.
Educational level: 23 missing values, Monthly household income: 53 missing values, Employed: 19 missing values, Smoking status: 39 missing values, Diabetes duration: 37 missing values, Alcohol consumption: 37 missing values, Body mass index: 28 missing values, Physical activity level: 16 missing values.
KNHANES, Korea National Health and Nutrition Examination Survey; KRW, Korea Republic Won; METs-h/week, metabolic equivalent task-hours per week.
[1]Comorbidities included hypertension, dyslipidemia, stroke, myocardial infarction/angina, renal failure, and cancer.

4. Association between comorbidities and low Health-Related Quality of Life by sex

Table 2 presents the results of the multivariable logistic regression analysis that examined the association between comorbidities and low HRQoL (defined as the lowest scores in EQ-5D domains) in elderly patients with T2DM, segmented by sex. In men, an increase in the number of comorbidities was associated with a significant decrease in all domains of EQ-5D (all *P* for trend < 0.05). Specifically, having three or more comorbidities was associated with low HRQoL in the domains of mobility (OR: 1.94, 95% CI: 1.22–3.09), self-care (OR: 2.49, 95% CI: 1.27–4.88), usual activity (OR: 3.64, 95% CI: 2.15–6.18) and pain/discomfort (OR: 1.71, 95% CI: 1.08–2.70) compared to those with no comorbidities. Similarly, in women, an increase in the number of co-

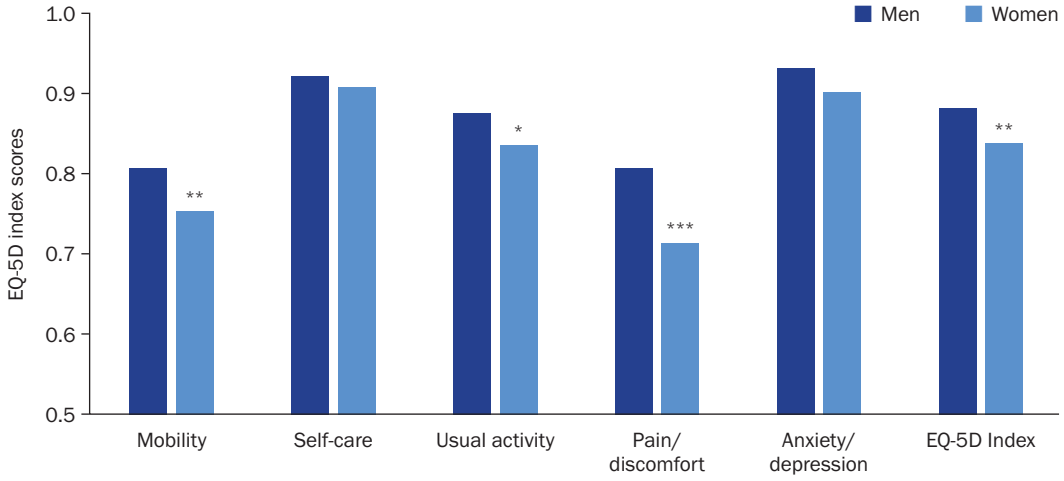

Fig. 2. EQ-5D domains and index scores of participants by sex.
Values are adjusted for age, body mass index, physical activity, education level, monthly household income, smoking status and alcohol consumption.
EQ-5D, EuroQol-5 Dimensions.
*P < 0.05, **P < 0.01, ***P < 0.001 by multivariable linear regression analysis between men and women.

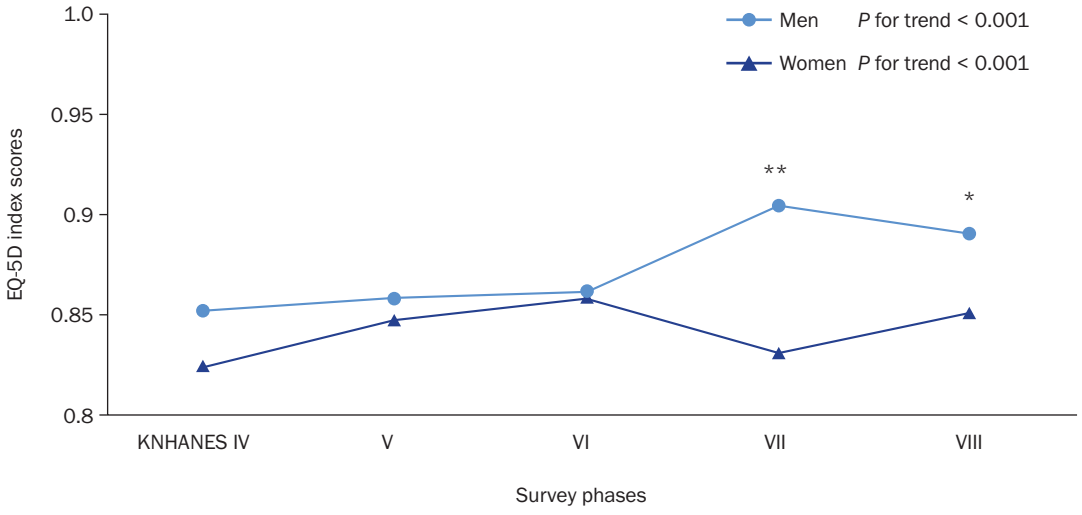

Fig. 3. Sex-specific trends in the EQ-5D Index scores across survey phases (KNHANES IV–VII).
Values are adjusted for age, body mass index, physical activity, education level, monthly household income, smoking status and alcohol consumption.
KNHANES, Korea National Health and Nutrition Examination Survey; EQ-5D, EuroQol-5 Dimensions.
*P < 0.05, **P < 0.01, indicates significance for sex differences, and P for trend represents significance in linear trends, both assessed by multivariable linear regression analysis.

morbidities correlated with low HRQoL across three aspects: usual activity, pain/discomfort, and anxiety/depression (all P for trend < 0.05). Having three or more comorbidities was associated with low HRQoL in the domains of usual activity (OR: 1.72, 95% CI: 1.11–2.66), pain/discomfort (OR: 1.90, 95% CI: 1.24–2.92), and anxiety/depression (OR: 1.74, 95% CI: 1.05–2.90).

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Table 2. Odds ratios and 95% confidence intervals for low Health-Related Quality of Life according to the number of comorbidities[1], analyzed separately for men and women

KNHANES (2008–2020)	Number of comorbidities				*P* for trend
	0	1	2	≥ 3	
Men					
Mobility	1	1.08 (0.74–1.58)	1.72 (1.17–2.52)	1.94 (1.22–3.09)	< 0.001
Self-care	1	1.59 (0.90–2.80)	2.55 (1.42–4.57)	2.49 (1.27–4.88)	< 0.001
Usual activity	1	1.78 (0.94–2.31)	2.74 (1.71–4.39)	3.64 (2.15–6.18)	< 0.001
Pain/discomfort	1	0.90 (0.63–1.28)	1.30 (0.88–1.93)	1.71 (1.08–2.70)	0.005
Anxiety/depression	1	1.16 (0.71–1.87)	1.77 (1.03–3.03)	1.75 (0.96–3.19)	0.010
Women					
Mobility	1	0.74 (0.53–1.03)	0.83 (0.59–1.17)	1.04 (0.68–1.60)	0.595
Self-care	1	0.60 (0.40–0.91)	0.74 (0.5–1.14)	1.04 (1.62–1.74)	0.574
Usual activity	1	0.81 (0.56–1.16)	1.01 (0.70–1.44)	1.72 (1.11–2.66)	0.006
Pain/discomfort	1	0.88 (0.64–1.23)	1.27 (0.91–1.77)	1.90 (1.24–2.92)	< 0.001
Anxiety/depression	1	1.13 (0.74–1.74)	1.35 (0.88–2.10)	1.74 (1.05–2.90)	0.015

Values are adjusted for age, body mass index, physical activity, education level, monthly household income, smoking status, and alcohol consumption.
KNHANES, Korea National Health and Nutrition Examination Survey.
[1]Comorbidities included hypertension, dyslipidemia, stroke, myocardial infarction/angina, renal failure, and cancer.

5. Comparison of food group consumption by EuroQol-5 Dimensions Index scores and sex

Table 3 shows the sex differences in the average food group consumption based on the EQ-5D Index scores among elderly patients with T2DM. Both men and women consumed fewer refined grains and had higher EQ-5D Index scores (*P* for trend < 0.001). In men, no significant differences were observed in other food groups in addition to refined grains. For women, higher EQ-5D Index scores were associated with higher consumption of meat, nuts, and vegetables (*P* for trend < 0.05).

DISCUSSION

This study found that elderly women with T2DM consistently exhibited a lower HRQoL than men did. This disparity has been particularly pronounced in recent years as indicated by EQ-5D Index trends. This study also revealed a significant correlation between increased comorbidities and lower HRQoL in men, which was not observed in women. Additionally, dietary habits linked to a higher EQ-5D Index, such as lower refined grain consumption and higher intakes of meat, nuts, and vegetables in women, suggest potential areas for targeted health interventions.

Our findings showing lower HRQoL in elderly women with T2DM than in men are underscored by broader social and economic factors. Globally, elderly women often have lower education and income levels and less economic participation [31-33]. These elements were linked to reduced HRQoL, which mirrors our results [34]. Additionally, in South Korea, the longer life expectancy of women paradoxically includes more years in poor health [4,35]. Social support gaps and entrenched sex roles further exacerbate HRQoL challenges [36]. Considering the higher prevalence and severity of chronic diseases in elderly women [37], which significantly affects life satisfaction [38], a holistic approach should be adopted and effective policies formulated to target the unique needs of this demographic.

Our study reinforces the significant impact of comorbidities on HRQoL in older men with T2DM, aligning with global research trends. This association was mirrored in a Dutch study involving 1,676 patients with T2DM that observed a marked decline in both mental and physical QoL with increased comorbidities [39]. Furthermore, a meta-analysis of patients with T2DM in Sub-Saharan Africa highlighted a negative correlation between comorbidities and HRQoL [30]. Comorbidities profoundly affect self-management and daily function-

Table 3. Food group consumption by EQ-5D Index score tertiles and sex

KNHANES (2008–2020)	EQ-5D Index score			*P* for trend
	T1 (lowest)	T2	T3 (highest)	
Food group (% of total energy)				
Men				
Refined grains	55.50 ± 1.03	50.10 ± 1.03	49.68 ± 0.73	< 0.001
Whole grains	1.73 ± 0.24	2.18 ± 0.42	1.53 ± 0.20	0.480
Potatoes and starches	1.65 ± 0.25	1.54 ± 0.23	2.02 ± 0.19	0.230
Legumes	3.67 ± 0.30	3.85 ± 0.34	3.85 ± 0.20	0.607
Eggs	1.39 ± 0.17	1.71 ± 0.26	1.39 ± 0.11	0.947
Meat	5.68 ± 0.50	6.05 ± 0.65	5.74 ± 0.33	0.894
Fish and shellfish	2.89 ± 0.24	3.10 ± 0.30	3.44 ± 0.27	0.320
Nuts	1.01 ± 0.16	1.42 ± 0.22	1.32 ± 0.13	0.196
Fruits	3.88 ± 0.39	4.36 ± 0.35	4.44 ± 0.24	0.462
Vegetables	4.88 ± 0.24	5.00 ± 0.25	5.20 ± 0.16	0.252
Kimchi and pickled vegetables	2.06 ± 0.11	2.21 ± 0.14	2.05 ± 0.08	0.909
Dairy	1.64 ± 0.19	1.59 ± 0.24	2.20 ± 0.19	0.092
Women				
Refined grains	58.07 ± 0.88	54.43 ± 0.96	53.44 ± 0.85	< 0.001
Whole grains	2.98 ± 0.32	1.92 ± 0.24	2.22 ± 0.28	0.074
Potatoes and starches	2.84 ± 0.32	3.04 ± 0.35	2.98 ± 0.33	0.759
Legumes	4.45 ± 0.32	3.96 ± 0.29	3.83 ± 0.23	0.118
Eggs	1.11 ± 0.16	1.15 ± 0.15	1.51 ± 0.15	0.072
Meat	3.27 ± 0.28	3.74 ± 0.30	4.40 ± 0.36	0.014
Fish and shellfish	1.88 ± 0.19	2.50 ± 0.21	1.97 ± 0.14	0.664
Nuts	0.75 ± 0.09	1.17 ± 0.17	1.35 ± 0.14	< 0.001
Fruits	4.47 ± 0.20	5.47 ± 0.22	5.70 ± 0.20	0.697
Vegetables	4.35 ± 0.18	5.41 ± 0.21	5.59 ± 0.19	< 0.001
Kimchi and pickled vegetables	1.78 ± 0.10	1.81 ± 0.10	1.84 ± 0.10	0.633
Dairy	3.13 ± 0.32	2.71 ± 0.26	2.66 ± 0.23	0.220

Mean ± SE.
EQ-5D, EuroQol-5 Dimensions; KNHANES, Korea National Health and Nutrition Examination Survey; T, tertile.

ing in patients with T2DM, ultimately deteriorating their QoL [40,41].

This study found that higher EQ-5D Index scores were associated with lower refined grain consumption in both men and women. High-glycemic foods such as refined grains increase the risk of inflammation and cardiovascular disease, which are known to exacerbate psychological disorders [42]. Refined grains can induce postprandial hyperglycemia and hyperinsulinemia, reducing the secretion of autonomic hormones such as adrenaline, cortisol, glucagon, and growth hormone [43,44], potentially affecting the QoL of patients with diabetes. Women with higher EQ-5D Index scores also showed an increased consumption of vegetables, meat, and nuts. Intake of vegetables can aid in blood sugar control [45] while nuts improve lipid profiles and reduce cardiac complications [46]. A comprehensive review of dietary guidelines for diabetics confirmed the long-term benefits of vegetable, nut, and moderate meat consumption on blood sugar and cardiovascular disease risk management [47]. These dietary habits influence blood sugar and complication management in patients with diabetes, subsequently impacting their mental health, including depression symptoms [48].

This study was based on an analysis of KNHANES data from 2008 to 2020. Generally, cross-sectional studies have limitations in establishing cause-and-effect relationships between variables. However, in this study,

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we leveraged sex as the primary exposure variable, which helped mitigate some of these limitations, as sex itself is not influenced by the study outcomes. While efforts were made to adjust for confounding factors selected through a review of prior literature and a preliminary analysis to compare the QoL of elderly patients with diabetes by sex, residual confounding factors not accounted for may be present because of the nature of observational studies. Lastly, the use of single-day 24-hour recall data to assess dietary intake presents a limitation. This method relies on participants' memory, which can be particularly challenging for those aged 65 and older due to potential cognitive decline. Additionally, using only a single day of recall data may not accurately represent typical dietary patterns due to daily variations in food intake, further affecting the reliability of the dietary assessment. Nevertheless, the KNHANES data used in this study provide robust guidelines for enhancing the validity and reliability of the measurements and analyses. As a nationally representative survey, KNHANES offers a comprehensive overview that is more representative of the general population compared to other datasets. The use of trained interviewers for data collection ensures high-quality data and reduces potential biases, thereby supporting the credibility of our findings. Despite the limitations mentioned, the comprehensive and representative nature of the KNHANES data contributes significantly to the understanding of dietary patterns and health outcomes in older adults with chronic diseases [23].

CONCLUSIONS

Our study revealed that elderly women with T2DM tend to experience lower levels of HRQoL compared to men, especially in recent years. Additionally, the impact of comorbidities and dietary habits on HRQoL varies by sex. Therefore, it's crucial to develop tailored treatment guidelines aimed at improving the HRQoL of elderly T2DM patients, with a focus on their sex-specific characteristics. Implementing these tailored guidelines could enhance the HRQoL of older women with T2DM and promote more equitable healthcare outcomes. This underscores the importance of considering sex differences to comprehensively improve the well-being of this population. Continuously assessing HRQoL in this demographic allows for a better understanding of the factors influencing health and QoL, leading to more effective management strategies.

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CONFLICT OF INTEREST

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

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DATA AVAILABILITY

This data that supports the findings of this study are openly available in the Korea National Health and Nutrition Examination Survey (KNHANES) at https://knhanes.kdca.go.kr/knhanes/main.do.

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Research Article

Analysis of health behavior changes among residents in depopulation areas in Korea: a cross-sectional study based on Community Health Survey data from 2010 to 2019

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Objectives: The total population of Korea began to decline in 2019; in particular, the population in rural areas has been rapidly decreasing and is aging. Therefore, the government has designated depopulation areas and is seeking ways to support them. To assess whether health disparities exist between areas with population decline and those without, this study used community health survey data to observe temporal changes in health behaviors between the two types of areas.
Methods: The analysis used Community Health Survey data from 2010 to 2019, and regional classification was divided by depopulation areas designated by the Ministry of the Interior and Safety. Trends in health behavior and chronic disease prevalence between depopulation and non-depopulation areas were analyzed. All analyses were conducted using complex sample analysis procedures in SAS 9.4 software.
Results: The smoking rate steadily decreased in both depopulation and non-depopulation areas, whereas the high-risk drinking rate increased slightly. The walking practice rate did not improve in depopulation areas compared to non-depopulation areas. Furthermore, nutritional labeling usage rate was consistently lower in depopulation areas than in non-depopulation areas, with the gap being the largest. The prevalence of obesity, diabetes, and hypertension showed that the gap between depopulation and non-depopulation areas is continuously increasing.
Conclusions: Health behaviors in depopulation areas have not improved, and the prevalence of chronic diseases is increasing rapidly. Therefore, the demand for health care services that support healthy lifestyle practices and chronic disease management in these areas is expected to increase.

Keywords: health behavior; chronic disease; health equity; community health

INTRODUCTION

Korea has been experiencing rapid population aging and regional population decline due to a sharp decrease in birth rates. In response, the government designated 89 regions as depopulation areas under the Special Act on Balanced National Development in an effort to prevent regional extinction and ensure socio-economic vitality in these areas [1]. Although the national population started to decline in 2019, depopulation areas have been experiencing continuous

decline for about 20 years [2]. This decline is attributed more to social factors, such as population migration due to industrial changes, rather than natural factors, like a decrease in birth rates. Depopulation areas face a shortage of socio-economic resources, leading to reduced local tax revenues, weakened financial investments, and subsequently deteriorating quality of life and living conditions for residents.

Currently, depopulation areas have higher proportions of elderly and vulnerable populations, fewer public sports facilities, medical facilities, and national and public childcare facilities, and higher mortality and suicide rates [3]. These regions also suffer from weakened functions of institutions providing essential services like healthcare and welfare, which are considered crucial for living conditions. A study using the 2020 Community Health Survey data examined the demographic and socio-economic characteristics of depopulation and non-depopulation areas, and analyzed differences in key health indicators. It found that depopulation areas had higher proportions of elderly people and non-professional/non-office workers, lower education levels and household incomes, and poorer outcomes in walking practice rates, hypertension treatment rates (for those aged 30 and above), and annual unmet medical care rates compared to non-depopulation areas [4].

Recent studies examining regional health disparities in South Korea have primarily focused on comparisons between urban and rural areas [5-9] or between the metropolitan area and non-metropolitan areas [10-12]. However, the regional disparities in South Korea cannot be fully explained by traditional urban-rural categories alone. Even small and medium-sized cities outside the metropolitan area are concerned about population decline, indicating the need for a categorization that considers these regional characteristics.

Therefore, this study aims to analyze and compare health behaviors and the prevalence of chronic diseases such as hypertension and diabetes in depopulation and non-depopulation areas using long-term data from the Community Health Survey. It seeks to observe whether the health disparities have changed due to the persistent population decline over the past decade.

METHODS

Ethics statement

Among the data from the 2010–2019 Community Health Survey used in this study, the data from 2010 to 2016 were collected after obtaining approval from the Institutional Review Board (IRB) of the Korea Disease Control and Prevention Agency (KDCA) (IRB No. 2010-02CON-22-P, 2011-05CON-04_C, 2012-07CON-01-2C, 2013-06EXP-01-3C, 2014-08EXP-01-3C, 2014-08EXP-09-4C-A, 2016-10-01-P-A), and data for 2017, 2018, and 2019 were collected after being exempted from deliberation by the IRB of the KDCA.

1. Survey data

The survey data used for this study are from the Community Health Survey, conducted annually at the city, county, and district levels by the KDCA under Article 4 of the Regional Health Act and Article 2 of the Enforcement Decree of the same Act since 2008. For analysis, data from 2010 to 2019 were integrated, excluding the COVID-19 pandemic period, resulting in a total of 1,826,491 data points. Depopulation and non-depopulation areas were classified based on the designation of depopulation areas by the Minister of the Interior and Safety in 2021, according to the Special Act on Balanced National Development (Notification No. 2021-66, October 19, 2021). As of 2019, 89 out of 255 regions with public health centers and health clinics were designated as depopulation areas (Figure 1).

2. Analysis methods

To observe the population characteristics and health behaviors of depopulation and non-depopulation areas from 2010 to 2020, available data from the Community Health Survey were used, including indicators such as age, sex, education level, and health behaviors (smoking rate, high-risk drinking rate, moderate physical activity rate, walking practice rate, and nutritional labeling usage rate) and disease prevalence rates (obesity, hypertension, and diabetes). Descriptive statistical analyses and year-by-year trend analyses were conducted. Changes in health behaviors and disease prevalence between depopulation and non-depopulation areas were analyzed after adjusting for sex, age, and education level. Statistical analyses were performed using SAS version 9.4 (SAS Institute Inc.), employing complex

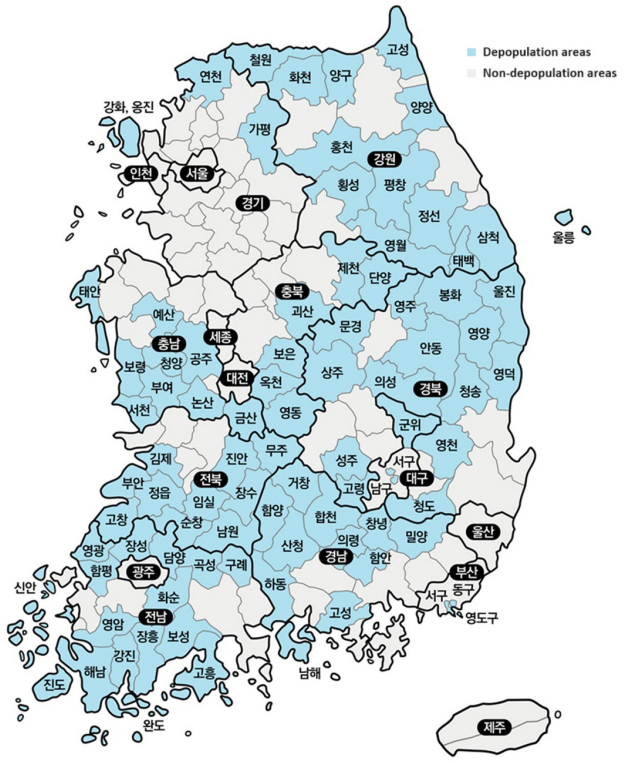

Fig. 1. Distribution of depopulation and non-depopulation areas.

sample analysis procedures (proc surveymeans, proc surveyfreq, proc surveylogistics).

RESULTS

1. Population characteristics of depopulation and non-depopulation areas

Analysis of the distribution of data by sex, age, and education level from the Community Health Survey from 2010 to 2019 revealed that depopulation areas had higher proportions of women and elderly people compared to non-depopulation areas. In particular, depopulation areas had lower proportions of individuals under 40 years old and higher proportions of those aged 50 and above. Additionally, depopulation areas had higher proportions of individuals with lower education levels, with more than half having an education level of middle school or below. While there were significant differences in the distribution of subjects by sex between depopulation and non-depopulation areas from 2010 to 2014, no significant differences were observed from 2015 onwards. However, significant differences in age and education level distribution persisted (Table 1).

2. Health behavior trends in depopulation and non-depopulation areas

The smoking rate was lower in depopulation areas compared to non-depopulation areas. In depopulation areas, the smoking rate steadily decreased from 23.0% in 2010 to 18.1% in 2019, while in non-depopulation areas, it decreased from 24.6% in 2010 to 19.0% in 2019. The odds ratio for the increase in years was 0.964, indicating a similar decreasing trend in both areas.

The high-risk drinking rate was lower in depopulation areas compared to non-depopulation areas until 2012, but became higher in depopulation areas from 2013 onwards. In depopulation areas, the high-risk drinking rate increased from 14.8% in 2010 to 19.1% in 2019, while in non-depopulation areas, it increased from 15.9% in 2010 to 18.0% in 2019, with a smaller increase in depopulation areas. The odds ratio for high-risk drinking with the increase in years was 1.037 (1.032–1.042) in depopulation areas and 1.015 (1.013–1.018) in non-depopulation areas, indicating a higher increasing trend in high-risk drinking rates in depopulation areas.

The moderate physical activity rate was higher in depopulation areas compared to non-depopulation areas. In depopulation areas, the rate remained almost unchanged from 27.0% in 2010 to 26.0% in 2019, while in non-depopulation areas, it increased from 20.9% in 2010 to 23.7% in 2019. The odds ratio for moderate physical activity with the increase in years was 0.990 (0.985–0.995) in depopulation areas and 1.022 (1.020–1.024) in non-depopulation areas, indicating a decreasing trend in moderate physical activity rates in depopulation areas and an increasing trend in non-depopulation areas.

The walking practice rate was higher in depopulation areas until 2013, after which it became higher in non-depopulation areas. In depopulation areas, the rate significantly decreased from 86.6% in 2010 to 79.9% in 2019, while in non- depopulation areas, it slightly increased from 82.5% in 2010 to 84.0% in 2019. The odds ratio for walking practice with the increase in years was 0.952 (0.947–0.958) in depopulation areas, showing a decreasing trend, and 1.022 (1.019–1.024) in non-depopulation areas, showing an increasing trend.

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Table 1. Characteristics of distribution of subjects between depopulation and non-depopulation areas

		2010			2011			2012			2013			2014		
		Depopulation areas	Non-depopulation areas	*P*-value	Depopulation areas	Non-depopulation areas	*P*-value	Depopulation areas	Non-depopulation areas	*P*-value	Depopulation areas	Non-depopulation areas	*P*-value	Depopulation areas	Non-depopulation areas	*P*-value
Sex	Male	49.0	49.5	0.0430	49.0	49.5	0.0212	49.0	49.6	0.0191	49.1	49.6	0.0245	49.1	49.6	0.0291
	Female	51.0	50.5		51.0	50.5		51.0	50.4		50.9	50.4		50.9	50.4	
Age group	19–29 years	13.4	19.8	< 0.0001	12.7	19.1	< 0.0001	12.2	18.6	< 0.0001	11.7	18.2	< 0.0001	11.5	18.0	< 0.0001
	30–39 years	12.4	21.9		12.0	21.2		11.7	20.8		11.3	20.2		10.8	19.5	
	40–49 years	16.7	22.7		16.2	22.4		16.0	22.3		15.7	22.0		15.6	22.0	
	50–59 years	18.5	17.3		19.6	18.5		19.8	18.9		20.4	19.5		20.5	19.7	
	60–69 years	17.5	10.3		16.7	10.4		16.5	10.5		15.8	10.5		16.5	10.8	
	≥ 70 years	21.6	8.1		22.7	8.5		23.8	8.9		25.2	9.6		25.1	9.9	
Education level	≤ Middle school graduate	53.3	23.9	< 0.0001	53.2	23.4	< 0.0001	52.8	22.8	< 0.0001	52.4	22.1	< 0.0001	51.2	21.7	< 0.0001
	High school graduate	30.3	39.6		30.9	40.0		30.5	39.4		30.5	39.3		30.6	39.0	
	≥ College graduate	16.4	36.5		15.9	36.6		16.7	37.7		17.1	38.6		18.2	39.3	
		2015			2016			2017			2018			2019		
		Depopulation areas	Non-depopulation areas	*P*-value	Depopulation areas	Non-depopulation areas	*P*-value	Depopulation areas	Non-depopulation areas	*P*-value	Depopulation areas	Non-depopulation areas	*P*-value	Depopulation areas	Non-depopulation areas	*P*-value
Sex	Male	49.2	49.6	0.0558	49.2	49.6	0.0848	49.3	49.6	0.1874	49.4	49.6	0.3430	49.4	49.6	0.5816
	Female	50.8	50.4		50.8	50.4		50.7	50.4		50.6	50.4		50.6	50.4	
Age group	19–29 years	11.3	17.9	< 0.0001	11.1	17.9	< 0.0001	10.9	17.8	< 0.0001	10.7	17.7	< 0.0001	10.3	17.6	< 0.0001
	30–39 years	10.2	18.9		9.9	18.4		9.5	17.9		9.1	17.4		8.6	16.8	
	40–49 years	15.3	21.7		14.8	21.2		14.3	20.8		13.8	20.3		13.2	19.7	
	50–59 years	20.5	19.8		20.6	19.9		20.6	19.9		20.5	20.0		20.3	20.1	
	60–69 years	17.1	11.5		17.3	12.0		17.6	12.4		17.9	12.7		18.9	13.4	
	≥ 70 years	25.6	10.2		26.3	10.6		27.1	11.2		28.0	11.9		28.6	12.4	
Education level	≤ Middle school graduate	50.0	20.8	< 0.0001	49.6	20.6	< 0.0001	48.8	20.0	< 0.0001	48.4	19.8	< 0.0001	47.3	19.6	< 0.0001
	High school graduate	30.6	38.5		30.2	37.9		30.7	37.6		31.6	37.6		31.6	37.3	
	≥ College graduate	19.4	40.7		20.2	41.5		20.6	42.4		20.0	42.5		21.1	43.0	

%.

Sex, age and education level by region type were measured as percentages with the effect of the complex sampling design effect and appropriate sampling weights of the national survey using the SURVEYFREQ procedure in the SAS program.

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The utilization rate of nutritional labeling showed the greatest difference between non-depopulation and depopulation areas among the health behavior indicators, with about a 10% difference between the two areas throughout the decade. The utilization rate of nutritional labeling decreased, falling from 24.0% in 2010 to 14.0% in 2018 in depopulation areas before rising to 19.0% in 2019. Similarly, in non-depopulation areas, it decreased from 34.4% in 2010 to 25.2% in 2018, before recovering to 29.1% in 2019. The odds ratio for nutritional labeling utilization with the increase in years was 0.935 (0.930–0.940) in depopulation areas and 0.942 (0.940–0.944) in non-depopulation areas, indicating a more pronounced decreasing trend in depopulation areas (Tables 2 and 3).

3. Disease prevalence trends in depopulation and non-depopulation areas

There was no difference in obesity rates between depopulation and non-depopulation areas in 2010, with rates of 22.2% and 22.4%, respectively. However, by 2012, the obesity rate in depopulation areas surpassed that of non-depopulation areas, reaching 32.0% in 2018 compared to 30.4% in non-depopulation areas (Figure 2). The odds ratio for obesity with the increase in years was 1.062 (1.058–1.066) in depopulation areas and 1.049 (1.047–1.051) in non-depopulation areas, indicating an increasing trend in both areas, but a more significant increase in depopulation areas.

The prevalence of diabetes remained consistently higher in depopulation areas compared to non-depopulation areas, with both areas showing a continuous rise. In depopulation areas, the prevalence of diabetes increased from 8.7% in 2010 to 12.6% in 2019, an increase of approximately 3.9% points. In non-depopulation areas, the prevalence rose from 6.1% in 2010 to 8.4% in 2019, an increase of about 2.3% points (Figure 3). The odds ratio for diabetes with the increase in years was 1.037 (1.034–1.041) in depopulation areas and 1.020 (1.018–1.023) in non-depopulation areas, indicating an increasing trend in both areas but a larger increase in depopulation areas.

Similarly, the prevalence of hypertension showed a continuous increase in both areas, with depopulation areas experiencing a more significant rise. In these areas, the prevalence of hypertension increased from 23.5% in 2010 to 31.9% in 2019, an increase of approximately 8.4% points. In non-depopulation areas, the prevalence rose from 15.9% in 2010 to 20.2% in 2019, an increase of about 4.3% points, indicating that the increase in depopulation areas was roughly double that in non-depopulation areas (Figure 4). The odds ratio for hypertension with the increase in years was 1.032 (1.029–1.035) in depopulation areas and 1.009 (1.007–1.011) in non-depopulation areas, showing an increasing trend in both areas but a more pronounced increase in depopulation areas. From 2010 to 2019, obesity rates, diabetes prevalence, and hypertension prevalence all

Table 2. Health behavior practice trends between depopulation and non-depopulation areas

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	*P* for trend
Smoking	Depopulation areas	23.0	22.8	22.1	21.5	21.2	19.8	19.4	18.6	18.5	18.1	< 0.0001
	Non-depopulation areas	24.6	24.0	23.8	23.2	22.7	21.0	21.1	20.3	20.4	19.0	< 0.0001
High risk drinking	Depopulation areas	14.8	18.7	15.8	18.8	19.5	19.8	19.0	19.7	19.4	19.1	< 0.0001
	Non-depopulation areas	15.9	19.0	17.0	18.6	18.8	18.8	18.5	18.6	18.4	18.0	< 0.0001
Physical activity	Depopulation areas	27.0	29.4	30.1	30.7	26.5	25.6	26.9	27.2	-	26.0	< 0.0001
	Non-depopulation areas	20.9	20.6	19.9	20.7	21.2	22.6	21.7	22.0	-	23.7	< 0.0001
Walking practice	Depopulation areas	86.6	83.7	84.2	82.6	80.1	79.9	78.8	80.0	80.1	79.9	< 0.0001
	Non-depopulation areas	82.5	81.4	81.2	81.3	81.4	82.3	81.5	82.9	85.3	84.0	< 0.0001
Nutrition facts usage	Depopulation areas	24.0	21.6	22.0	22.9	15.1	15.2	15.9	15.8	14.0	19.0	< 0.0001
	Non-depopulation areas	34.4	34.9	34.3	33.1	25.6	25.1	25.8	26.4	25.2	29.1	< 0.0001

All estimates were produced to represent the Korean population using complex sampling design parameters, such as strata, cluster, and sample weight, in the PROC SURVEYFREQ procedures.
P for trend adjusted for sex, age, and education level from PROC SURVEYLOGISTIC procedures.

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Table 3. ORs for health behavior practice between depopulation and non-depopulation areas

		Depopulation areas			Non-depopulation areas		
		OR	95% CI	*P*-value	OR	95% CI	*P*-value
Smoking	Year	0.964	(0.960–0.968)	< 0.0001	0.964	(0.962–0.966)	< 0.0001
	Sex	0.036	(0.035–0.037)	< 0.0001	0.049	(0.048–0.050)	< 0.0001
	Age group	0.978	(0.977–0.979)	< 0.0001	0.981	(0.981–0.981)	< 0.0001
	Education level	0.8 87	(0.872–0.902)	< 0.0001	0.785	(0.778–0.791)	< 0.0001
High risk drinking	Year	1.037	(1.032–1.042)	< 0.0001	1.015	(1.013–1.018)	< 0.0001
	Sex	0.167	(0.161–0.172)	< 0.0001	0.203	(0.200–0.205)	< 0.0001
	Age group	0.990	(0.989–0.991)	< 0.0001	0.994	(0.994–0.994)	< 0.0001
	Education level	1.006	(0.985–1.028)	0.5596	0.874	(0.866–0.882)	< 0.0001
Physical activity	Year	0.990	(0.985–0.995)	< 0.0001	1.022	(1.020–1.024)	< 0.0001
	Sex	0.671	(0.660–0.681)	< 0.0001	0.607	(0.601–0.613)	< 0.0001
	Age group	0.988	(0.987–0.989)	< 0.0001	0.995	(0.994–0.995)	< 0.0001
	Education level	0.839	(0.825–0.853)	< 0.0001	1.000	(0.992–1.008)	0.9571
Walking practice	Year	0.952	(0.947–0.958)	< 0.0001	1.022	(1.019–1.024)	< 0.0001
	Sex	0.753	(0.733–0.775)	< 0.0001	0.868	(0.856–0.879)	< 0.0001
	Age group	0.994	(0.993–0.995)	< 0.0001	1.004	(1.004–1.005)	< 0.0001
	Education level	1.055	(1.028–1.083)	< 0.0001	0.980	(0.970–0.990)	0.0002
Nutrition facts usage	Year	0.935	(0.930–0.940)	< 0.0001	0.942	(0.940–0.944)	< 0.0001
	Sex	3.271	(3.193–3.352)	< 0.0001	3.635	(3.600–3.670)	< 0.0001
	Age group	0.965	(0.964–0.966)	< 0.0001	0.976	(0.976–0.976)	< 0.0001
	Education level	1.912	(1.876–1.948)	< 0.0001	1.831	(1.817–1.845)	< 0.0001

OR and 95% CI were calculated from survey logistic regression analyses.
OR, odds ratio; 95% CI, 95% confidence interval.

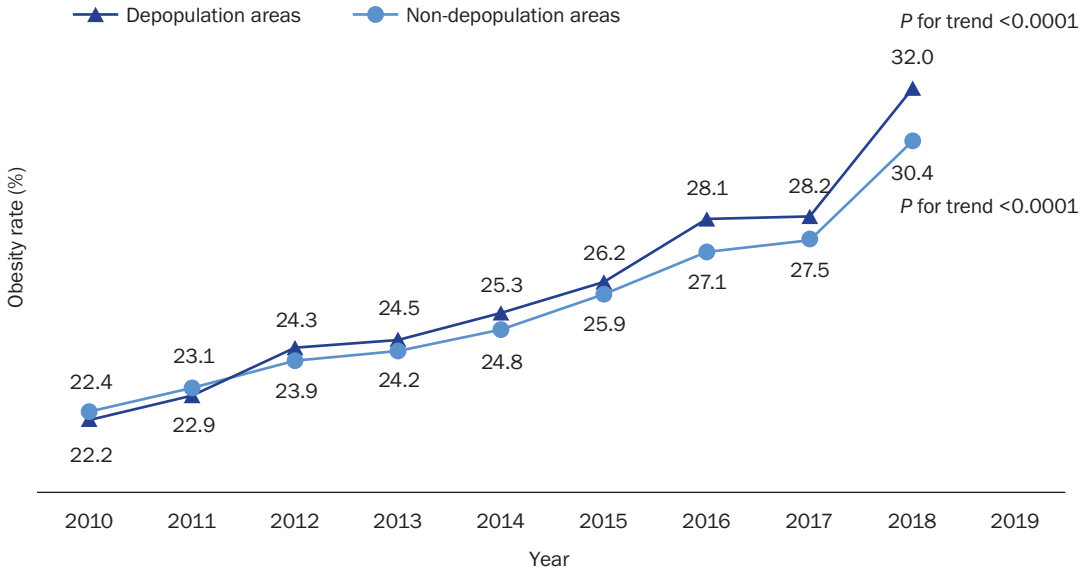

Fig. 2. Obesity rate trends between depopulation and non-depopulation areas.
Obesity rate by region type was measured as a percentage of complex sampling design effect and appropriate sampling weights of the national survey using the SURVEYFREQ procedure in the SAS program.
P for trend adjusted for sex, age and education level from PROC SURVEYLOGISTIC procedures.

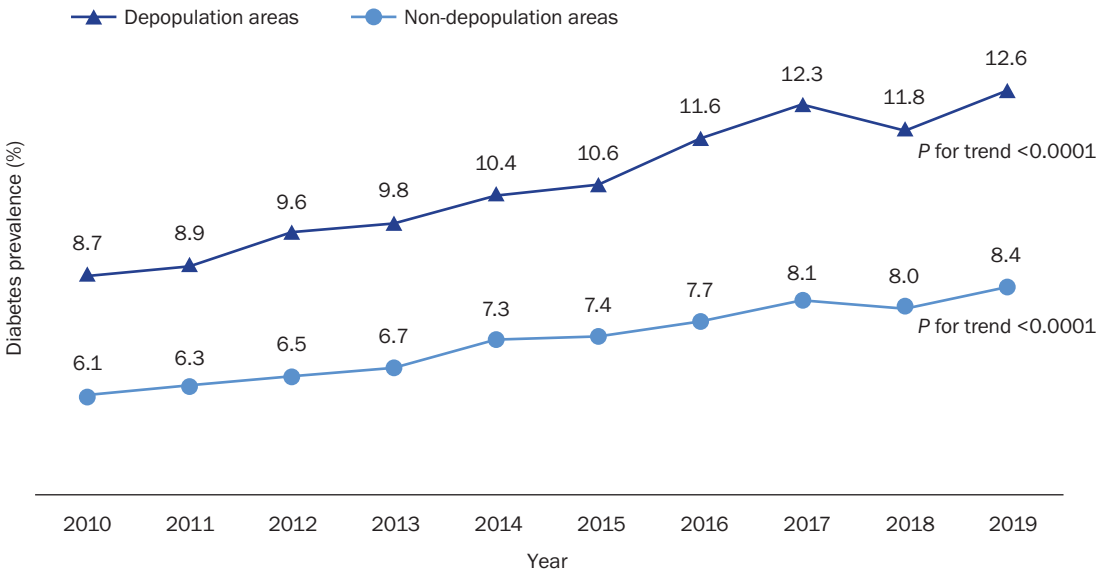

Fig. 3. Diabetes prevalence trends between depopulation and non-depopulation areas.
Diabetes prevalence by region type was measured as a percentage of complex sampling design effect and appropriate sampling weights of the national survey, using the SURVEYFREQ procedure in the SAS program.
P for trend adjusted for sex, age and education level from PROC SURVEYLOGISTIC procedures.

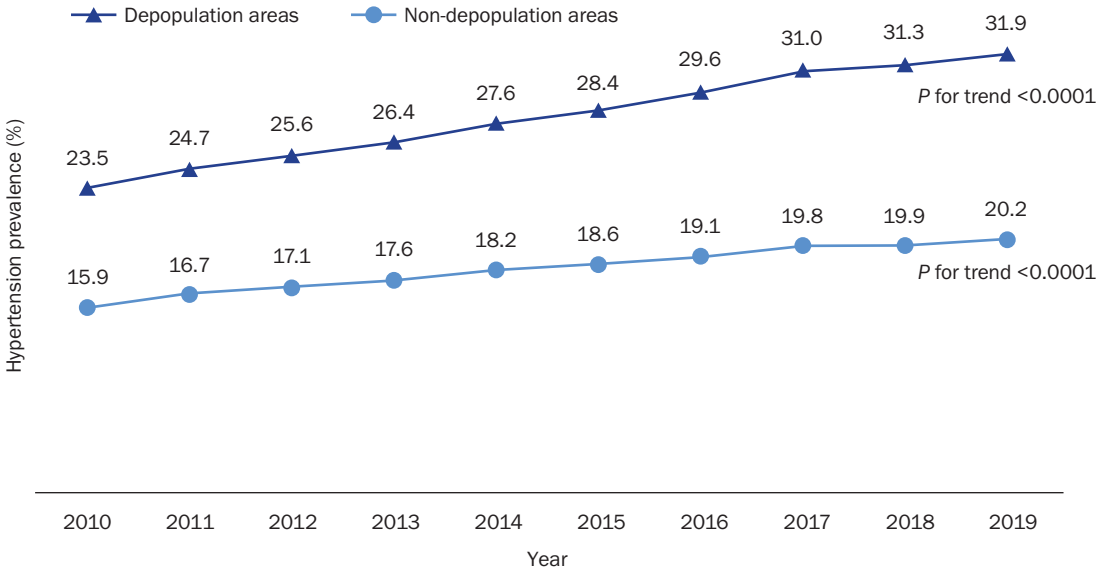

Fig. 4. Hypertension prevalence trends between depopulation and non-depopulation areas.
Hypertension prevalence by region type was measured as a percentage of the complex sampling design effect and appropriate sampling weights of the national survey using the SURVEYFREQ procedure in the SAS program.
P for trend adjusted for sex, age and education level from PROC SURVEYLOGISTIC procedures.

increased in both depopulation and non-depopulation areas. However, the increase in depopulation areas was large, leading to a widening gap between the two regions (Table 4, Figures 2-4).

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Table 4. ORs for chronic disease between depopulation and non-depopulation areas

		Depopulation areas			Non-depopulation areas		
		OR	95% CI	*P*-value	OR	95% CI	*P*-value
Obesity	Year	1.062	(1.058–1.066)	< 0.0001	1.049	(1.047–1.051)	< 0.0001
	Sex	0.675	(0.663–0.687)	< 0.0001	0.447	(0.443–0.452)	< 0.0001
	Age group	0.992	(0.991–0.992)	< 0.0001	1.005	(1.005–1.006)	< 0.0001
	Education level	0.922	(0.907–0.900)	< 0.0001	0.911	(0.905–0.918)	< 0.0001
Diabetes	Year	1.037	(1.034–1.041)	< 0.0001	1.020	(1.018–1.023)	< 0.0001
	Sex	0.769	(0.754–0.785)	< 0.0001	0.637	(0.628–0.646)	< 0.0001
	Age group	1.032	(1.031–1.033)	< 0.0001	1.057	(1.057–1.058)	< 0.0001
	Education level	0.762	(0.745–0.779)	< 0.0001	0.762	(0.753–0.770)	< 0.0001
Hypertension	Year	1.032	(1.029–1.035)	< 0.0001	1.009	(1.007–1.011)	< 0.0001
	Sex	1.120	(1.103–1.137)	< 0.0001	0.718	(0.711–0.726)	< 0.0001
	Age group	1.064	(1.063–1.064)	< 0.0001	1.079	(1.079–1.080)	< 0.0001
	Education level	0.840	(0.827–0.852)	< 0.0001	0.826	(0.819–0.833)	< 0.0001

OR and 95% CI were calculated from survey logistic regression analyses.
OR, odds ratio; 95% CI, 95% confidence interval.

DISCUSSION

A study investigating the population change in depopulating areas found that from 2010 to 2020, the proportion of young people in these areas decreased more significantly, while the proportion of elderly people increased more sharply compared to non-depopulating areas [13]. This has raised concerns about the deepening polarization of the population structure between depopulating and non-depopulating areas. Our study also confirmed that depopulating areas have higher proportions of elderly and low-education populations. Out of 89 depopulating areas, 85 were in non-metropolitan regions. Referring to a study indicating that the proportion of elderly single-person households is increasing significantly more in rural areas compared to urban areas [14], it is anticipated that the proportion of elderly single-person households would also be high in our study's depopulating areas.

The results of this study show that in depopulating areas, health behavior indicators related to health risks, such as smoking rates, were lower compared to non-depopulating areas. However, active health-promoting behaviors, such as moderate physical activity, walking practice, and nutritional labeling usage, were lower. Particularly, while the rates of moderate physical activity and walking practice improved in non-depopulating areas due to increased health awareness, these rates decreased in depopulating areas. This aligns with the results from the National Health Promotion Comprehensive Plan [15], which showed a decline in aerobic physical activity practice in certain areas. Given that regional disparities were calculated using the absolute difference in indicators, it is difficult to capture the changes due to the reversal phenomenon between regions, as observed in our study.

Additionally, the prevalence of diabetes and hypertension increased more sharply in depopulating areas. This can be interpreted as a health disparity resulting from differences in healthcare service benefits, as suggested by a study reporting that diabetes patients in depopulating areas receive less diabetes management education and fewer complication screenings compared to those in non-depopulating areas [16]. The high prevalence of diabetes and hypertension in depopulating areas suggests a high demand for health-promoting healthcare services. With most elderly individuals having at least one chronic disease [17], managing chronic diseases inevitably increases with the rising elderly population, highlighting the need to supplement healthcare services in these depopulating areas.

A study on the elderly in rural areas of South Korea found a significant association between inconvenient transportation and unmet medical needs [18], indicating that the characteristics of depopulating areas are closely linked to transportation and geographical fac-

tors [19]. Therefore, policy efforts to improve access to health-promoting healthcare services in these areas are crucial.

The "Special Act on Support for Depopulating Areas 2022" was enacted to provide a legal basis for effective responses to population decline and regional extinction, led by local regions with national administrative and financial support [20]. Although this special act allows for special support for depopulating areas, various amendments have been proposed to increase the law's effectiveness. These amendments include support for education (proposed by Representative Seo Dong-young in February 2023), childcare (proposed by Representative Lee Gae-ho in November 2022), foreign resident policies (proposed by Representative Lim Yi-ja in December 2022), cultural facilities (proposed by Representative Kim Hyung-dong in January 2023), and lifestyle population and relationship population (proposed by Representative Choi Hyung-doo in April 2023). However, these discussions have yet to include support for healthcare services that aid health-promoting behaviors in depopulating areas [21].

While various factors exacerbate regional health inequalities, merely allocating resources and support may not suffice to mitigate these inequalities [22]. Nevertheless, without substantial investment to enhance access to healthcare services, especially as individual capabilities diminish due to aging, health disparities will likely widen. Given that healthcare services supporting health-promoting behaviors are often publicly funded in rural areas, it is essential to secure stable public personnel and resources. Recent strategies to revitalize depopulating areas consider lifestyle population perspectives across various policy fields, such as culture, arts, and transportation [23]. In healthcare, utilizing healthcare professionals to support health-promoting behaviors should be actively reviewed from a lifestyle population perspective to effectively enhance the health of local residents in depopulating areas.

CONCLUSIONS

This study observed changes in health behaviors and disease prevalence in depopulation and non-depopulation areas using Community Health Survey data. However, due to the limitations of the data, the causes of these changes could not be fully identified. To effectively address the issues of population decline and regional extinction, as intended by the "Special Act on Support for Depopulating Areas," multidimensional analyses that include various socio-economic and geographical factors, in addition to the Community Health Survey data, are necessary to provide policy implications for enhancing regional health capabilities and addressing health disparities.

CONFLICT OF INTEREST

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

FUNDING

This study was performed with financial support from the Korea Disease Control and Prevention Agency in 2023.

DATA AVAILABILITY

Data sharing is not applicable to this article as publicly available data.

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Instructions for authors

KJCN
Korean Journal of Community Nutrition

Revised in July 23, 2024

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The *Korean Journal of Community Nutrition* (KJCN), the official journal of the Korean Society of Community Nutrition, is a peer-reviewed, open access journal. It is published bimonthly in February, April, June, August, October and December. KJCN aims to publish original research articles and reviews covering all aspects of community nutrition. The journal also welcomes research notes and educational materials that provide a wide range of findings of community nutrition field. Topics of interest include nutrition throughout the life cycle, nutrition assessment, nutrition education, nutritional epidemiology, dietary behavior, clinical nutrition, international nutrition, nutrition policy, food service management, food culture and other topics related to the improvement of human nutritional status.

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- Both sexes/genders should be included in the human studies, and the differences between the sexes/genders should be analyzed and reported.
- If only one sex/gender is reported, or included in the

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This research was supported by a grant from the National Research Foundation of Korea (Grant No. ***).

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The journal encourages authors to describe the study according to the reporting guidelines relevant to their research design, such as those outlined by the EQUATOR Network (http://www.equator-network.org/home/) and the United States National Institutes of Health/ National Library of Medicine (http://www.nlm.nih.gov/services/research_report_guide.html).

- Ethics Statement

Authors should present an “Ethics statement” immediately after the heading “Methods”. In case of reviews, research notes and educational materials, “Ethics statement” should be presented after introduction section.

<Example>
The informed written consent was obtained from each participant. The study protocol was approved by the Institutional Review Board of *** (approval number).]
<Example>
Obtainment of informed consent was exempted by the institutional review board.

- Conflict of Interest

<Example>
There are no financial or other issues that might lead to conflict of interest.
<Example>
Kildong Hong has been an editor since 2021. However, he was not involved in the review process of this manuscript. Otherwise, there was no conflict of interest.

- Acknowledgments

Describe the person who helped write the thesis or research but was not appropriate as an author.

<Example>
We thank the physicians who performed the sample collection.

- Data Availability

Authors should provide a data availability statement. Providing access to research data is optional.

<Example>
The data that support the findings of this study are openly available in [repository name e.g “KNHANES”] at http://doi.org/[doi].

4) **Abstract:** A structured abstract of 250~300 words must be written in English under the following headings: Objectives, Methods, Results, and Conclusions. Abstracts should be accompanied by keywords in English.
5) **Keywords:** A Three to five keywords are recommended with one or two words except for technical terms. The terminology should be listed, in principle, in MeSH (www.nlm.nih.gov/mesh/MBrowser.html). Keywords are written in lowercase letters except for proper nouns, and keywords are separated by a semicolon (;).
6) **Abbreviations:** All abbreviations must be defined in parentheses at first mention in the text. Abbreviations used in a table or figure should be defined in their respective table footnote or figure legend.
7) **Numbers and measurements:** Numbers should be presented in Arabic numerals. For most measurements, the International System of Units (SI) is recommended. The unit symbol should be placed after the numerical value and a space should be left between the numerical value and the unit symbol except %, ˚C.
8) **References**
   - References should be numbered consecutively in the order in which they appear in the text using Arabic numerals in brackets.
   - When more than one reference is cited at the same

point in the text, they are included in the same bracket as below

<Example>
[1-3] or [4, 7]

- When the authors' names of the references are inserted in the text, the last names of the authors are given in English. When the reference has two authors, both authors' names should be joined by '&', and when the reference has more than two authors, the first author's name should be given followed by 'et al.'

<Example>
Kim [2], Park & Lee [5], Brown *et al*. [7]

- Reference list should be given in English in numerical order corresponding to the order of citation in the text.
- References should follow the National Library of Medicine (NLM) style guide (http://www.nlm.nih.gov/citingmedicine).
- Abbreviations of journal names should be written according to the international rules for the abbreviation (https://www.ncbi.nlm.nih.gov/journals) or KoreaMed (https://www.koreamed.org/JournalBrowserNew.php).
- Master's thesis and doctoral dissertation should be cited less than three.

(1) Journal articles

① *Published journal articles*

Authors. Article title. Journal title Year of publication; Volume(Issue): Start page-Last page.

<Example> Mo YJ, Kim SB. Sodium related recognition, dietary attitude and education needs of dietitians working at customized home visiting health service. Korean J Community Nutr 2014; 19(6): 558-567.

When an article has more than six authors, the names of the first six authors should be given followed by 'et al.'

<Example> Yon MY, Lee HS, Kim DH, Lee JY, Nam JW, Moon GI et al. Breast-feeding and obesity in early childhood - based on the KNHANES 2008 through 2011-. Korean J Community Nutr 2013; 18(6): 644-651.

② *Forthcoming journal articles*

Authors. Article title. Journal title Year of publication. Forthcoming.

<Example> 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. Forthcoming.

(2) Books

① *Entire books*

Authors. Title. Edition. Publisher; Year of publication. p. Start page-Last page.

<Example> Park YS, Lee JW, Seo JS, Lee BK, Lee HS, Lee SK. Nutrition education and counselling. 5th ed. Kyomunsa; 2014. p. 32-55.

<Example> Ministry of Health and Welfare (KR), The Korean Nutrition Society. Dietary reference intakes for Koreans 2020: Minerals. Ministry of Health and Welfare; 2020. p. 25-46.

② *Book chapter*

Chapter authors. Chapter title. In: Editor names, editors. Book title. Edition. Publisher; Year of publication. p. Start page-Last page

<Example> Tamura T, Picciano MF, McGuire MK. Folate in pregnancy and lactation. In: Bailey LB, editor. Folate in Health and Disease. 2nd ed. CRC press; 2010. p. 111-131.

③ *Translated books*

Translators. Translated title(translated version). Edition. Original language originally written by authors. Publisher; Year of publication. p. Start page-Last page.

<Example> Mo SM, Kwon SJ, Lee KS. Do you know dining table of children? (translated version). 1st ed. Japanese original written by Adachi M. Kyomunsa; 2000. p. 20-22.

(3) Scientific reports

Authors. Report title. Performing organization; Year of publication Month of publication. Report No. Report number.

<Example> Lee YM. A study on development of food safety and nutrition education program for preschooler. Ministry of Food and Drug Safety; 2013 Nov. Report No. 13162consumer110.

(4) Thesis and dissertaion

Author. Title. [Book type]. Publisher; Year of publication. master's thesis for master degree, dissertation for doctoral degree

<Example> Ahn SY. The perception of sugar reduction in nutrition teachers or dieticians in charge of school meals and their use of added sugar in Seoul. [master's thesis]. Sookmyung Women's University; 2014.

(5) Conference papers

Authors of paper. Title of paper. Proceedings of Conference title; Year Month Day; Place of conference: p. Start page-Last page.

<Example> Shim JE. Infant and child feeding practices for development of healthy eating habits. Proceedings of 2014 Annual Conference of the Korean Society of Community Nutrition; 2014 Nov 14; Seoul: p. 195-213.

(6) Articles in magazine or newspaper

① *Magazine articles*

Author. Article title. Magaxine title. Year Month: Page.

<Example> Lee BM. Nutrition treatment of hereditary metabolic diseases. Nutrition and Dietetics. 2013 Dec: 12-19.

② *Newspaper articles*

Author or Organization. Article title. Newspaper title. Year Month Day; Section: Page.

<Example> Lee JH. Sodium reduction need to readjust policy. Food and Beverage News. 2014 Sep 29; Sect. A: 1.

(7) Materials on the internet

① *Web sites*

Author or Organization. Title [Internet]. Publisher; Year [cited Year Month Day]. Available from: electronic address

<Example> The Korean Society of Community Nutrition. Nutrient story [Internet]. The Korean Society of Community Nutrition; 2007 [cited 2015 May 12]. Available from: http://www.dietnet.or.kr/

② *Web page*

Author or Organization. Title [Internet]. Publisher; Year [updated Year Month Day; cited Year Month Day]. Available from: Electronic address

<Example> Ministry of Food and Drug Safety. Winter food poisoning, be careful of norovirus [Internet]. Ministry of Food and Drug Safety; 2014 Nov 14 [updated 2014 Dec 11; cited 2015 Feb 1]; Available from: http://www.mfds.go.kr/fm/article/view.do?articleKey=1245&searchTitleFlag=1&boardKey=4&menuKey=167&currentPageNo=1

8) Tables and Figures: Tables and Figures must be written in English, and limited to a maximum of 10 altogether. Each table and figure should be prepared on a separate page and placed at the end of the text according to the order cited in the text. Citation of tables or figures in the text is as Table 1 or Fig. 1. Vertical lines are not used in tables. A title should be placed at the top of a table or at the bottom of a figure. The footnotes of the table are presented on Arabic numerals as superscripts 1), 2), 3). In case of indicating levels of significance, *P*-values should be presented in the body of each table, and if necessary, symbols can be used as *, **, ***, etc. To indicate the result of multi-range tests, letters such as a, b, c, etc. can be used.

9. PUBLICATION

Once the review process is completed, the manuscript cannot undergo any modifications in their contents or changes of the authors. PDF page proofs will be emailed to the corresponding author and should be returned within 3 days. The author pays the publication fee for the published paper, including manuscript editing fees, reference proofreading fees, and file processing fees. Authors who choose to withdraw a manuscript after it has undergone peer-review will be charged the review fee.

Any issues not indicated in these instructions will be reviewed and decided by the Editorial Committee. Any additional questions or information on manuscript submission and publication can be clarified by contacting the editorial office.

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The code of research ethics of the Korean Society of Community Nutrition

Enactment Jan 21, 2008
1st revision April 19, 2010
2nd revision March 28, 2014
3rd revision February 28, 2020

I. GENERAL RULES

1. Title

This code is titled as 'The Code of Research Ethics of the Korean Society of Community Nutrition.'

2. Purpose

The purpose of the code is to establish the standard for the research ethics observed by the members of the Korean Society of Community Nutrition and the contributors to the Korean Journal of Community Nutrition, and determine the establishment and operation of the Committee on the Research Ethics (hereafter the 'Committee') for fair and systematic verification in the case of the scientific misconduct.

II. ETHICS CODE FOR A RESEARCHER

3. Integrity of Researcher

A researcher should conduct research and publish research results with research integrity.

4. Inclusion of Scientific Misconduct

(1) Fabrication refers to the act of creating, documenting, or reporting the data or the research results that do not exist.
(2) Falsification refers to the act of creating the documentation that do not match study results by manipulating the research materials, equipment, or procedures or changing or omitting data or research results.
(3) Plagiarism refers to steal others' ideas, procedures, results, or records without legitimate authorization.
(4) The improper authorship refers to the act which confers authorship on the person without any academic contribution due to gratitude or seniority, or does not reward with authorship without proper cause to the person who academically contributes or devotes the research contents or results.
(5) It includes the acts which seriously exceed generally accepted criteria.

5. Prohibition of Duplicate Submission or Duplicate Publication of Research Product

A researcher should not submit or publish the same research results in two different places.

6. Authorship

Contributors who have made substantive intellectual contributions to a paper are given credit as author and authorship is based on the following four criteria.
(1) Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND
(2) Drafting the work or reviewing it critically for important intellectual content; AND
(3) Final approval of the version to be published; AND
(4) Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

7. Record of Published Work

(1) An author should accept the credit for only the accomplishments of the research he/she conducted or contributed to and take responsibility for them.

(2) The order of the authors (including translators) of articles or other publications should be determined with fairness according to the extent of the contribution to research regardless of relative positions. Simply being in a particular position should not guarantee a credit as a co-author, the first author, or a corresponding author. Neither the act of not crediting the sufficient contribution to research with authorship can be justified. When the contribution to research is low, a statement of appreciation is expressed in a footnote, a preface, or an acknowledgement.

8. Citation and Reference

(1) An author who cites academic materials should make efforts to describe them accurately and state their sources clearly. The materials that are obtained from personal communication can be cited with the permission from the researcher who provides information.

(2) When an author cites or makes a reference to others' words, he/she should state the fact in a footnote, and distinguish them from his/her original thoughts or results of interpretation.

9. Role and Ethics for a Journal Editor

(1) An editor should request a reviewer with expertise in the field, objectivity, and impartial judgment for the evaluation of submitted manuscripts.

(2) An editor should not disclose the information about the author or the content of the manuscript until the submitted manuscript is decided to be published.

10. Role and Ethics for a Reviewer

(1) A reviewer should evaluate the manuscript under review with commitment and impartiality within a specified period and notify a journal editor of results.

(2) A reviewer should notify a journal editor immediately of the intention to resign from reviewing a manuscript when he/she believes oneself to be unsuitable for reviewing the manuscript.

(3) A reviewer should evaluate a manuscript with objective criteria and impartiality without consideration of one's academic beliefs or personal relationship with its author. A reviewer should not reject a manuscript without logical reasons or on the reason that it is in conflict with his/her own view or interpretation, and rate a manuscript without reading it thoroughly.

(4) A reviewer should respect an author's personality and individuality as an intellectual and use comments in a polite and gentle manner as much as possible, and should not use degrading or insulting expressions.

(5) A reviewer should maintain confidentiality of a manuscript under review and should not cite the content of a manuscript prior to its publication.

III. ESTABLISHEMENT AND OPERATION OF THE COMMITTEE

11. Function of the Committee

The Committee reviews and decides the issues below related to the research ethics of the members of the Korean Society of Community Nutrition.

1. The establishment of the research ethics
2. The prevention and investigation on the scientific misconduct
3. Whistleblower protection and confidentiality
4. Verification on the violation of the research ethics, process of the verification results and follow-up measures
5. Restoration in the honor of the examinee
6. Other issues imposed by the chair of the Committee

12. Organizing Principles of the Committee

The Committee consists of 5 members. The committee is chaired by the President of the Society and the Editor-in-chief serves as the associate chair of the committee. The other three are appointed by the President of the Society with the recommendation from the Executive Board.

13. Report and Receipt of the Scientific Misconduct

The whistle-blower may provide the information to the secretariat of the editorial board in the Korean Society of Community Nutrition directly or through the telephone, written document or e-mail on the real name. However, if the contents and evidence of the misconduct are specific, the report provided by an anonymous informant is considered as the case by the real-name person.

14. Authority for Verification and Recommendation of the Committee

The Committee is authorized to conduct an investigation about the allegation of the violation of the ethics code using a wide range of evidence from informants, the person under investigation, witnesses, and reference materials. The committee reviews and decides the status of violation of the ethics code based on the results of investigation, and recommends appropriate sanctions to the president based on the decision.

15. Verification Process of the Committee

The verification process for the act of violation of research ethics proceeds in the order of preliminary inquiry, investigation, and judgment. The investigation should be completed within 6 months. However, when the investigation is unlikely to be completed within the time frame, the investigation period may be extended with the committee chair's approval. When an informant or the person under investigation disagrees with the decision, he/she may file an appeal within 30 days from receiving notification, and the Committee may conduct reinvestigation if necessary.

16. Assurance of Opportunity to Be Heard

The member who is alleged to violate the Code of Research Ethics should be given a written notice of the overview of the issue under investigation. He/she is guaranteed to have an opportunity to submit a letter of explanation, and as long as he/she whishes, an opportunity to attend one or more of the Committee meetings in the investigation procedure and provide an oral explanation.

17. Confidentiality Duty for a Member of the Committee

A member of the Committee shall not disclose the identification of the reporter and the member suspected of the research ethics violation until the final decision is confirmed by the society.

18. Disciplinary Procedures and Content

In the event of proposed disciplinary measures by the Ethics Committee, the committee chair convenes the Executive Board and makes a final decision on the status and the content of discipline. The member who is determined to have violated the Code of Research Ethics may be given disciplines including warning, ban on manuscript submission for a specified period, and suspension or cancellation of membership depending on the severity of the issue, and the article may be retracted and the results may be disclosed if necessary.

19. Revision of the Code of Research Ethics

Revision procedure of the Code of Research Ethics follows the revision procedure of the code of the Society.

Author's checklist

KJCN
Korean Journal of Community Nutrition

Revised in July 23, 2024

Authors' quick submission checklist
(※ Please include the checklist when submitting the manuscript to the submission site.)

Category		Items to review	Check
Title page	1. Title	- Spelling and typographical errors in paper titles - Titles should be written in sentence case, with only the first word of the text and proper-nouns capitalized. The study design should be included in the title or subtitle. e.g., Development and Effectiveness Evaluation of the STEAM Education Program on Food Groups for Kindergarteners -> Development and effectiveness evaluation of the STEAM education program on food groups for kindergarteners: a non-randomized controlled study e.g., Program Evaluation using the RE-AIM Framework: A Systematic Review and Application to a Pilot Health Promotion Program for Children -> Evaluation of the pilot health promotion program for children: a systematic review	
	2. Author Information	- Include all author titles and affiliations, and indicate the position before the affiliation	
	3. Submission	- The title page, the copyright transfer agreement, and IRB approval are all included when submitting your paper to the submission site by uploading them to the 'Attachment' section. - Remove the cover page including author information from the submitted paper before submitting	
	4. ORCID	- ORCID should be stated for all authors e.g., Gildong Hong: https://orcid.org/https://orcid.org/0000-0000-0000-0000	
	5. Funding	e.g., This research was supported by a grant from the National Research Foundation of Korea (Grant No. 000). - When there is no funding associated with the manuscript, "none" should be stated.	
Abstract	1. Structure	- Objectives-Methods-Results-Conclusions	
	2. Keywords	- Three to five keywords are recommended with one or two words except for technical terms. - The terminology should be listed, in principle, in MeSH (www.nlm.nih.gov/mesh/MBrowser.html). - Keywords are written in lowercase letters except for proper nouns, and keywords are separated by a semicolon (;).	
	3. Abbreviations	- Abbreviations should only be used if they are repeatedly used throughout the abstract. If an abbreviation is not used after it has been defined, use the full name instead - Define an abbreviation the first time it appears in the abstract	
Main body	1. Structure	- Title page, Abstract, Introduction, Methods (including ethics statement), Results, Discussion, Conclusion, Conflict of Interest, Acknowledgments, Data Availability References, Tables, and Figures - Upload tables and figures as a single file and do not separate them	
	2. Statistical software	- Enter the correct type and version of statistical software e.g., IBM SPSS Statistics 25 (IBM Corporation, Armonk, NY, USA) e.g., SAS 9.4 (SAS Institute, Cary, NC, USA)	
	3. Ethics Statement	- Authors should present an "Ethics Statement" immediately after the heading "Methods". In case of reviews, research notes and educational materials, "Ethics Statement" should be presented after introduction section e.g., The informed written consent was obtained from each participant. The study protocol was approved by the Institutional Review Board of *** (approval number: ***). *IRB approval statement will be included in the final version, but do not include specific IRB information (e.g., institution name) when submitting. e.g., Obtainment of informed consent was exempted by the institutional review board.	
	4. Conflict of Interest	- Conflict of interest must be stated. e.g., There are no financial or other issues that might lead to conflict of interest. e.g., Gildong Hong has been an editor since 2021. However, he was not involved in the review process of this manuscript. Otherwise, there was no conflict of interest. *Author information will be included in the final version but do not include it when submitting.	

(continued to the next page)

(Continued)

Category		Items to review	Check
	5. Acknowledgments	- List individuals who contributed to the writing or research, but do not meet the criteria for authorship. e.g., We thank the physicians who performed the sample collection. *This information will be included in the final version, but do not include it when submitting.	
	6. Data Availability	- Authors should provide a data availability statement. Providing access to research data is optional. e.g., The data that support the findings of this study are openly available in [repository name e.g "KNHANES"] at http://doi.org/[doi].	
	7. References	- Notation method: [1], [2, 5], [15-20], etc. without spaces before square brackets, when adding commas between references, add a space after commas. e.g., research on something[1] or Kim & Lee's research[2, 5] - References in the text should be listed in numerical order - The number of citations for the type of dissertation should not exceed 3. - The total number of references should be no more than 50 - Verify that the reference adheres to the KJCN guidelines	
	8. Other indications such as units	- Write numbers and units with a space (50 kg, 600 kcal), but attach % and °C. - g/dl (X), g/dL (O) - When indicating P-value, use capital, italic P: e.g., P-value - Use a dash '-' to indicate a range of numbers: e.g., 20-25 - Use comma notation to separate thousands (this also applies to text and tables): For example, 65,450,000.	
	9. Tables, figures	- Capitalize only the first letter of table and figure titles - Capitalize only the first letter of variables in the table - Use lowercase 'n' in tables and figures. - Additional checklists for tables and figures can be found in the section below.	

*Examples shown in the tables are based on recent publication, 2024.

GUIDELINE FOR TABLES AND FIGURES

Please adhere the following guidelines for tables and figures.

1. To indicate the total number of items outside of the table's body, include it in parentheses at the end of the table's title. For example, "Sociodemographic characteristics of children (n = 80)"
2. The table heading should provide a descriptive title for the values presented, rather than simply using "Mean ± SD" as the title.
3. When describing the contents of the table in the text:
   ① To present an average value, use Mean ± SD or Mean ± SE, and be mindful of spacing (e.g., 22.0 ± 2.3, with a space before and after the '±' symbol)
   ② Units should be written in parentheses within the table (e.g., Energy (kcal/day)) instead of next to it (Energy, kcal/day)
4. Footnotes or legends explanations for tables or figures should be written in English
5. The footnotes or legends should be arranged in the following order: Values displayed as statistical outcomes, statistical analysis method, indication of significance, etc.
   ① The presentation of values of statistical outcomes, such as n (%), Mean ± SD, n (%) or Mean ± SD, etc, are displayed in the first line of the footnote without comment numbers.
   ② Statistical analysis method and significance indication - Both statistical analysis methods and significance are discussed. - Post-hoc analysis results can only be presented when the ANOVA test yields significant results.
   ③ The full name of any abbreviations used in the title or table body should be provided in the footnote.
   ④ Any other content that requires explanation should be accompanied by corresponding comment numbers, following the submission guidelines. Verify that the comment numbers match the numbers indicated in the table body.

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Author(s): _____

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3. The manuscript or any part of it has not been published elsewhere (abstracts excluded). The manuscript is not currently being considered for publication by any other journals and will not be submitted for such review while under review by the journal.

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투고규정

KJCN
Korean Journal of Community Nutrition

(2024년 7월 23일 개정)

1. 학회지의 특성

본 학회지는 대한지역사회영양학회의 학술지로서, 전문가 심사를 거친 논문만을 게재하고, 논문 전문은 학회 홈페이지를 통해 공개된다. 학회지는 2개월마다(2월, 4월, 6월, 8월, 10월, 12월) 발행되며, 발행일은 발간월의 마지막날이다. 생애주기영양, 영양판정,영양교육, 영양역학, 식행동, 임상영양, 국제영양, 영양정책,급식및 외식 관리, 식문화와 기타 지역사회영양학 분야의 연구논문(research articles), 종설(reviews), 연구단보(research notes),교육자료(educational materials) 등을 게재할 수 있다.

2. 투고 자격

저자 중 적어도 1명이 대한지역사회영양학회 회원이어야 투고할수 있으며, 비회원의 경우 편집위원회에서 위촉 또는 국외 기관에 소속된 저자가 투고할 시 가능하다.

3. 원고의 종류

1) **연구논문:** 지역사회영양학 분야의 새로운 논문
2) **종설:** 특정 주제에 대하여 간결하고 정확하게 최신문헌 및 견해를 기술한 논문, 체계적인 문헌고찰은 PRISMA 가이드라인을 따라야 함
3) **연구단보:** 지역사회영양학과 관련된 새로운 아이디어, 연구방법, 정책적 이슈 등에 대한 토의 보고
4) **교육자료:** 영양교육 프로그램의 내용과 활용, 또는 새로운 교육 접근방법 등에 관한 논문

4. 연구 및 출판윤리

1) **이중게재:** 원고는 다른 학회지에 발표되거나 투고되지 않은것이어야 한다.
2) **저자됨:** 원고의 저자는 연구설계, 자료 수집 및 분석, 원고 작성에 기여를 하고, 연구와 관련된 문제의 조사와 해결에 책임을 다할 것을 동의한 자이어야 한다.
3) **피험자 보호:** 연구의 대상이 사람인 경우 헬싱키 선언에 입각하여 피험자를 보호하여야 하며, 연구를 수행하기 전 기관생명윤리위원회(Institutional Review Board; IRB)의 승인을 받아야 한다.
4) **이해관계:** 연구를 지원하는 회사나 기관과 경제적 또는 개인적 관계가 있는 경우 이를 논문에 명백하게 기술해야 한다.
5) **윤리규정 준수:** 저자는 본 학회 연구윤리규정을 준수하여야 하며, 본 규정에 언급되지 않은 연구 및 출판윤리에 대해서는 국제표준출판윤리규정(http://publicationethics.org/international-standards-editors-and-authors)을 적용한다.
6) **저작권:** 본 학회지에 게재된 논문의 저작권은 본 학회에 귀속된다. 논문투고시 모든 저자는 저작권이전동의서에 사인하여 제출해야 한다.
7) **프리프린트(preprint):** 본 학회지는 프리프린트로 사전 공유된 연구논문을 허용하지 않는다.

5. 성(SEX)/젠더(GENDER)에 대한 고려

논문에서 결과에 영향을 줄 수 있는 인자로 생물학적 성(sex) 또는 사회문화적 성인 젠더(gender)를 인식하고 이에 대한 아래 내용을 논문에 포함하여야 한다.

- 성별 기술에서 성(sex)과 젠더(gender)를 구분하여 올바르게기술한다.
- 연구 대상에 남성과 여성을 대상으로 포함하여 연구하고 그 결과를 비교분석하여 논문을 발표한다.
- 단일 성을 대상으로 연구한 경우는 학술적으로 타당한 근거를 제시한다.

6. 논문투고

교신저자는 온라인투고시스템(https://submit-kjcn.or.kr)으로 저자정보가 삭제된 원고파일을 제출한다. 저자정보가 포함 된 표지, 모든 저자의 서명이 작성된 IRB 승인서 사본, 저자체크리스트는 온라인 투고사이트 '첨부파일'에 업로드 한다.

7. 전문가 심사

편집이사 또는 편집위원은 저자정보가 삭제된 투고논문을 두 명의 전문가에게 심사하도록 보내고, 심사자는 대한지역사회영양학회지의 심사규정에 따라 심사한다. 편집이사는 심사자의 의견에 따라 첫 번째 결정을 내리고 6주 안에 교신저자에게 알린다.

두 명의 심사자의 의견이 다를 때에는 또 다른 심사자에게 심사하도록 한다.

8. 원고 작성법

1) 원고 작성: 원고는 MS 워드를 사용하여 한글 또는 영문으로 작성한다. 글자 크기는 11 point, 행간은 200% 또는 2줄 간격으로 하며, 영문 글꼴은 Times New Roman 으로 한다. 영문초록을 1쪽으로 하여 쪽번호를 표기하며, 원고 왼쪽 여백에 줄 번호를 매긴다.

2) 표지: 다음의 내용을 포함한다.

- 원고의 종류(연구논문, 종설, 연구단보, 교육자료)
- 압축한 제목(Running head)은 50자 이내의 영문으로 기재
- 제목을 국문논문은 국문과 영문 모두 기재, 영문논문은 영문만 기재
- 영문 제목은 기본적으로 소문자로 작성(단, 문장의 첫 단어와 고유 명사는 대문자로 작성). 관찰 연구(단면조사연구, 환자-대조군 연구 또는 전향적 코호트 연구), 임상 연구, 체계적 문헌고찰 또는 메타 분석의 경우 제목 또는 부제목에 연구디자인 제시
- 저자, 소속 및 직위를 국문과 영문으로 기재, 단 영문논문의 경우 영문으로만 기재

  교신저자 이름 뒤에는 "†" 표시를 붙이고, 소속기관이 다를 경우는 저자이름 끝에 1), 2), 3)을 순서에 따라 붙이고, 해당인의 소속기관명 앞에 같은 숫자를 붙인다. 소속이 같으나, 직위가 다를 경우에도 , , 을 순서에 따라 붙인다. 연구자의 직위(교수, 강사, 학생, 연구원 등)는 영문의 경우 소속 앞에 기재한다. 소속과 직위가 없는 경우에 는 이름만 기재한다. 현재 소속이 없는 미성년자의 경우 최종 소속, 직위, 재학년도를 별도로 제출한다.

〈예〉

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- 교신저자의 성명, 주소 및 전화번호, 팩스번호, 전자우편주소를 영문으로 기재. 전화와 팩스번호는 국가코드도 표기

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  모든 저자는 ORCID 등록시 소속과 직위를 등록해야하며, 이는 추후저자신분 확인이 필요할 경우 자료로 활용할 수 있다. 모든 저자의 ORCID 번호를 표기하며, 그 예는 다음과 같다.

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- 연구지원내역(Funding)

  해당하는 내용이 없더라도 'None.' 으로 기재한다.

〈예〉

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3) 원고의 구성: 원고의 부제목은 모두 영문으로 작성하고, 구성은 다음과 같다. Title page, Abstract, Introduction, Methods, Results, Discussion, Conclusion, ORCID, Conflict of Interest, Funding, Acknowledgments, Data Availability, References, Tables, Figures 순으로 한다. 단, 교육자료의 경우 결과와 고찰의 내용을 콘텐츠(Contents), 평가(Evaluation), 시사점(Implications) 등의 내용으로 구성할 수 있다. 종설의 경우 연구논문의 구성과 달리 서론, 본론, 결론의 구성으로 기술할 수 있다. 그러나 주제범위 고찰(scoping review)이나 체계적 고찰(systematic review)은 연구논문의 구성을 따라야 한다.

본 학회지는 EQUATOR 네트워크(http://www.equator-network.org/home/)와 미국국립보건원/국립의학도서관(http://www.nlm.nih.gov/services/research_report_guide.html)에서 안내하는 보고지침에 따라 원고를 구성하도록 권장한다.

- 연구윤리(Ethics Statement)

  저자는 "방법(Method)" 연구윤리에 관해 영문으로 기술

해야 한다. 부제목 바로 아래에 제시하며 종설, 연구노트, 교육자료 등의 경우에는 서론 뒤(본론 전)에 제시한다.

〈예〉
The informed written consent was obtained from each participant. The study protocol was approved by the Institutional Review Board of *** (approval number: IRB승인번호).
〈예〉
Obtainment of informed consent was exempted by the institutional review board.

• 이해상충(Conflict of Interest)

〈예〉
There are no financial or other issues that might lead to conflict of interest.
〈예〉
Kildong Hong has been an editor since 2021. However, he was not involved in the review process of this manuscript. Otherwise, there was no conflict of interest.

• 감사의 글(Acknowledgments)
논문작성이나 연구를 도왔지만 저자로서 적절하지 않은 분 등을 기술한다.

〈예〉
We thank the physicians who performed the sample collection.

• 데이터가용성(Data Availability)
저자는 데이터가용성에 대한 설명을 작성해야하며, 데이터에 대해 접근을 허용하는 것은 선택사항이다.
〈예〉
The data that support the findings of this study are openly available in [repository name e.g "KNHANES"] at http://doi.org/[doi].

4) **영문초록:** 영문초록은 목적(Objectives), 연구방법(Methods), 결과(Results), 결론(Conclusions)의 소제목으로 구분하여 250~300단어로 작성한다. 초록 아래쪽에 주제어(Keywords)를 영문으로 표기한다.
5) **키워드:** 전문 용어를 제외한 1~2개의 단어로 구성된 3~5개의 키워드를 기재한다. 해당 키워드는 MeSH(https://meshb.nlm.nih.gov/search) 에 검색되는 단어로 작성한다. 키워드는 고유명사를 제외하고 모두 소문자로 표기하며, 구분 기호는 세미콜론(;)으로 작성한다.
6) **약어:** 제일 처음 나오는 곳에 완전한 이름을 먼저 표기한 후 괄호 안에 약어를 표기하며, 표 또는 그림에 사용된 약어는 각주 또는 그림 설명에서 설명한다.
7) **수량 및 단위:** 수량은 아라비아 숫자로, 도량단위는 SI 단위를 권장한다. %, ℃를 제외한 모든 단위는 숫자와 띄어쓴다.
8) **참고문헌**
• 본문 중에는 인용된 순서대로 [ ] 안에 번호로 기재한다.
• 본문의 한 문장에서 여러 개의 참고문헌을 인용할 때에는 다음과 같이 기재한다.

〈예〉 [1-3] 또는 [4, 7]

• 본문 중에 참고문헌의 저자를 기재하는 경우 영문 last name을 표기한다. 저자가 2명일 경우에는 두 저자 사이에 &를 삽입하고, 3인 이상일 때는 제 1저자만 표기하고 "등"을 쓴다.

〈예〉 Kim[3]은, Park & Lee[5]는, Brown 등[7]은

• 참고문헌 목록은 인용된 순서에 따라 아라비아 숫자와 함께 영문으로 표기한다.
• The National Library of Medicine (NLM) 표준체제(http://www.nlm.nih.gov/citingmedicine)를 따라 작성한다.
• 학회지명은 약어로 표기하되 국제 약어 관례(PubMed 등재지 검색 사이트 http://www.ncbi.nlm.nih.gov/journals) 또는 KoreaMed 등재지 검색 사이트(http://www.koreamed.org/JournalBrowserNew.php)를 참고한다.
• 학위논문은 필요한 경우 3개 이내로 인용한다.

(1) 학술지
① 출판 된 학술지 논문
저자명. 논문명. 학술지약어 연도; 권(호): 시작페이지-마지막 페이지. 순으로 기재

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8) 표 또는 그림

표와 그림은 영문으로 작성하며, 합하여 10개 이내로 하고, 한 장에 하나씩 작성하여 인용된 순서대로 본문 뒤에 첨부한다. 본문에 인용할 때는 Table 1 또는 Fig. 1 등으로 표기한다. 표 작성 시에는 종선은 사용하지 않는 것을 원칙으로 하며, 표의 제목은 표의 상단에, 그림의 제목은 그림의 하단에 기재한다. 각주는 1), 2), 3) 등으로 나타내고 하단에 그 내용을 표시한다. 단, 통계분석의 유의성 표시는 표 본문에 *P*-values를 제시하는 것으로 하고, 필요한 경우 *, **, *** 등으로, 다중 범위 검정에서는 a, b, c 등으로 사용한다

9. 출판

심사가 끝난 논문은 내용이나 저자를 바꿀 수 없다. 교신저자는 교정본 PDF 파일을 e-mail로 받으면 3일 이내에 교정하여 보내야 한다. 원하는 저자에 한하여 게재된 논문의 별쇄본 20부를 제공한다. 저자는 게재된 논문의 게재료로 원고 편집비, 참고문헌 교정비, 파일 가공비 등 소요되는 비용을 부담한다. 단, 심사과정이 시작된 이후 논문을 철회한 경우에는 논문의 심사 단계에서 발생한 심사료 비용을 부담한다. 본 규정에 명시되지 아니한 사항은 편집위원회의 심의를 거쳐 결정한다.

논문투고와 출판 관련 모든 문의사항은 편집사무실로 연락한다.

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제정 2008. 1. 21
1차 개정 2010. 4. 19
2차 개정 2014. 3. 28
3차 개정 2020. 2. 28

제1장 총칙

제1조 (명칭)
이 규정은 “대한지역사회영양학회 연구윤리규정”이라 한다.

제2조 (목적)
이 규정은 대한지역사회영양학회 회원 및 대한지역사회영양학회지 투고자가 지켜야 할 연구윤리의 기준을 확립하고, 연구부정행위 발생 시 공정하고 체계적인 검증을 위한 연구윤리위원회(이하 “위원회”라 한다)의 설치 및 운영에 관한 사항을 규정함을 목적으로 한다.

제2장 연구자의 윤리규정

제3조 (연구의 진실성)
연구자는 연구의 진실성을 준수하여 연구를 수행하고 그 결과를 발표하여야 한다.

제4조 (연구부정행위의 범위)
연구부정행위는 다음 각 호와 같다.
1. 위조란 존재하지 않는 데이터나 연구 결과를 만들어 내고 이를 기록하거나 보고하는 행위를 의미한다.
2. 변조란 연구자료, 장비 또는 과정을 조작하거나, 데이터나 연구 결과를 변경하거나 생략하여 연구 기록이 연구결과와 부합하지 않게 하는 행위를 의미한다.
3. 표절이란 정당한 권한 없이 타인의 아이디어, 과정, 결과 또는 기록을 도용하는 것을 의미한다.
4. 부당한 논문저자 표시란 연구내용 또는 결과에 대하여 학문적으로 공헌 또는 기여를 한 사람에게 정당한 이유없이 논문저자 자격을 부여하지 않거나, 학문적으로 공헌 또는 기여를 하지 않은 자에게 감사의 표시 또는 예우 등을 이유로 논문저자 자격을 부여하는 행위를 말한다.
5. 기타 통상적으로 용인되는 범위를 심각하게 벗어난 행위를 포함한다.

제5조 (연구물의 중복 투고 및 이중 게재금지)
연구자는 연구결과를 중복 투고 및 이중 게재 하지 않아야 한다.

제6조 (저자됨)
저자는 출판하는 논문의 연구에 지적인 공헌을 한 자로서 다음 각 호의 자격을 모두 충족하여야 한다.
1. 연구의 구상이나 설계 또는 자료의 수집이나 분석이나 해석을 하는 데 있어서 상당한 공헌을 한 자
2. 논문의 초안을 작성하거나 주요 내용을 검토한 자
3. 출간될 원고를 최종 승인한 자
4. 연구의 정확성이나 무결성과 관련된 문제를 적절히 조사하고 해결하는 것에 책임이 있음을 동의한 자

제7조 (출판 업적의 명기)

① 저자는 자신이 행하거나 기여한 연구에 대해서만 업적을 인정받으며 그에 대한 책임을 진다.

② 논문이나 기타 출판의 저자(역자 포함)의 순서는 상대적 지위에 관계없이 연구에 기여한 정도에 따라 공정하게 정해져야 한다. 단순히 특정 직책으로 인하여 공동저자, 제1저자, 또는 교신저자가 될 수 없다. 연구에 충분히 기여했음에도 저자로 인정되지 않는 행위 또한 정당화될 수 없다. 연구에 대한 기여도가 낮을 경우 각주, 서문, 사의 등에서 사사의 글로 표시한다.

제8조 (인용 및 참고 표시)

① 저자가 학술 자료를 인용할 경우에는 정확하게 기술하도록 노력해야 하고 출처를 명확히 밝혀야 한다. 개인적인 접촉으로 얻은 자료의 경우에는 정보를 제공한 연구자의 동의를 받은 후 인용할 수 있다.

② 저자가 타인의 글을 인용하거나 참고할 경우에는 각주를 통해 인용 및 참고 여부를 밝혀야 하며, 선행연구의 결과인 부분과 저자의 독창적인 견해 또는 해석의 결과인 부분이 구분될 수 있도록 하여야 한다.

제9조 (논문 편집위원회의 역할및 윤리)

① 편집위원은 투고된 논문을 해당 분야의 전문적 지식과 객관적이고 공정한 판단 능력을 지닌 심사위원에게 평가 하도록 의뢰하여야 한다.

② 편집위원은 투고된 논문의 게재가 결정될 때까지는 저자에 대한 사항이나 논문의 내용을 공개하지 않아야 한다.

제10조 (논문 심사위원의 역할및 윤리)

① 심사위원은 심사 대상 논문을 심사규정이 정한 기간 내에 성실하고 공정하게 평가하고 결과를 편집위원에게 통보하여야 한다.

② 심사위원은 자신이 논문의 내용을 평가하기에 적임자가 아니라고 판단될 경우에는 편집위원에게 즉시 사퇴의사를 통보하여야 한다.

③ 심사위원은 심사 대상 논문을 개인적인 학술적 신념이나 저자와의 사적인 친분 관계를 떠나 객관적 기준에 의해 공정하게 심사하여야 한다. 충분한 근거를 명시하지 않은 채 논문을 탈락시키거나, 심사자 본인의 관점이나 해석과 상충된다는 이유로 논문을 탈락시켜서는 안 되며, 심사 대상 논문을 제대로 읽지 않은 채 평가하지 않아야 한다.

④ 심사위원은 전문 지식인으로서의 저자의 인격과 독립성을 존중하여야 하고, 평가의견은 가급적 정중하고 부드러운 표현을 사용하며 저자를 비하하거나 모욕적인 표현을 해서는 안 된다.

⑤ 심사위원은 심사 대상 논문에 대한 비밀을 지켜야 하며, 논문이 게재된 학술지가 출판되기 전에 논문의 내용을 인용해서는 안 된다.

제3장 연구윤리위원회의 설치와 운영

제11조 (위원회의 기능)

위원회는 대한지역사회영양학회 회원의 연구윤리와 관련된 다음 각 호의 사항을 심의, 의결한다.

1. 연구윤리 확립에 관한 사항
2. 연구부정행위의 예방, 조사에 관한 사항
3. 제보자 보호와 비밀유지에 관한 사항
4. 연구윤리 위반 검증 및 검증결과 처리와 후속조차에 관한 사항
5. 피조사자 명예회복 조치에 관한 사항
6. 기타 위원회 위원장이 부여하는 사항

제12조 (위원회의 구성)

위원회는 위원 5인 이상으로 구성하며, 위원장은 학회장으로 하고 부위원장은 편집이사로 하며 그 외 3인은 상임 이사회의 추천을 받아 학회장이 임명한다.

제13조 (연구부정행위의 제보 및 접수)

제보자는 대한지역사회영양학회 편집위원회 사무국에 직접 또는 전화, 서면, 전자우편 등으로 제보할 수 있으며 실명으로 제보해야 한다. 단, 익명제보라 하더라도 구체적인 연구부정행위의 내용과 증거를 포함하여 제보한 경우 이를 실명제보에 준한다.

제14조 (위원회의 검증 및 심의 권한)
위원회는 윤리규정 위반으로 보고된 사안에 대하여 제보자, 피조사자, 증인, 참고인 및 증거자료 등을 통하여 폭넓게 조사를 실시할 수 있고, 그러한 조사 결과에 따라 윤리규정 위반여부를 심의·판정한다.

제15조 (위원회의 검증 절차)
연구윤리 위반행위에 대한 검증절차는 예비조사, 본조사, 판정의 단계로 진행하며 모든 조사 일정은 6개월 이내에 종료되어야 한다. 단, 이 기간 내에 조사가 이루어지기 어렵다고 판단될 경우에는 위원장의 승인을 거쳐 조사 기간을 연장할 수 있다. 제보자 또는 피조사자가 판정에 불복할 경우에는 통보를 받은 날로부터 30일 이내에 이의신청을 할 수 있으며, 윤리위원회에서 이를 검토하여 필요한 경우 재조사를 실시할 수 있다.

제16조 (소명기회의 보장)
연구윤리규정 위반으로 보고된 회원에게는 조사대상이 된 사안의 개요를 서면 통지하고 정해진 기간 내에 소명서를 제출할 기회를 보장하고 본인이 희망하는 경우 본 조사 절차 중 1회 이상 윤리위원회의 회의에 출석하여 구술로 해명할 수 있는 기회를 주는 등 충분한 소명 기회를 주어야 한다.

제17조 (연구윤리위원의 비밀 보호 의무)
연구윤리위원은 제보자의 신원을 노출시켜서는 안 되며, 학회의 최종 결정이 내려질 때까지 연구윤리규정 위반으로 보고된 회원의 신분을 공개해서도 안 된다.

제18조 (징계의 절차 및 내용)
위원회의 징계 건의가 있을 경우, 위원장은 상임이사회를 소집하여 징계 여부 및 징계 내용을 최종적으로 결정한다. 연구윤리규정을 위반했다고 판정된 회원에 대해서는 사안의 경중을 고려하여 경고, 일정기간의 논문투고금지, 회원자격의 정지 또는 박탈 등의 징계를 할 수 있으며, 필요한 경우 논문 게재 취소와 그 결과를 공개할 수 있다.

제19조 (연구윤리규정의 개정)
연구윤리규정의 개정 절차는 본 학회의 규정 개정절차에 준한다.

자가점검표

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[논문 투고 전 저자 확인사항]
(※ Check 후 투고사이트에 함께 제출합니다.)

구분		확인사항	Check
논문표지	1. 제목	- 논문제목 철자 및 오타 - 영문 제목은 기본적으로 소문자로 작성 (단, 문장의 첫 단어와 고유 명사는 대문자로 작성) 관찰 연구 (단면조사연구, 환자-대조군 연구 또는 전향적 코호트 연구), 임상 연구, 체계적 문헌고찰 또는 메타 분석의 경우; 제목 또는 부제목에 연구디자인 제시 예) Development and Effectiveness Evaluation of the STEAM Education Program on Food Groups for Kindergarteners -〉 Development and effectiveness evaluation of the STEAM education program on food groups for kindergarteners: a non-randomized controlled study 예) Program Evaluation using the RE-AIM Framework: A Systematic Review and Application to a Pilot Health Promotion Program for Children -〉 Evaluation of the pilot health promotion program for children: a systematic review	
	2. 저자정보	- 저자, 소속 및 직위를 국문과 영문으로 기재, 단 영문논문의 경우 영문으로만 기재, 영문 기재시 소속 앞으로 직위 표기 - 저자 중 1인 이상은 학회 회원일 것. 단, 비회원의 경우 편집위원회에서 위촉 또는 국외 기관에 소속된 저자가 투고할 시 가능	
	3. 제출	- 논문표지는 본 체크리스트 및 저작권이전동의서, IRB승인서와 함께 투고사이트 '첨부파일'에 업로드 (투고사이트에 논문 제출시 동시 제출, 투고논문에는 표지부분 삭제)	
	4. ORCID	- 모든 저자의 ORCID 기술 예) Gildong Hong: https://orcid.org/0000-0000-0000-0000	
	5. Funding (연구지원내역)	예) This research was supported by a grant from the National Research Foundation of Korea (Grant No. 000). - 해당하는 내용이 없더라도 'None.' 으로 기재	
영문초록	1. 작성순서	- Objectives-Methods-Results-Conclusions 의 순서 - Results 소제목 반드시 작성.	
	2. 키워드	- 전문 용어를 제외한 1~2개의 단어로 구성된 3~5개의 키워드 기재 - 키워드는 MeSH(https://meshb.nlm.nih.gov/search) 에 검색되는 단어로 작성 - 키워드는 고유명사를 제외하고 모두 소문자로 표기하며, 구분 기호는 세미콜론(;)으로 작성	
	3. 약어사용	- 약어를 정의하고, 그 약어가 논문에서 더 이상 사용되지 않는다면 약어 사용할 필요 없음. 전체 명칭 (full name)으로 작성 - 약어를 두 번 이상 본문에서 사용할 경우, 맨 처음 약어가 등장할 때 전체 명칭에 대해 약어 정의	
논문본문	1. 작성순서	- 원고의 부제목은 모두 영문으로 작성. Title page, Abstract, Introduction, Methods, Results, Discussion, Conclusion, Conflict of Interest, Acknowledgments, Data Availability, References, Tables, Figures 순서로 작성 - 투고 시 표, 그림을 포함하여 하나의 파일로 업로드	
	2. 통계 패키지 정보 기입	- 종류 및 버전 정확히 기입 예) IBM SPSS Statistics 25 (IBM Corporation, Armonk, NY, USA) 예) SAS 9.4 (SAS Institute, Cary, NC, USA)	
	3. Ethics Statement (연구윤리)	- 저자는 "방법(Method)" 부제목 바로 아래에 연구윤리에 관해 영문으로 기술. 종설, 연구노트, 교육자료 등의 경우에는 서론 뒤(본론 전)에 영문으로 제시. 예) The informed written consent was obtained from each participant. The study protocol was approved by the Institutional Review Board of *** (approval number: ***). *IRB 기관표시는 최종본에 기재(투고시 내용 삭제후 업로드) 예) Obtainment of informed consent was exempted by the institutional review board.	
	4. Conflict of Interest (이해상충)	예) There are no financial or other issues that might lead to conflict of interest. 예) Gildong Hong has been an editor since 2021. However, he was not involved in the review process of this manuscript. Otherwise, there was no conflict of interest. *저자정보는 최종본에 기재(투고시 내용 삭제후 업로드)	

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구분		확인사항	Check
	5. Acknowledgments (감사의 글)	– 논문작성이나 연구를 도왔지만 저자로서 적절하지 않은 분 등을 기술. 예) We thank the physicians who performed the sample collection. *관련내용은 최종본에 기재(투고시 내용 삭제후 업로드)	
	6. Data Availability (데이터가용성)	– 저자는 데이터가용성에 대한 설명을 작성해야하며, 데이터에 대해 접근을 허용하는 것은 선택사항 예) The data that support the findings of this study are openly available in [repository name e.g “KNHANES”] at http://doi.org/[doi].	
	7. 참고문헌	– 표기방법: 대괄호[ ]앞 띄어쓰기 없이 [1], [2, 5], [15–20] 등 표기, 문헌 사이 쉼표 추가시, 쉼표 뒤 띄어쓰기 예) ~에 관한 연구[1] 또는 Kim & Lee의 연구[2, 5] – 본문 내 참고문헌의 인용이 번호순으로 되어 있는지 확인 – 학위 논문 인용은 3개 이내로 제한 – 전체 참고문헌 50개 이내 – 참고문헌 표기 규정에 맞는지 확인	
	8. 단위 등 기타 표시	– 숫자와 단위 띄어쓰기(50 kg, 600 kcal), 단, %, ℃ 붙임 – g/dl(X), g/dL(O) – P값 표기 시 : P 대문자, 기울임체 : 예) P–value – 숫자 등의 범위 표기 시 ‘–’를 사용: 예) 20–25 – 천 단위 쉼표 표기(본문, 표에도 적용): 예) 65,450,000	
	9. 표, 그림	– 표와 그림 제목: 첫 글자만 대문자 – 표에서 변수들 영문 표기시 : 첫 글자만 대문자 – 표와 그림에서 n을 소문자로 표기 – 투고규정에 따르며 그 외 형식은 별첨한 가이드라인에 따름	

*예시는 2024년도 최근 게재논문을 참고.

[논문 투고 전 저자 확인사항_표와 그림]

표와 그림 작성 시 다음의 사항을 유의하여 주시기 바랍니다.

1. 자료의 전체 수를 표 본문의 내용 밖으로 표시하고자 할 때는 표 제목 끝의 괄호 안에 제시
   예) Sociodemographic characteristics of children (n = 80)

2. 표 본문의 제목줄(table head)은 가능하면 제시된 값을 설명하는 것으로 하고, 단순히 Mean ± SD 등 만을 제목으로 하는 것을 지양함

3. 표 본문의 내용 작성 시
- 평균값을 제시하는 경우 Mean ± SD, Mean ± SE 으로 사용, 띄어쓰기 확인
  예) 22.0 ± 2.3 : ' ± ' 앞뒤로 띄어쓰기
- 표에서 단위는 괄호 안에 넣어서 표기
  예) Energy (kcal/day) (O)
  Energy, kcal/day (X)

4. 표와 그림을 설명하는 주석은 모두 영문으로 표기

5. 주석의 기술 순서는 가능하면 자료의 형태, 통계분석 방법 및 유의성 표시, 기타의 순서로 작성함
   1) 자료의 형태 제시
      예) n (%), Mean ± SD, n (%) or Mean ± SD 등 주석 번호 없이 첫줄에 제시
   2) 통계분석 방법 및 유의성 표시
      ① 통계적 유의성 뿐 아니라 통계분석 방법도 함께 제시함
      ② 사후검정 결과는 분산분석 등의 유의확률 제시가 선행되어야 함
   3) 약어를 사용한 경우 전체 명칭 (full name)을 주석으로 제시함
   4) 기타 설명이 필요한 내용은 이후 투고규정에 따라 순서대로 번호를 달고 각주로 제시하며 표 본문에 표기한 번호와의 일치여부 확인