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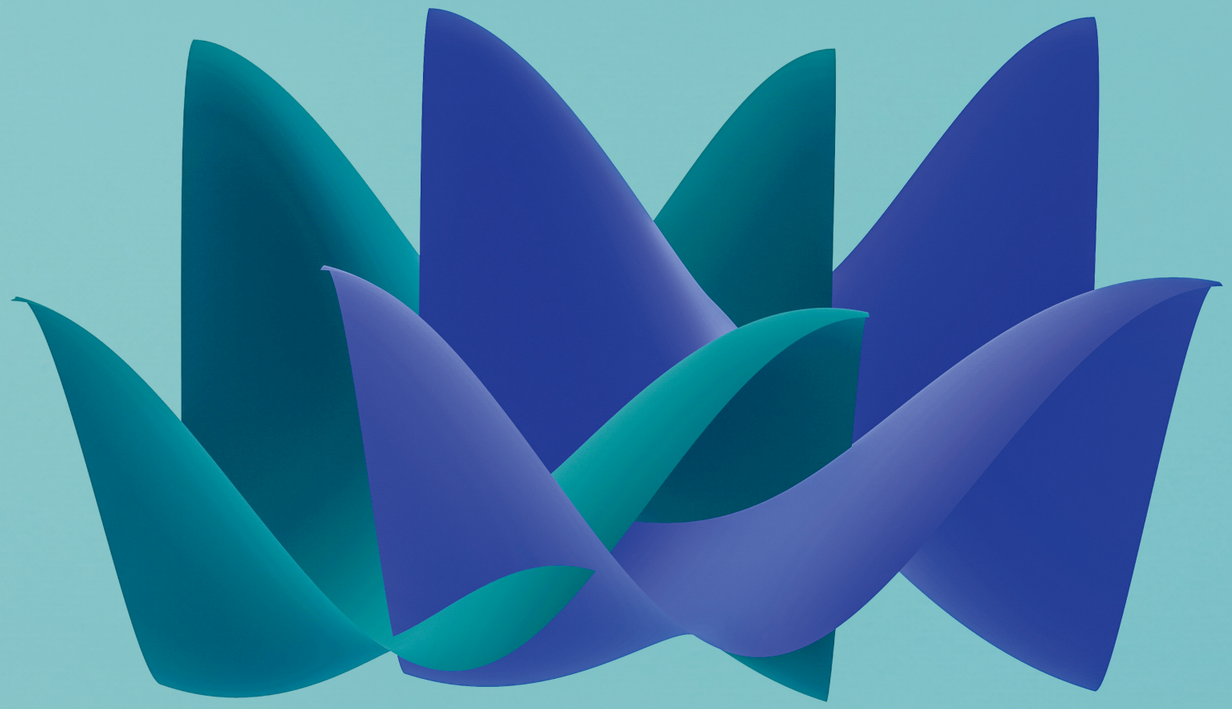

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AIMS AND SCOPE

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

KJCN is distributed to the members of Korean Society of Community Nutrition. This journal is open access and full text PDF files are available at the official website (http://kjcn.or.kr). The membership fee including subscription fee and postal charges is 50,000 Won for regular members, 20,000 Won for students, and 100,000 Won for institutional members.

ABSTRACTING AND INDEXING

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Research Article

Food and nutrient intake in pregnant women with singletons or multiples and post-delivery changes in intake in Korea: an observational study

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Objectives: Nutrient intake during pregnancy and lactation is crucial for the health of both mother and offspring. Diet and nutrient metabolism potentially vary according to ethnicity and fetal number; nevertheless, recent studies validating this are inadequate. Furthermore, few studies have tracked changes in intake after delivery. We compared the food and nutrient intakes between pregnant women in Korea carrying singletons and multiples during late pregnancy and assessed their changes through postpartum.

Methods: Ninety-eight pregnant women were recruited from Chonnam National University Hospital between January 2019 and December 2023, and 48 responded to follow-up. Third trimester and postpartum intake were assessed via food frequency questionnaires and supplement questionnaires. Student's t-test, Mann–Whitney U test, chi-square test, paired t-test or Wilcoxon signed-rank test was performed and adjustments were made for covariates.

Results: Nutrient intake was generally adequate relative to the Dietary Reference Intakes for Koreans, with no differences between singleton- and multiple-pregnancy women. Sixty-six of 98 (67%) pregnant women consumed meat, fish, vegetables, and fruit daily. Dairy intake was low, while the mean iron intake during pregnancy reached 54.2 ± 34.0 mg/d, exceeding the tolerable upper intake level, mainly owing to supplements. Postpartum fruit and vitamin C intake decreased, with no significant differences between breastfeeding and non-breastfeeding women.

Conclusion: Dietary intake did not significantly differ between Korean singleton- and multiple-pregnancy women. Dairy intake was low and iron intake was excessive. Fruit intake decreased after delivery; however, difference in dietary intake according to breastfeeding status was minimal. Nutritional education may be necessary to promote a balanced diet in pregnant and postpartum women.

Trial Registration: Clinical Research Information Service Identifier KCT0005118.

Keywords: pregnancy; lactation; diet; Korean people; twins

INTRODUCTION

Adequate nutrient intake during pregnancy and lactation is important for maternal health and offspring development. The appropriate intake of iron, omega-3 fatty acids, calcium, and folic acid significantly impacts short- and long-term health outcomes, including maternal complication prevention and fetal brain development and growth [1-3]. In addition, nutrient metabolism during pregnancy is dynamically modulated to support fetal growth and development, optimizing nutrient absorption and utilization. During pregnancy, intestinal calcium absorption is enhanced compared to the non-pregnant state, while renal calcium reabsorption is also upregulated [4]. Maternal iron absorption is also increased to accommodate the expansion of blood volume and fetal iron storage [5]. In South Korea, the consumption of dietary supplements among pregnant women has been reported to be relatively high up to 2013 [6-8]. The government has recommended universal iron supplementation and free iron supplements for pregnant women have been provided since 2012, possibly contributing to a further increase in supplement intake. Although iron supplementation serves as an effective strategy for preventing iron deficiency, careful consideration is required as risk of adverse events due to excessive intake may increase, including risk of gestational diabetes and hypertension. However, the diet and nutrient intake of Korean pregnant women have not been recently reported.

Furthermore, current research on postpartum changes in nutrient intake among lactating women is lacking in the Asian population. Studies based on the National Health and Nutrition Examination Survey indicate that non-Hispanic Asians have higher Healthy Eating Index scores than Whites and Blacks [9]. Postpartum care practices, including traditional food intake, vary according to ethnicity. On the other hand, nutrient metabolism differs among Asians for certain nutrients [10]. However, nutrient metabolism during pregnancy and lactation has been understudied in Asians, in addition to other races and ethnicities. Therefore, additional data on food intake among Asian pregnant women are required to understand their nutritional security status and biology.

Meanwhile, the rate of multiple births has steadily been increasing worldwide since 2000. The 2021 fertility rate for multiple births in the United States was 3.1% [11], while the 2022 figure for Korea was 5.8% [12]. Multiple pregnancies are considered to have higher nutritional requirements than singleton pregnancies to address the demands of two or more fetuses. However, studies on the appropriate nutritional intake for mothers with multiple pregnancies and their fetuses are lacking. Therefore, studies on the dietary intake of pregnant women with multiples are required to examine nutritional security and can serve as a basis for physiological nutrition research in pregnant women.

This study aimed to investigate nutritional intake in Korean pregnant women during the third trimester of pregnancy and postpartum using a food frequency questionnaire (FFQ) and supplement questionnaire. This study 1) evaluated food group and nutrient intake, 2) analyzed post-delivery changes in intake depending on lactation status, and 3) compared intake between singleton- and multiple-pregnancy women.

METHODS

Ethics statement

This study received consent from all participants before commencement, obtained approval from the Institutional Review Board of Chonnam National University Hospital (CNUH-2018-125), and was registered with the Clinical Research Information Service (KCT0005118).

1. Study design

This study was conducted as an observational study and is presented according to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines [13].

2. Participants

This study analyzed the dietary intake of pregnant women participating in a study assessing the association of dietary intake with bone mineral density and nutrient transport in the placenta. Pregnant women scheduled for delivery in the Department of Obstetrics and Gynecology, Chonnam National University Hospital, Gwangju, were recruited between January 2019 and July 2023. The participants were Korean women aged

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over 20 years and more than 24 weeks pregnant with 1–3 fetuses. To be included in the study, women had to be scheduled for delivery via cesarean section or induced labor at Chonnam National University Hospital owing to scheduling reasons. The exclusion criteria were as follows: 1) intrauterine fetal death, 2) disease or medication potentially affecting bone metabolism, 3) genetic disease, 4) pregnancy with 4 or more fetuses, and 5) implausible energy intake (< 500 or > 5,500 kcal/d). Additionally, participants with body mass index (BMI) above or below 3 standard deviations of the mean were considered outliers and excluded, as such extreme values could potentially affect the results (n = 1). A total of 98 women participated, among whom 48 were included in the follow-up analysis (Fig. 1). Women were classified as non-lactating if they had breastfed for less than 21 days. Lactating women visited the hospital within 1 month of weaning, while non-lactating women visited 6 months after delivery.

3. Dietary assessment

Food intake during the third trimester of pregnancy was investigated once between 1 day before delivery and 3 days after delivery. Post-delivery intake was assessed within 1 month of weaning in breastfeeding mothers and at 6 months postpartum in non-breastfeeding mothers. Food intake was surveyed using a semi-quantitative FFQ from the Korea National Health and Nutrition Examination Survey [14] and analyzed using the database provided by Korea Disease Control and Prevention Agency. A trained dietitian conducted face-to-face interviews and used food models where necessary. The FFQ included 112 food and beverage items, categorized into 17 food groups based on the main ingredients (Supplementary Table 1), from which the intakes of food groups, energy, and 22 nutrients were calculated. Serving sizes for each food group were defined according to the 2020 Dietary Reference Intakes for Koreans (KDRIs). The number of servings consumed per day was calculated. In addition, heme-iron intake was calculated by applying the percentage heme content of animal products to the individual ingredients of foods in the FFQ [15].

Dietary supplement intake was evaluated via interviews, and their nutritional content was used to calculate daily intake. Only supplements taken consistently for at least 2 weeks during the third trimester of pregnancy or after delivery were included in the analysis. When categorizing supplement type, a supplement was classified based on the most emphasized nutrient on the packaging if it comprised more than 1 nutrient (similar to how a consumer would self-report the supplement). If it contained 5 or more nutrients, it was classified as a multivitamin. Where a participant could not remember the name of the product, the mean supplemental intake of other participants that took the same type of supplement was considered.

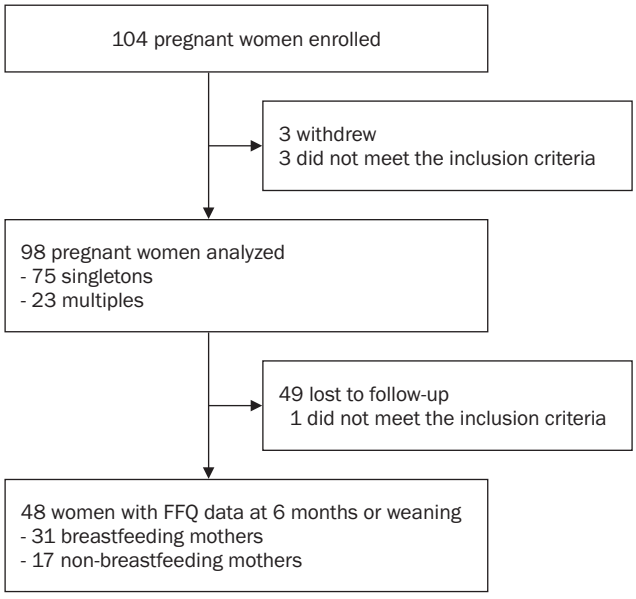

Fig. 1. Flowchart of pregnant women participating in diet assessment during late pregnancy and post-delivery.
FFQ, food frequency questionnaire.

4. Adequacy of intake

Personal energy requirements were calculated using the 2020 KDRIs. Although physical activity was not specifically investigated, pregnancy is generally considered a period of low activity according to the KDRIs; thus, we used the coefficient for low physical activity. Nutrient intake adequacy was analyzed based on the estimated average requirement (EAR) or adequate intake (AI) and tolerable upper intake level (UL) of the 2020 KDRIs [16].

5. Other characteristics

Maternal pre-pregnancy weight, height, smoking status,

and drinking habits were self-reported. Data regarding maternal age at pregnancy, weight at delivery, gestational age, parity, diseases, and delivery complications were obtained from medical records. Breastfeeding status was verified monthly during follow-up.

6. Statistical analysis

Participants were categorized according to the number of fetuses carried (singletons or multiples), and data collected during follow-up were analyzed based on lactation status. Differences between groups were analyzed using the student's t-test or Chi-square test. Non-normally distributed variables were transformed to approximate a normal distribution or analyzed using the Mann–Whitney U test. Food group and nutrient intakes during the third trimester of pregnancy and after delivery were compared using the paired t-test or Wilcoxon signed-rank test. Adjustments were made for maternal age, pre-pregnancy BMI, BMI at delivery, length of gestation, and fetal number using the general linear model. Statistical analysis was performed using SAS software (version 9.4; SAS Institute), and statistical significance was established at $P < 0.05$.

RESULTS

1. Participant characteristics

A total of 98 mothers were included in this analysis (75 singletons and 23 multiples [22 twins and 1 triplet]; Fig. 1). The mean maternal age and gestational length were 32.7 ± 3.9 years and 256.3 ± 9.2 days, respectively (Table 1). Multiple-pregnancy women exhibited shorter gestational lengths than their singleton counterparts (248.1 ± 9.4 d vs. 258.9 ± 7.5 d, $P < 0.001$). Eighty-seven percent of the participants took supplements, with the most common being iron (61 of 98 women; 62%), vitamin D (44 of 98 women; 45%), multivitamins (42 of 98 women; 43%), probiotics (28 of 98 women; 29%), omega-3 fatty acids (27 of 98 women; 28%), and calcium (9 of 98 women; 9%). More than half (51 of 98 participants; 52%) of the participants had a disease, with the predominant diseases being diabetes (17 of 98 women; 17%), hypertension (11 of 98 women; 11%), and thyroid-related diseases (11 of 98 women; 11%). Approximately 1 participant consumed alcohol during pregnancy, and none smoked during pregnancy.

2. Intake during the third trimester of pregnancy

The mean daily intake of rice, which served as the participants' staple food, was 2.15 ± 0.88 servings (Table 2). On average, participants consumed 4.27 ± 2.83 and 2.49 ± 2.15 servings of vegetables and fruits per day, respectively (Table 2). Sixty-seven percent of the participants met the Korean dietary guidelines for pregnant and lactating women in terms of "consuming meat, fish, vegetables, and fruit daily" (Supplementary Table 2). However, only 9 pregnant women consumed dairy products more than 3 times a day. No significant differences in intake were found between singleton- and multiple-pregnancy women for most food groups (Table 3).

The mean daily energy intake from food during the third trimester of pregnancy was 2,255.7 ± 812.8 kcal. Most women met the EAR for vitamin A, thiamine, riboflavin, niacin, and vitamin C (Table 2). The mean calcium intake was 610.6 ± 270.5 mg/d, which constituted 87% of the recommended nutrient intake (RNI) (700 mg/d). No difference in nutrient intake from foods during late pregnancy was observed between singleton- and multiple-pregnancy women (Table 4). The mean total intakes (from foods and supplements) of most nutrients met their respective RNIs or AIs (Fig. 2A). A substantial proportion of pregnant women did not fulfil the recommendations for energy (72 of 98 women; 74%) or fiber (65 of 98 women; 66%) intake.

The mean iron intake from diet was 15.5 ± 6.6 mg/d, accounting for approximately 65% of the RNI (24 mg/d), while the mean iron intake from supplements was 54.2 ± 34.0 mg/d, exceeding the UL (Supplementary Table 3), resulting in 69% of the participants consuming iron in excess of the UL from diet and supplements (Fig. 2C). Iron intake from supplements was higher in multiple-pregnancy mothers than in their singleton counterparts. Supplement-based iron intake was primarily in the form of non-heme iron, except for 1 participant.

3. Post-delivery intake

Among the 98 participants registered in this study, 48 (31 breastfeeding and 17 non-breastfeeding women) were followed beyond delivery (Fig. 1). The participants that agreed to the follow-up and those that dropped out dis-

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Table 1. Characteristics of Korean pregnant women carrying singletons or multiples assessed at delivery

Variable	All (n = 98)	Women carrying singletons (n = 75)	Women carrying multiples (n = 23)	*P*-value
Age (year)	32.7 ± 3.9	32.6 ± 4.2	33.1 ± 3.1	0.576
Height (cm)	161.9 ± 6.1	161.1 ± 5.9	164.2 ± 6.4	0.034
Pre-pregnancy weight (kg)	58.5± 10.0	58.3 ± 10.4	58.8 ± 8.9	0.760
Pre-pregnancy BMI (kg/m^2)	22.3 ± 3.4	22.4 ± 3.5	21.8 ± 2.9	0.462
Weight at delivery (kg)	70.3 ± 11.2	69.7 ± 11.7	72.1 ± 9.2	0.302
BMI at delivery (kg/m^2)	26.8 ± 3.9	26.8 ± 4.1	26.7 ± 3.1	0.978
Length of gestation (day)	256.3 ± 9.2	258.9 ± 7.5	248.1 ± 9.4	< 0.001
Parity	0.82 ± 0.90	0.85 ± 0.93	0.70 ± 0.82	0.792
Supplement intake	86 (88)	66 (88)	20 (87)	0.894
Disease	51 (52)	37 (49)	14 (61)	0.333
Diabetes	17 (17)	13 (17)	4 (17)	0.995
Hypertension	11 (11)	8 (11)	3 (13)	0.752
Thyroid disease	11 (11)	7 (9)	4 (17)	0.284
Preeclampsia	4 (4)	1 (1)	3 (13)	0.013
Smoking	0 (0)	0 (0)	0 (0)	-
Drinking	1 (1)	1 (1)	0 (0)	0.578

Mean ± SD or n (%).
BMI, body mass index.
Statistical analyses were performed with a significance level of $P < 0.05$. Comparisons were made using Student's t-test, the Mann–Whitney U test, or the Chi-squared test.

played similar characteristics. No significant differences in baseline characteristics were found between breastfeeding and non-breastfeeding mothers (Table 5).

After childbirth, regardless of lactation status, fruit and dairy intake decreased, whereas coffee and alcohol consumption increased (Table 6). Dairy and leafy vegetable intakes decreased in breastfeeding mothers, but not in non-breastfeeding mothers. Additionally, the increase in coffee intake was significantly greater in non-breastfeeding mothers than in breastfeeding mothers (0.4 ± 1.0 vs. 1.4 ± 1.1 serving/d; $P = 0.002$). Sixteen out of 31 breastfeeding women (52%) were compliant with Dietary Guidelines for pregnant and lactating women in terms of "consuming meat, fish, vegetables, and fruit every day", while only 3 participants consumed dairy products 3 times a day (Supplementary Table 2).

Similar to that during pregnancy, a considerable proportion of women did not meet the Estimated Energy Requirement or EAR and AI for fiber and potassium intake from foods and supplements, even after delivery (Fig. 2D). Energy intake remained unchanged after delivery; however, vitamin C intake from foods significantly decreased in both breastfeeding (mean change: –62.1 ± 231.1 mg/d, $P = 0.01$) and non-breastfeeding (mean change: –104.4 ± 229.7 mg/d, $P = 0.02$) women (Table 7). After delivery, 10 of 49 participants (20%) consumed iron in excess of the UL. Owing to the small number of multiple-pregnancy mothers that were followed-up, statistically comparing maternal intake by lactation status according to the number of newborns was not possible; however, the mean intakes are presented in Supplementary Tables 4 and 5. Supplement intake was similar between lactating and non-lactating mothers (Supplementary Table 6).

DISCUSSION

We examined the dietary intake of Korean pregnant women carrying singletons or multiples during late pregnancy and postpartum. The intake of most foods, supplements, and nutrients did not significantly differ between singleton- and multiple-pregnancy women. Korean pregnant women were found to generally consume a balanced diet; however, dairy intake was low. The mean calcium and iron intake from food was inadequate both pre- and post-delivery. Iron was overcon-

Table 2. Mean intakes of food groups and nutrients of Korean pregnant women carrying singletons or multiples during the third trimester of pregnancy

Food group (serving/d)	All (n = 98)	Nutrient (/d)	All (n = 98)
Rice	2.15 ± 0.88	Energy (kcal)	2,255.7 ± 812.8
Flour	1.03 ± 0.70	Protein (g)	84.7 ± 39.3
Meat	1.06 ± 0.82	% of total kcal	14.8 ± 2.6
Fish and shellfish	0.50 ± 0.65	Fat (g)	58.7 ± 29.6
Eggs	0.72 ± 0.77	% of total kcal	23.3 ± 6.8
Beans	0.61 ± 0.61	SFA (g)	18.1 ± 9.0
Vegetables	4.27 ± 2.83	MUFA (g)	18.3 ± 9.9
Starchy vegetables	0.40 ± 0.52	PUFA (g)	14.2 ± 7.3
Leafy vegetables	2.07 ± 1.47	Omega-3 (g)	1.7 ± 0.9
Other vegetables	1.80 ± 1.61	Omega-6 (g)	12.7 ± 6.6
Mushrooms	0.11 ± 0.23	Cholesterol (mg)	357.7 ± 224.5
Seaweed	0.28 ± 0.23	Carbohydrate (g)	345.9 ± 122.9
Fruits	2.49 ± 2.15	% of total kcal	61.6 ± 8.9
Dairy products	1.25 ± 0.95	Fiber (mg)	23.0 ± 11.1
Nuts and seeds	0.04 ± 0.15	Calcium (mg)	610.6 ± 270.5
Oils and sweets	1.23 ± 1.02	Phosphorus (mg)	1,235.5 ± 501.4
Salty foods	2.30 ± 1.90	Total iron (mg)	15.5 ± 6.6
Fermented foods	2.69 ± 1.98	Heme (mg)	1.4 ± 1.2
Coffee	0.29 ± 0.50	Non-heme (mg)	14.1 ± 5.7
Alcohol	0.00 ± 0.00	Sodium (mg)	3,526.1 ± 1,743.6
		Potassium (mg)	3,531.9 ± 1,580.0
		Vitamin A (μg/RE)	770.7 ± 361.0
		Retinol (μg)	148.3 ± 75.6
		Carotene (μg)	3,531.1 ± 1,882.2
		Thiamin (mg)	2.2 ± 0.9
		Riboflavin (mg)	1.8 ± 0.8
		Niacin (mg)	16.5 ± 7.5
		Vitamin C (mg)	196.0 ± 172.6

Mean ± SD.
SFA, saturated fatty acids; MUFA, mono-unsaturated fatty acids; PUFA, poly-unsaturated fatty acids.

sumed via supplements. Fruit, dairy, and vitamin C intake decreased postpartum, regardless of breastfeeding status.

The women in the present study may have been trying to maintain healthy dietary habits during pregnancy. The mean age of the participants was 34.5 years, which exceeds that of pregnant women from other countries; nonetheless, it did not largely deviate from the mean age of delivery in Korea (33.5 years of age) [17]. As the age at child birth of Korean women and the education status, and thus employment status, of women increased during the past decades, participants of this study may be more financially stable and invested in their pregnancies compared to pregnant women decades ago. This may result in better diet quality and nutrition status during pregnancy as income and education status are known to be positively associated with diet quality [18, 19]. The proportion of participants who consumed meat, fish, vegetables, and fruits every day (68.4%) exceeded that of Korean pregnant women in 2013 [6-8, 20]. Additionally, the post-delivery change in food intake, such as the decrease in fruit intake and increase in coffee and alcohol consumption, indicate that women attempted to consume healthier foods during pregnancy. Participants of this study consumed approximately 4.4 servings of vegetables per day, which could be cal-

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Table 3. Mean food group intakes during the third trimester of pregnancy in singleton- and multiple-pregnancy mothers

Food group (serving/d)	Women carrying singletons (n = 75)	Women carrying multiples (n = 23)	*P*-value	Adjusted *P*
Rice	2.11 ± 0.91	2.28 ± 0.76	0.400	0.711
Flour	1.04 ± 0.65	1.02 ± 0.88	0.456	0.327
Meat	1.06 ± 0.80	1.05 ± 0.91	0.920	0.723
Fish and shellfish	0.45 ± 0.52	0.67 ± 0.96	0.137	0.822
Eggs	0.75 ± 0.84	0.61 ± 0.53	0.753	0.389
Beans	0.61 ± 0.67	0.60 ± 0.40	0.292	0.600
Vegetables	4.15 ± 2.82	4.66 ± 2.90	0.346	0.767
Starchy vegetables	0.44 ± 0.56	0.29 ± 0.30	0.409	0.109
Leafy vegetables	2.01 ± 1.51	2.24 ± 1.36	0.214	0.551
Other vegetables	1.70 ± 1.52	2.13 ± 1.90	0.393	0.973
Mushrooms	0.10 ± 0.23	0.14 ± 0.23	0.083	0.353
Seaweed	0.26 ± 0.24	0.34 ± 0.22	0.043	0.220
Fruits	2.46 ± 1.91	2.59 ± 2.86	0.616	0.638
Dairy products	1.31 ± 1.01	1.08 ± 0.68	0.516	0.443
Nuts and seeds	0.05 ± 0.17	0.01 ± 0.03	0.108	0.156
Oils and sweets	1.25 ± 0.95	1.20 ± 1.26	0.358	0.429
Salty foods	2.28 ± 1.91	2.38 ± 1.92	0.647	0.625
Fermented foods	2.69 ± 1.99	2.71 ± 1.99	0.935	0.674
Coffee	0.30 ± 0.52	0.24 ± 0.47	0.500	0.938
Alcohol	0.00 ± 0.00	0.00 ± 0.00	> 0.999	> 0.999

Mean ± SD.
Student's t-test or the Mann–Whitney U test was applied to compare food group intake between groups. General linear model was applied and adjusted for pre-pregnancy body mass index, age, and length of gestation.

culated as approximately 330 g/d, assuming a serving size of 75 g. This intake is substantially higher than that reported in pregnant women in Japan, the Netherlands, and the United States (43.9–158 g/d) [21-23]. Additionally, the fruit intake of participants of this study exceeded that of pregnant women in Japan and the Netherlands [21-25]. Vegetable and fruit intake among Koreans ranks third highest among Organization for Economic Cooperation and Development countries [26]. In addition to the traditionally higher intake of fruits and vegetables among Koreans, participants of this study also exhibited a higher fruit intake than Korean women of childbearing age (91.9 ± 0.61 g) [27]. Consistently, although our participants' calcium intakes during pregnancy were lower than those of their counterparts in other countries [21, 22, 24, 25, 28, 29], they remained higher than the mean calcium intake of Korean women of childbearing age (432 mg/d) [27]. However dairy and calcium intake decreased after delivery, suggesting that Korean pregnant women aimed to increase their calcium intake during pregnancy by ingesting more dairy products or supplements. The proportion of pregnant women ingesting supplements (86 out of 98 women; 87%) almost doubles that of other women of similar age (48.3%) [30, 31] and coincides with that of pregnant women surveyed 10 years ago [6-8]. These characteristics suggest that pregnant women are particularly interested in health and nutrition compared to Korean women of childbearing age.

Nevertheless, iron was overconsumed. During pregnancy, the absorption of non-heme iron increases [32]. Iron absorption rates have not been reported in pregnant Asian women, despite recent reports of ethnic differences in iron absorption. We analyzed heme and non-heme iron separately, referring to a recent database of the heme iron content of animal foods [15]. In our study, non-heme iron intake accounted for 90% of the total iron intake, displaying consistency with the calculated non-heme iron intake ratio from Korean food according to the KDRIs [16]. As non-pregnant East Asian

Table 4. Mean nutrient intakes from foods during the third trimester of pregnancy of mothers carrying singletons or multiples

Nutrients (/d)	Women carrying singletons (n = 75)	Women carrying multiples (n = 23)	*P*-value	Adjusted *P*
Energy (kcal)	2,265.1 ± 851.2	2,225.0 ± 688.9	> 0.999	0.318
Protein (g)	84.6 ± 39.9	84.9 ± 38.1	0.849	0.431
% of energy intake	14.8 ± 2.6	15.0 ± 2.9	0.867	0.981
Fat (g)	59.7 ± 31.4	55.5 ± 22.9	0.791	0.187
% of energy intake	23.6 ± 7.2	22.5 ± 5.3	0.680	0.310
SFA (g)	18.5 ± 9.5	16.9 ± 7.3	0.542	0.101
MUFA (g)	18.7 ± 10.5	17.1 ± 7.8	0.683	0.171
PUFA (g)	14.4 ± 7.9	13.5 ± 4.9	0.902	0.386
Omega-3 (g)	1.7 ± 1.0	1.7 ± 0.8	0.702	0.418
Omega-6 (g)	12.9 ± 7.1	11.9 ± 4.4	0.993	0.332
Cholesterol (mg)	369.1 ± 238.4	320.7 ± 171.0	0.497	0.109
Carbohydrate (g)	345.6 ± 126.5	346.8 ± 113.1	0.967	0.545
% of energy intake	61.3 ± 9.2	62.5 ± 7.7	0.565	0.315
Fiber (mg)	23.2 ±11.9	22.2 ± 8.2	0.880	0.698
Calcium (mg)	626.2 ± 293.8	559.6 ± 169.5	0.599	0.095
Phosphorus (mg)	1,250.5 ± 529.5	1,186.4 ± 402.7	0.810	0.195
Total iron (mg)	15.5 ± 6.8	15.5 ± 5.8	0.788	0.499
Heme iron (mg)	1.4 ± 1.2	1.4 ± 1.3	0.981	0.470
Non-heme iron (mg)	14.1 ± 6.0	14.1 ± 4.8	0.758	0.531
Sodium (mg)	3,559.5 ± 1,828.0	3,417.0 ± 1,465.6	0.960	0.416
Potassium (mg)	3,645.1 ± 1,663.5	3,571.3 ± 1,437.6	0.977	0.427
Vitamin A (μg/RE)	785.3 ± 375.4	723.1 ± 312.1	0.683	0.135
Retinol (μg)	153.2 ± 78.0	132.5 ± 66.4	0.292	0.057
Carotene (μg)	3,577.9 ± 1,967.8	3,378.8 ± 1,601.0	0.993	0.374
Thiamin (mg)	2.2 ± 0.9	2.2 ± 0.8	0.971	0.375
Riboflavin (mg)	1.8 ± 0.8	1.7 ± 0.6	0.637	0.172
Niacin (mg)	16.6 ± 7.8	16.0 ± 6.7	0.939	0.295
Vitamin C (mg)	205.5 ± 181.8	165.1 ± 137.3	0.432	0.296

Mean ± SD.
SFA, saturated fatty acids; MUFA, mono-unsaturated fatty acids; PUFA, poly-unsaturated fatty acids.
Student's t-test or the Mann–Whitney U test was applied to compare intakes. General linear model was applied and adjusted for pre-pregnancy body mass index, age, and length of gestation.

women exhibit higher absorption rates of non-heme iron than their White counterparts [10], it is possible that Korean pregnant women may excessively absorb iron due to both high intakes and greater absorption rates. Once absorbed, most iron is not excreted; therefore, excess iron accumulates in the liver, heart, and pancreas in the non-pregnant state. Iron overload during pregnancy potentially aggravates the risk of "small for gestational age," preterm birth, intrauterine death [33], copper and zinc deficiency [34, 35], and gestational diabetes [36]. In Korea, iron supplements are available to pregnant women free of charge at public health centers, irrespective of income, an initiative regarded to have an impact on iron containing supplement use. Our results suggest that Korean pregnant women potentially overconsume iron from supplements, indicating the need to reconsider the necessity of universal iron supplementation for pregnant women and limit the amount of iron contained in prenatal supplements.

In this study, the intakes of most foods and nutrients during pregnancy did not significantly differ between singleton- and multiple-pregnancy mothers. Knowledge regarding the appropriate nutrient intake for women carrying multiples is currently limited. Some organiza-

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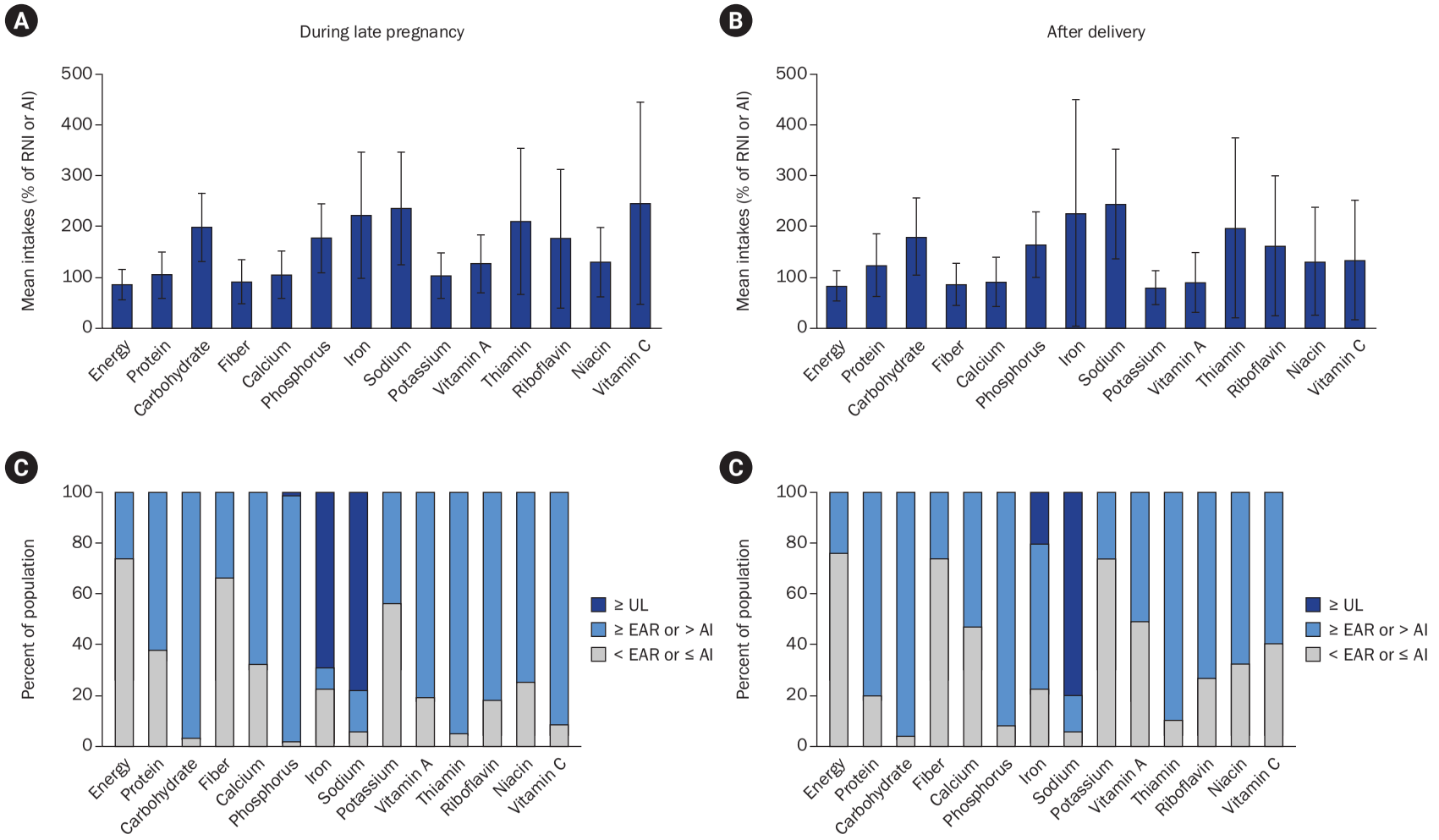

Fig. 2. (A) Mean nutrient intakes from foods and supplements during late pregnancy shown as percentages of the respective RNIs or AIs. (B) Mean nutrient intakes of women after childbirth shown as percentages of the respective RNIs or AIs. (C) Prevalence of nutrient intake in pregnant women according to the EAR, AI, or UL. (D) Prevalence of nutrient intake in women after delivery according to the EAR, AI, or UL. All nutrients were based on the 2020 KDRIs. EAR, RNI, and UL values were used for all nutrients, except fiber and potassium, which were calculated based on the AI, and sodium, which was based on the chronic disease risk reduction intake. (A, B) Participants consuming extreme amounts of iron (≥ 140 mg/d, n = 2), thiamine (≥ 33 mg/d, n = 2), riboflavin (≥ 27 mg/d, n = 1), or vitamin C [≥ 1,000 mg/d, (A): n = 6, (B): n = 2] were excluded from the analysis of the corresponding nutrient. These extreme intakes emanated from supplements. (C, D) Black, excess is above the UL; gray, adequate is above the EAR or AI but below the UL; light gray, deficient is below the EAR or AI.
RNI, recommended nutrient intakes; AI, adequate intake; EAR, estimated average requirement; UL, tolerable upper intake level.

Table 5. Characteristics of participants with follow-up

Variable	All (n = 48)	Breastfeeding mothers (n = 31)	Non-breastfeeding mothers (n = 17)	*P*-value
Age (year)	33.0 ± 3.5	32.5 ± 3.6	34.1 ± 3.2	0.143
Height (cm)	161.9 ± 6.3	161.1 ± 6.5	163.5 ± 5.9	0.219
Pre-pregnancy weight (kg)	58.7 ± 9.2	58.0 ± 8.6	60.2 ± 10.2	0.421
Pre-pregnancy BMI (kg/m^2)	22.4 ± 3.0	22.3 ± 2.9	22.5 ± 3.4	0.874
Weight at delivery (kg)	71.8 ± 10.6	70.0 ± 9.0	74.9 ± 12.8	0.127
BMI at delivery (kg/m^2)	27.3 ± 3.4	27.0 ± 2.9	28.0 ± 4.2	0.386
Length of gestation (d)	256.5 ± 8.8	255.4 ± 8.9	258.4 ± 8.6	0.206
Parity	0.79 ± 0.99	0.84 ± 0.97	0.71 ± 1.05	0.766
Breastfeeding period (d)	68.7 ± 74.4	101.4 ± 69.5	9.0 ± 7.8	< 0.001
Supplement	32 (67)	23 (74)	9 (53)	0.211
Disease	28 (58)	17 (55)	11 (65)	0.507
Diabetes	12 (25)	7 (23)	5 (29)	0.601
Hypertension	8 (17)	4 (13)	4 (24)	0.345
Thyroid disease	6 (13)	4 (13)	2 (12)	0.909
Preeclampsia	1 (2)	0 (0)	1 (6)	0.172
Smoking	0 (0)	0 (0)	0 (0)	-
Drinking	0 (0)	0 (0)	0 (0)	-

Mean ± SD.
BMI, body mass index.
A mother was classified as breastfeeding if her breastfeeding duration was ≥ 3 weeks. Student's t test, the Mann–Whitney U test, or the Chi-squared test were applied to compare characteristics between breastfeeding and non-breastfeeding mothers.

tions recommend that women with multiple pregnancies take additional calcium, vitamin D, iron, and folic acid [37]. However, according to certain intervention studies, high-dose folic acid supplementation in pregnant women with multiple pregnancies did not mitigate the risk of complications, such as preeclampsia, while iron supplementation exclusively benefitted mothers with anemia [38]. Regarding calcium, bone resorption in women pregnant with twins exceeds that in women with singletons during the second and third trimesters of pregnancy [39], indicating that the increase in the fetal calcium needs of multiple fetuses are met via maternal metabolic changes. In this study, pregnant women with multiples were expected to increase their energy, food, and nutrient intakes owing to elevated physiological needs. However, similar intakes were noted between singleton- and multiple-pregnancy mothers, revealing the possibility that the mother may respond to fetal needs by increasing her absorption rate or the efficiency of nutrient transport to the fetuses, rather than increasing intake [4, 5]. On the other hand, dietary intake is influenced by many environmental factors as well, therefore the intakes of pregnant women may not reflect physiological requirements. Whether, and if so, how, the mother physiologically acknowledges and responds to the increased number of fetuses warrants further research. In addition, studies on nutrient intake and the short- and long-term health outcomes of mothers with multiples and their children may facilitate the establishment of appropriate dietary guidelines.

Limitations

Our study has several limitations. First, the number of participants is small. Owing to the COVID-19 pandemic, in addition to the rapid decrease in birth rate, unexpected challenges in recruitment were encountered. Nonetheless, our research staff were able to prevent increases in dropout rates during COVID-19. Second, participants were recruited from tertiary hospitals, resulting in a relatively large number of participants with diseases. Such participants may be more health-conscious and consume healthier foods than the general pregnant population [40, 41]. Third, this study may not be entirely generalizable because it is limited to women that delivered

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Table 6. Changes in food group intakes from the third trimester of pregnancy to postpartum according to breastfeeding status

Food group (serving/d)	Breastfeeding mothers (n = 31)				Non-breastfeeding mothers (n = 17)				Difference between groups	
	Late pregnancy	After delivery	Δ in intakes	$P^{1)}$	Late pregnancy	After delivery	Δ in intakes	$P^{1)}$	$P^{2)}$	$P^{3)}$
Rice	2.08 ± 0.91	1.99 ± 0.86	−0.09 ± 1.37	0.721	2.12 ± 0.88	1.62 ± 0.75	−0.50 ± 1.05	0.065	0.174	0.375
Flour	1.06 ± 0.71	1.13 ± 0.86	0.07 ± 0.88	0.979	1.05 ± 0.71	1.18 ± 0.71	0.13 ± 0.71	0.467	0.931	0.509
Meat	1.28 ± 0.96	1.14 ± 0.66	−0.13 ± 0.98	0.557	1.06 ± 0.99	1.18 ± 1.08	0.12 ± 0.97	0.980	0.722	0.373
Fish and shellfish	0.55 ± 0.71	0.67 ± 0.87	0.12 ± 1.20	0.365	0.32 ± 0.28	0.29 ± 0.31	−0.03 ± 0.40	0.787	0.620	0.940
Eggs	0.72 ± 0.79	0.73 ± 0.62	0.01 ± 0.80	0.127	0.70 ± 0.66	0.73 ± 0.73	0.04 ± 0.91	0.660	0.296	0.721
Beans	0.76 ± 0.82	0.49 ± 0.45	−0.27 ± 0.80	0.167	0.55 ± 0.51	0.43 ± 0.34	−0.12 ± 0.56	0.527	0.593	0.520
Vegetables	4.83 ± 3.29	4.17 ± 3.65	−0.66 ± 3.99	0.128	3.86 ± 2.08	2.37 ± 1.42	−1.50 ± 2.76	0.040	0.477	0.625
Starchy vegetables	0.45 ± 0.68	0.43 ± 0.41	−0.02 ± 0.76	0.216	0.30 ± 0.33	0.28 ± 0.33	−0.02 ± 0.52	0.881	0.826	0.824
Leafy vegetables	2.45 ± 1.61	1.72 ± 1.49	−0.73 ± 1.76	0.013	1.97 ± 1.35	1.14 ± 0.71	−0.83 ± 1.64	0.053	0.863	0.792
Other vegetables	1.93 ± 1.67	2.02 ± 2.40	0.09 ± 2.72	0.551	1.59 ± 1.43	0.95 ± 0.89	−0.64 ± 1.76	0.133	0.413	0.546
Mushrooms	0.14 ± 0.33	0.17 ± 0.41	0.03 ± 0.50	0.708	0.09 ± 0.14	0.04 ± 0.08	−0.05 ± 0.14	0.187	0.327	0.675
Seaweed	0.33 ± 0.30	0.63 ± 0.72	0.30 ± 0.71	0.067	0.27 ± 0.22	0.26 ± 0.27	−0.004 ± 0.32	0.850	0.109	0.277
Fruits	2.54 ± 2.31	1.55 ± 1.82	−0.99 ± 2.56	0.008	2.25 ± 1.53	0.86 ± 0.65	−1.39 ± 1.83	0.005	0.485	0.365
Dairy products	0.59 ± 0.74	0.20 ± 0.22	−0.39 ± 0.69	0.004	0.26 ± 0.34	0.31 ± 0.37	0.04 ± 0.38	0.654	0.029	0.014
Nuts and seeds	0.04 ± 0.16	0.02 ± 0.04	−0.02 ± 0.14	0.426	0.04 ± 0.10	0.02 ± 0.05	−0.02 ± 0.11	0.557	> 0.999	0.593
Oils and sweets	1.31 ± 1.04	1.57 ± 1.32	0.26 ± 1.08	0.232	1.05 ± 0.94	1.89 ± 1.59	0.84 ± 1.17	0.010	0.090	0.072
Salty foods	2.49 ± 2.11	2.18 ± 2.16	−0.31 ± 2.42	0.219	2.45 ± 1.91	1.53 ± 1.07	−0.92 ± 2.35	0.128	0.406	0.424
Fermented foods	3.01 ± 2.23	2.27 ± 2.16	−0.74 ± 2.40	0.010	2.64 ± 1.98	1.74 ± 1.11	−0.90 ± 2.42	0.472	0.819	0.844
Coffee	0.22 ± 0.36	0.63 ± 0.94	0.41 ± 0.96	0.024	0.19 ± 0.31	1.62 ± 1.09	1.43 ± 1.10	< 0.001	0.001	0.002
Alcohol	0.00 ± 0.00	0.16 ± 0.39	0.16 ± 0.39	0.025	0.00 ± 0.00	0.30 ± 0.51	0.30 ± 0.51	0.028	0.143	0.260

Mean ± SD.

[1)]The paired t-test or Wilcoxon's signed-rank test were applied to compare intakes between the third trimester of pregnancy and after delivery.

[2)]Student's t-test or the Mann–Whitney U test was applied to compare changes in intakes between groups.

[3)]General linear model was applied and adjusted for maternal age, body mass index at delivery, and number of fetuses.

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Table 7. Changes in nutrient intake from food from the third trimester of pregnancy to postpartum according to breastfeeding status

Nutrients (/d)	Breastfeeding mothers (n = 31)				Non-breastfeeding mothers (n = 17)				Difference between groups	
	Late pregnancy	After delivery	Δ in intakes	$P^{1)}$	Late pregnancy	After delivery	Δ in intakes	$P^{1)}$	$P^{2)}$	$P^{3)}$
Energy (kcal)	2,317.1 ± 865.8	2,177.4 ± 697.5	−146.7 ± 937.7	0.448	2,167.7 ± 725.4	2,008.3 ± 924.1	−159.4 ± 831.6	0.267	0.451	0.923
Protein (g)	90.8 ± 45.5	82.5 ± 26.2	−8.3 ± 46.1	0.567	84.3 ± 43.8	76.3 ± 43.7	−8.0 ± 38.6	0.179	0.321	0.954
% of energy intake	15.3 ± 2.7	15.4 ± 2.3	0.1 ± 3.2	0.791	15.2 ± 3.3	14.7 ± 2.2	−0.5 ± 2.8	0.626	0.509	0.535
Fat (g)	65.4 ± 32.6	60.1 ± 26.9	−5.3 ± 33.3	0.618	57.2 ± 31.9	56.1 ± 37.0	−1.1 ± 31.6	0.547	0.746	0.704
% of energy intake	25.0 ± 6.0	24.4 ± 5.6	−0.6 ± 7.7	0.662	23.3 ± 8.3	23.9 ± 5.5	0.5 ± 9.7	0.582	0.659	0.714
SFA (g)	20.1 ± 9.7	18.5 ± 10.0	−1.6 ± 10.9	0.211	18.0 ± 10.3	17.4 ± 11.6	−0.6 ± 9.6	0.521	0.897	0.739
MUFA (g)	20.6 ± 11.1	18.8 ± 9.1	−1.7 ± 11.4	0.369	18.0 ± 11.0	18.0 ± 12.6	0.001 ± 10.9	0.705	0.983	0.669
PUFA (g)	15.8 ± 8.2	14.9 ± 6.9	−0.9 ± 8.7	0.774	13.1 ± 6.0	12.3 ± 7.2	−0.8 ± 5.9	0.305	0.189	0.948
Omega-3 (g)	1.9 ± 1.0	1.8 ± 0.8	−0.1 ± 1.2	0.795	1.5 ± 0.7	1.3 ± 0.7	−0.2 ± 0.6	0.131	0.244	0.933
Omega-6 (g)	14.1 ± 7.4	13.4 ± 6.1	−0.8 ± 7.7	0.748	11.7 ± 5.5	11.1 ± 6.7	−0.6 ± 5.4	0.305	0.181	0.915
Cholesterol (mg)	341.9 ± 124.6	366.5 ± 174.5	−7.8 ± 224.6	0.685	341.2 ± 218.0	343.1 ± 213.9	1.9 ± 190.0	0.990	0.490	0.644
Carbohydrate (g)	341.9 ± 124.6	320.0 ± 107.9	−21.9 ± 154.8	0.434	326.8 ± 100.4	288.7 ± 112.3	−38.1 ± 144.7	0.302	0.746	0.701
% of energy intake	59.6 ± 7.9	58.8 ± 7.5	−0.8 ± 10.0	0.705	61.0 ± 11.5	59.0 ± 7.6	−2.0 ± 12.9	0.680	0.724	0.749
Fiber (mg)	24.7 ± 13.3	21.0 ± 9.8	−3.7 ± 13.7	0.178	21.5 ± 7.7	17.8 ± 9.2	−3.7 ± 12.0	0.129	0.518	0.906
Calcium (mg)	678.2 ± 325.0	614.0 ± 301.5	−64.2 ± 396.7	0.278	563.3 ± 214.3	481.3 ± 229.4	−82.1 ± 228.9	0.131	0.844	0.942
Phosphorus (mg)	1,313.0 ± 594.9	1,203.8 ± 398.3	−109.3 ± 641.4	0.504	1,219.2 ± 463.8	1,033.6 ± 501.7	−185.6 ± 446.3	0.070	0.281	0.745
Total iron (mg)	16.6 ± 8.2	15.0 ± 5.4	−1.5 ± 8.4	0.482	15.1 ± 5.0	12.7 ± 6.2	−2.4 ± 6.3	0.077	0.219	0.801
Heme iron (mg)	1.7 ± 1.6	1.4 ± 0.7	−0.3 ± 1.6	0.731	1.3 ± 1.1	1.3 ± 1.1	−0.03 ± 1.1	0.383	0.605	0.488
Non-heme iron (mg)	14.9 ± 7.1	13.6 ± 5.0	−1.2 ± 7.3	0.498	13.8 ± 4.3	11.4 ± 5.3	−2.3 ± 5.8	0.075	0.219	0.662
Sodium (mg)	3,801.3 ± 1,915.5	3,838.0 ± 1,476.4	36.6 ± 2,027.2	0.676	3,338.4 ± 1,299.4	3,319.9 ± 1,883.4	−18.5 ± 1,708.4	0.588	0.219	0.994
Potassium (mg)	3,743.9 ± 1,876.5	3,256.4 ± 1,192.3	−487.5 ± 1,879.5	0.234	3,557.5 ± 1,290.3	2,561.3 ± 1,231.3	−996.2 ± 1,736.0	0.027	0.149	0.415
Vitamin A (μg/RE)	844.4 ± 451.7	699.2 ± 326.6	−154.2 ± 437.2	0.080	757.9 ± 324.3	594.7 ± 343.2	−163.2 ± 407.6	0.052	0.620	0.924
Retinol (μg)	155.9 ± 77.2	149.6 ± 91.1	−6.3 ± 89.9	0.447	146.3 ± 84.2	132.2 ± 74.6	−14.1 ± 67.2	0.538	0.590	0.742
Carotene (μg)	3,948.7 ± 2,371.8	3,064.4 ± 1,541.9	−884.3 ± 2,198.8	0.036	3,469.4 ± 1,724.7	2,530.0 ± 1,539.2	−939.4 ± 2,227.6	0.051	0.605	0.953
Thiamin (mg)	2.4 ± 1.1	2.1 ± 0.8	−0.3 ± 1.1	0.130	2.1 ± 0.7	1.8 ± 1.0	−0.3 ± 1.0	0.093	0.311	0.992
Riboflavin (mg)	1.9 ± 0.8	1.7 ± 0.7	−0.2 ± 0.9	0.214	1.7 ± 0.7	1.6 ± 0.9	−0.1 ± 0.6	0.225	0.812	0.995
Niacin (mg)	17.4 ± 9.5	15.5 ± 5.3	−1.9 ± 9.5	0.479	16.2 ± 6.0	14.1 ± 8.6	−2.1 ± 8.1	0.092	0.189	0.903
Vitamin C (mg)	207.1 ± 177.0	145.0 ± 185.0	−62.1 ± 231.1	0.010	202.9 ± 199.8	98.6 ± 69.4	−104.4 ± 229.7	0.020	0.897	0.265

Mean ± SD.

SFA, saturated fatty acids; MUFA, mono-unsaturated fatty acids; PUFA, poly-unsaturated fatty acids.

[1)]The paired t-test or Wilcoxon's signed-rank test were applied to compare intakes between the third trimester of pregnancy and after delivery.

[2)]Student's t-test or the Mann–Whitney U test was applied to compare changes in intakes between groups.

[3)]General linear model was applied and adjusted for maternal age, body mass index at delivery, and number of fetuses.

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at one hospital, despite originating from various parts of southwestern Korea. Furthermore, the importance of dietary quality, in addition to food and nutrient intake, has been emphasized; however, no diet quality index has been validated for use in Korean pregnant women. Finally, in breastfeeding women, food intake may vary depending on the amount of breastmilk produced. However, few participants were breastfeeding, and accurately assessing the amount of breastmilk generated is difficult. Since 44 women out of 48 participants (92%) in this study provided both breastmilk and formula to their newborns, the results of this study may be applicable to lactating mothers who practice mixed feeding. Since the rate of exclusive breastfeeding is decreasing both in Korea and globally [42] while that of mixed feeding is increasing, the findings of this study may help formulate recommendations for this population. Despite its limitations, this study possesses the strength of analyzing dietary intake changes by tracking the same participants from the third trimester of pregnancy through the postpartum period. In addition, this study used an FFQ appropriately developed to capture the dietary habits of Koreans. Furthermore, the intake of iron, an important nutrient for pregnant women, was analyzed in the form of heme and non-heme iron using a recent database.

Conclusion

In conclusion, this study examined overall dietary intake in the third trimester of pregnancy using an FFQ. Food and supplement intakes were similar between singleton- and multiple-pregnancy Korean women. Korean women adequately consumed most nutrients and endeavored to eat healthier during pregnancy by consuming more fruits and dairy and reducing coffee and alcohol consumption relative to post-delivery. Participants consumed excessive iron via supplements during pregnancy. Further research is required to assess the physiological and health effects of food and nutrient intake in pregnant women.

CONFLICT OF INTEREST

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

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DATA AVAILABILITY

Research data is optionally available upon a reasonable request to the corresponding author.

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During the preparation of this work, the author(s) used DeepL in order to translate the manuscript to English. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

SUPPLEMENTARY MATERIALS

Supplementary Table 1. Classification of food groups included in the food frequency questionnaire.
Supplementary Table 2. Percentage of women complying with the "Dietary Guidelines for Pregnant and Breastfeeding Women in Korea".
Supplementary Table 3. Nutrient intakes from dietary supplements during the third trimester of pregnancy in women carrying singletons or multiples.
Supplementary Table 4. Mean (± SD) dietary intakes of food groups and nutrients after delivery in breastfeeding mothers according to number of fetuses.
Supplementary Table 5. Mean (± SD) dietary intakes of food groups and nutrients after delivery in non-breastfeeding mothers according to number of fetuses.
Supplementary Table 6. Postpartum nutrient intake from dietary supplements by breastfeeding status.

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Research Article

Nutrition quotient for preschoolers and key impacting factors in Korea: a cross-sectional study on food literacy, social support, and the food environment of primary caregivers

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Objectives: This study evaluated the nutrition quotient for preschoolers (NQ-P) and analyzed the impact of key factors, such as caregivers' food literacy, social support, and food environment, on the eating habits of preschool children in Korea. This study also sought to provide foundational data for developing tailored nutrition education programs by identifying the nutrition education needs of caregivers.

Methods: This study was conducted among caregivers of preschool children (aged 0–6 years) using an online self-administered survey conducted from August 22 to August 28, 2023. A total of 1,116 survey responses were analyzed. This study assessed children's NQ-P score, caregivers' food literacy, social support, food environment, and nutritional education needs. Data were analyzed using SPSS 29.0 (IBM Co.).

Results: The average NQ-P score for preschool children was 52, showing a tendency for the balance score to decrease and the moderation score to increase with age. Children from rural and low-income areas exhibited significantly lower NQ-P scores. Caregivers' food literacy was higher in urban and higher-income groups. Multiple regression analysis revealed that social support, food literacy, income, and food environment significantly affected children's NQ-P scores. The effectiveness of nutrition education varied based on the income level, with nutrition education on healthy eating being the most preferred topic for preschool children.

Conclusion: This study confirmed that caregivers' food literacy and social support significantly affected preschool children's nutritional status. This suggests a need for tailored nutritional education and dietary support policies, particularly for low-income and rural populations.

Keywords: food literacy; nutrition quotient for preschoolers; child, preschool; social support

INTRODUCTION

The preschool years represent a critical period of continuous physical, cognitive, and social development during which dietary preferences and eating behaviors

are established that often persist into adulthood. Thus, ensuring appropriate nutritional intake and fostering healthy eating habits during this stage is essential [1-4]. In Korea, various dietary issues have been identified among preschoolers, including nutritional imbalances, selective eating, skipping breakfast, and increased consumption of processed foods. These factors contribute to health problems, such as obesity, underweight, and childhood diabetes [5]. According to the 2023 National Health Statistics, 2.9% of children aged 1–2 years and 7.3% of children aged 3–5 years exhibited nutritional deficiencies, while excessive nutrient intake was observed in 4.1% and 3.5%, respectively, potentially impacting their physical development. Additionally, breakfast skipping rates were 6.6% among children aged 1–2 years and 7.1% of children aged 3–5 years, 24.9% of children aged 1–2 years, and 40.4% of children aged 3–5 years consumed at least one out-of-home meal per day [6].

The COVID-19 pandemic has further influenced dietary patterns, leading to a decline in dining out, increased food delivery, and greater reliance on dietary supplements [7]. Restrictions on outdoor activities also resulted in increased screen time and decreased physical activity, significantly altering preschoolers' daily routines [8]. However, research on the dietary habits of preschoolers, including infants aged 0–1 year, in Korea is limited. Notably, no studies have employed the revised 2021 nutrition quotient for preschoolers (NQ-P). Thus, a precise assessment of dietary habits is needed to evaluate nutritional status and eating behaviors in this population group, along with the development of targeted dietary management strategies and nutrition education programs to support healthy growth and formation of proper eating habits [9].

Primary caregivers play a pivotal role in shaping preschoolers' dietary patterns. Their food choices and home food environments significantly affect the children's future eating habits and overall health [10]. Parental influence on their children operates both directly (through parenting behaviors and interactions) and indirectly (through socioeconomic status, occupational status, and living environment, all of which affect parenting attitudes and roles) [11]. Moreover, caregivers' nutritional knowledge and attitudes have a profound impact on preschoolers' dietary intake and the formation of appropriate eating habits. Assessing caregivers' nutritional awareness and knowledge is essential for predicting children's future health behaviors. Caregivers with higher nutritional awareness are more likely to apply their knowledge to foster proper eating habits among their children [12].

Several factors influence preschoolers' dietary habits, including socioeconomic status, food literacy, and food environment. As preschoolers' eating habits are strongly influenced by their primary caregivers, examining factors such as caregivers' food literacy, social support, and food environment is important. However, studies on these factors are limited. The preschool age is crucial for establishing eating habits that persist into adulthood. This period is not only critical for physical growth and emotional development, but also for nutritional well-being, underscoring the importance of systematic nutrition education in this group and those associated with them [13]. With the growing need for nutrition education programs, studies have examined caregivers' requirements for such programs. However, most of this research has focused on school-aged children, such as elementary and middle school students, whereas studies on preschoolers' nutritional education needs have been limited to specific regions or qualitative focus group interviews [14-18].

This study aimed to provide a comprehensive understanding of the dietary environment and nutritional status of preschoolers by conducting a multifaceted analysis of the NQ-P and food literacy, social support, and food environment of their primary caregivers. Furthermore, this study aimed to generate evidence-based policy recommendations for improving nutritional support for preschoolers. Additionally, to facilitate the promotion of healthy eating habits, this study examined the nutritional education needs of primary caregivers, providing a basis for the development of effective evidence-based nutritional education programs.

METHODS

Ethics statement

The study was approved by the institutional review board of Hallym University (IRB No. HIRB-2023-018).

1. Study design

This cross-sectional study was designed in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (https://www.strobe-statement.org/).

2. Study participants and data collection period

This study made use of Data Spring (https://www.d8aspring.com), a professional survey agency that targets primary caregivers of preschoolers across Korea. Participants were selected based on their voluntary agreement to participate in the survey, and their status as primary caregivers was verified using preliminary screening questions. A combination of convenience and regional quota sampling was used, with urban and rural areas accounting for 90% and 10% of the respondents, respectively. The survey was conducted over 7 days (August 22 to 28, 2023). Among the 1,262 voluntary respondents, 146 were excluded because of ineligibility, resulting in a final sample of 1,116 valid responses (response rate: 88.4%).

3. Study measures

1) General characteristics

The survey collected demographic data on the primary caregivers, including their sex, age, relationship with the child(ren) in their care, residential area, and monthly household income. For the preschoolers, information on sex, age, height (cm), and weight (kg) was collected. The body mass index (BMI; kg/m^2) was calculated to assess weight status. Following Kim *et al.* [19] classification criteria, preschoolers were categorized based on age-specific BMI percentiles as follows: underweight (< 5th percentile), normal weight (5th–85th percentile), overweight (85th–95th percentile), and obese (≥ 95th percentile). For ages 0–2 years, overweight was defined as a weight-for-length ≥ 95th percentile on growth charts.

2) Nutrition quotient for preschoolers

The NQ-P is a validated tool used to assess the nutritional status and dietary quality of preschoolers [20, 21]. The NQ-P comprises three domains: balance, moderation, and practice. Each domain comprises 15 items. A weighted scoring system is used to derive the final NQ-P score. Cronbach's α for the NQ-P in this study was 0.626, confirming its reliability.

3) Primary caregivers' food literacy, social support, and food environment

Food literacy was assessed using a life-cycle-specific Food Literacy Scale [22-24]. The adult version of this tool consists of 25 items across five domains (total score: 100 points): production (7 items), selection (5 items), preparation and cooking (7 items), intake (3 items), and disposal (3 items). The domain scores were calculated by applying item-specific weights, summing the weighted scores within each domain, and then applying additional domain-specific weights to obtain a total score. Cronbach's α for the Food Literacy Scale in this study was 0.927, indicating high reliability. To assess social support for dietary practices, previously validated measurement tools were adapted to fit the caregiving context [25]. Participants responded to four items using a 5-point Likert scale regarding the availability of fresh food at home, parental involvement in meal preparation, and snack guidance over the past 3 months. The items included questions regarding the availability of fresh fruits and vegetables at home, availability of fresh milk and dairy products, frequency of meal preparation for preschoolers, and encouragement of healthy snacking (e.g., fruits, vegetables, milk, and yogurt). The Social Support Scale demonstrated a Cronbach's α value of 0.716, confirming its internal consistency. The food environment was assessed using a 5-item scale developed by Yang and Kim [26]. The five domains of the Food Environment Scale included availability, physical accessibility, affordability, acceptability, and accommodation. Each domain was rated on a 5-point Likert scale, ranging from "strongly disagree" (1 point) to "strongly agree" (5 points). The Food Environment Scale exhibited high reliability, with Cronbach's alpha = 0.869.

4) Nutrition education needs

Nutritional education needs were assessed based on prior research [17, 18, 27]. The survey included three key items: perceived effectiveness of nutrition education (rated on a 5-point Likert scale from "strongly disagree" to "strongly agree"), participation in nutrition education

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within the past 3 months (response options: yes/no/unsure), and preferred nutrition education topics (multiple responses allowed).

4. Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics 29.0 (IBM Co.), with statistical significance accepted at $P < 0.05$. Descriptive statistics were calculated for all the variables. Continuous variables were presented as mean ± standard deviation. Categorical variables are expressed as frequencies (n) and percentages (%). For comparisons of the NQ-P, food literacy, social support, food environment, and nutrition education needs according to the preschoolers' and caregivers' characteristics were compared by using independent t-tests and one-way analysis of variance. Chi-square and Duncan's multiple comparison tests were used for analysis of categorical variables. A stepwise multiple linear regression analysis was conducted to evaluate the impact of primary caregivers' food literacy, social support, food environment, monthly income, residential area, and the perceived effectiveness of nutritional education on preschoolers' NQ-P scores. Multiple response frequency analysis was used to identify the caregivers' preferred nutrition education topics.

RESULTS

1. General characteristics of study participants

Table 1 presents the general characteristics of the participants. Among primary caregivers, females were predominant. Almost two-thirds of participants were in their 30s, followed by those in their 40s, 20s, and 50s. In terms of relationship with the child, 40.9% of the caregivers were fathers and 58.5% were mothers. Regarding the regional distribution, the vast majority of the participants resided in urban areas, whereas only about 10% lived in rural areas. Monthly household income was distributed as follows: most (about one-third) had an income of 400–599 million KRW, followed by those with incomes of 200–399 million KRW, 600–799 million KRW, 800 million KRW, and 200 million KRW, in descending order. Among the preschoolers, just more than half were boys. Each age group (0–1 years, 2–4 years, and 5–6 years) accounted for roughly one-third of the children. Just more than two-thirds of the children were classified as normal weight, while the rest were classified as underweight, overweight, or obese.

2. NQ-P and domain scores

Table 2 presents the total and domain scores of the NQ-P according to sex, age, region, and household income.

Table 1. Characteristics of the study subjects

Variable	Category	Value
Main caregiver (n = 1,116)		
Sex	Male	460 (41.2)
	Female	656 (58.8)
Age (year)	20–29	58 (5.2)
	30–39	701 (62.8)
	40–49	346 (31.0)
	50–59	11 (1.0)
Relationship	Father	457 (40.9)
	Mather	653 (58.5)
	Grandparents	4 (0.4)
	Other	2 (0.2)
Region	Urban	997 (89.3)
	Rural	119 (10.7)
Education level	High school	116 (10.4)
	University	878 (78.7)
	Graduate	122 (10.9)
Occupation	Office worker	537 (48.1)
	Sale or service	73 (6.6)
	Professional	115 (10.3)
	Self-employed business	54 (4.8)
	Housewives	310 (27.8)
	Others	27 (2.4)
Family income (million KRW/month)	< 200	43 (3.9)
	200–399	297 (26.6)
	400–599	420 (37.6)
	600–799	214 (19.2)
	≥ 800	142 (12.7)
Children (n = 1,116)		
Sex	Male	577 (51.7)
	Female	539 (48.3)
Age (year)	0–1	369 (33.1)
	2–4	374 (33.5)
	5–6	373 (33.4)
Weight status	Underweight	133 (11.9)
	Normal weight	762 (68.3)
	Overweight	124 (11.1)
	Obesity	97 (8.7)

n (%).

Table 2. Scores of NQ-P and its factors by sex, age, region and household income

Variable	Total (n = 1,116)	Sex			Age (year)				Region			Household income			
		Male (n = 577)	Female (n = 539)	*P*-value[1]	0–1 (n = 369)	2–4 (n = 374)	5–6 (n = 373)	*P*-value[2]	Urban (n = 997)	Rural (n = 119)	*P*-value[1]	Upper (n = 356)	Middle (n = 420)	Low (n = 340)	*P*-value[2]
NQ-P[3]	52.3 ± 11.8	52.4 ± 11.9	52.2 ± 11.7	0.788	51.0 ± 12.4[a]	52.9 ± 11.7[b]	53.0 ± 11.2b	0.037	52.6 ± 11.7	49.7 ± 12.6	0.013	54.6 ± 11.7[c]	52.5 ± 10.7[b]	49.5 ± 12.5[a]	< 0.001
Balance	48.6 ± 13.7	48.5 ± 13.4	48.7 ± 14.1	0.788	50.0 ± 15.1[b]	49.0 ± 12.8[b]	46.7 ± 13.1[a]	0.003	49.0 ± 13.6	44.8 ± 14.5	0.001	52.2 ± 13.9[c]	48.1 ± 12.9[b]	45.4 ± 13.8[a]	< 0.001
Moderation	40.4 ± 19.9	41.6 ± 20.3	39.1 ± 19.5	0.039	29.4 ± 23.3[a]	45.2 ± 16.2[b]	46.4 ± 14.5[b]	< 0.001	40.3 ± 19.9	40.9 ± 20.8	0.757	39.6 ± 20.1	41.8 ± 19.0	39.5 ± 20.8	0.197
Practice	59.5 ± 18.8	59.4 ± 19.2	59.6 ± 18.5	0.857	59.0 ± 18.6	58.8 ± 19.5	60.7 ± 18.4	0.346	59.8 ± 18.6	57.1 ± 20.3	0.144	61.8 ± 18.3[b]	60.1 ± 18.1[b]	56.5 ± 20.0[a]	0.001

Mean ± SD.
NQ-P, nutrition quotient for preschoolers.
[1]*P*-value was determined by t-test.
[2]*P*-value was determined by ANOVA.
[3]This score encompasses the balance, moderation, practice dimensions of NQ-P.
[a,b,c]Values with different superscripts within each row are significantly different at $P < 0.05$, as determined by Duncan's multiple comparison test.

Significant sex differences were observed in the moderation domain, with boys scoring higher than girls ($P < 0.05$). Age-related differences were also noted in the total NQ-P score ($P < 0.05$), balance domain ($P < 0.01$), and moderation domain ($P < 0.001$), whereas no significant differences were observed in the practice domain. Balance scores declined with increasing age ($P < 0.01$), whereas moderation scores increased with age ($P < 0.001$). Regional analysis revealed that preschoolers in rural areas had significantly lower total NQ-P scores ($P < 0.05$) and balance domain scores ($P < 0.01$) than did their urban counterparts. Additionally, household income correlated positively with the total NQ-P scores ($P < 0.001$), balance scores ($P < 0.001$), and practice scores ($P < 0.05$), whereas no significant differences were observed in the moderation domain.

3. Primary caregivers' food literacy, social support, and food environment scores

Table 3 presents the total scores for primary caregivers' food literacy, social support, and food environment by urban/rural area and monthly household income. Regarding food literacy, urban caregivers had significantly higher total ($P < 0.01$), production ($P < 0.05$), intake ($P < 0.01$), and disposal ($P < 0.05$) domain scores. Income-based analysis revealed significantly higher food literacy scores in the higher-income groups across all domains, including total score ($P < 0.001$), production ($P < 0.001$), selection ($P < 0.001$), preparation and cooking ($P < 0.001$), intake ($P < 0.001$), and disposal ($P < 0.01$). Although social support scores showed no significant regional differences, they varied significantly according to income level ($P < 0.01$), with high-income groups scoring the highest, followed by middle-income, and low-income groups. Food environment analysis showed significantly higher scores in urban versus rural areas ($P < 0.001$), which increased with higher household income levels ($P < 0.001$).

4. Impact of primary caregivers' characteristics on preschoolers' NQ-P scores

Table 4 presents the correlations between primary caregivers' characteristics and preschoolers' NQ-P scores. Significant positive correlations were found between preschoolers' NQ-P scores and caregivers' food literacy,

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social support, food environment, and the perceived effectiveness of nutrition education (all $P < 0.001$). A stepwise multiple linear regression analysis (Table 5) revealed that caregivers' social support ($P < 0.001$), food literacy ($P < 0.001$), monthly income ($P < 0.01$), and food environment ($P < 0.05$) were significant predictors of preschoolers' NQ-P scores (adjusted $R^2 = 0.188$, $P < 0.001$). Social support, food literacy, and food environment were positively associated and lower income was negatively associated with preschoolers' NQ-P scores.

Table 3. Scores of food literacy, social support and food environment by region and household income

Variable	Total (n = 1,116)	Region		*P*-value[1)]	Household income			*P*-value[2)]
		Urban (n = 997)	Rural (n = 119)		Upper (n = 356)	Middle (n = 420)	Low (n = 340)	
Food literacy[3)]	62.3 ± 13.8	62.7 ± 13.7	59.2 ± 14.4	0.008	65.6 ± 13.8[c]	62.6 ± 13.3[b]	58.7 ± 13.5[a]	< 0.001
Production	54.0 ± 21.3	54.5 ± 21.1	49.4 ± 23.1	0.013	57.7 ± 22.1[c]	54.6 ± 20.9[b]	49.3 ± 20.2[a]	< 0.001
Selection	59.0 ± 17.1	59.2 ± 16.9	57.3 ± 19.1	0.259	60.9 ± 18.0[b]	59.8 ± 16.8[b]	55.9 ± 16.2[a]	< 0.001
Preparation and cooking	69.0 ± 15.2	69.2 ± 15.2	67.3 ± 15.0	0.197	72.5 ± 14.8[c]	68.5 ± 14.7[b]	66.0 ± 15.6[a]	< 0.001
Intake	62.6 ± 17.1	63.2 ± 16.8	58.0 ± 18.7	0.002	66.8 ± 16.1[c]	62.9 ± 16.1[b]	57.9 ± 18.2[a]	< 0.001
Disposal	68.6 ± 16.6	69.0 ± 16.4	65.8 ± 17.2	0.044	71.1 ± 16.0[b]	68.4 ± 16.1[a]	66.4 ± 17.3[a]	0.001
Social support[4)]	4.0 ± 0.7	4.0 ± 0.7	3.9 ± 0.7	0.053	4.1 ± 0.6[b]	4.0 ± 0.7[a]	3.9 ± 0.6[a]	0.005
Food environment[5)]	3.7 ± 0.7	3.7 ± 0.7	3.4 ± 0.8	< 0.001	3.8 ± 0.7[c]	3.7 ± 0.7[b]	3.5 ± 0.8[a]	< 0.001

Mean ± SD.
[1)]*P*-value was determined by t-test.
[2)]*P*-value was determined by ANOVA.
[3)]This score encompasses the balance, moderation, practice dimensions of NQ-P.
[4)]Measured using a 5-point Likert scale (never = 1, always = 5).
[5)]Measured using a 5-point Likert scale (strongly disagree= 1, strongly agree = 5).
[a,b,c]Values with different superscripts within each row are significantly different at $P < 0.05$, as determined by Duncan's multiple comparison test.

Table 4. Correlation analysis of NQ-P, food literacy, social support, food environment and nutrition education effectiveness

	NQ-P	Food literacy	Social support	Food environment	Nutrition education effectiveness
NQ-P	1				
Food literacy	0.361***	1			
Social support	0.368***	0.502***	1		
Food environment	0.255***	0.372***	0.399***	1	
Nutrition education effectiveness	0.162***	0.323***	0.262***	0.225***	1

NQ-P, nutrition quotient for preschoolers.
***P*-value was determined by correlation analysis.

Table 5. Linear multiple regression analysis to explore factors related to the NQ-P in each domain (stepwise)

Variable	B	SE	β	t	*P*-value[1)]	TOL	VIF
(Constant)	21.198	2.255			< 0.001		
Social support	1.039	0.146	0.231	7.139	< 0.001	0.695	1.440
Food literacy	0.172	0.028	0.201	6.227	< 0.001	0.699	1.430
Household income (low)[2)]	−2.371	0.705	−0.093	−3.361	0.001	0.960	1.042
Food environment	0.238	0.097	0.074	2.451	0.014	0.794	1.260
$F = 65.577$; $P < 0.001$; $R^2 = 0.191$; adj. $R^2 = 0.188$							

NQ-P, nutrition quotient for preschoolers; SE, standard error; TOL, tolerance; VIF, variance inflation factor.
[1)]*P*-value was determined by linear multiple regression analysis.
[2)]Reference group: household income (upper).

5. Nutrition education needs assessment

Table 6 presents primary caregivers' perceptions of nutrition education effectiveness and recent participation in nutrition education programs. The mean effectiveness score of nutrition education was 3.9, with no significant urban–rural differences. However, income-related differences were observed, with lower-income caregivers rating nutrition education effectiveness lower than did middle- and high-income caregivers ($P < 0.01$). Regarding participation in nutrition education programs within the past 3 months: about one-quarter reported participation, more than half stated that they had not participated, and the remainder were unsure. Significant urban-rural differences were noted ($P < 0.01$), whereas no significant differences were observed across income levels.

Table 7 presents caregivers' preferred nutrition education topics, which included the following, in descending order of preference: healthy eating education, sensory education using food ingredients, food hygiene education, unbalanced diet education, sustainable dietary education, cooking education, traditional food culture education, and other.

DISCUSSION

The preschool years represent a crucial period for establishing lifelong dietary habits, and preschoolers' eating

Table 6. Scores of nutrition education effectiveness and nutrition education experience by region and household income

Variable	Total (n = 1,116)	Region		*P*-value	Household income			*P*-value
		Urban (n = 997)	Rural (n = 119)		Upper (n = 356)	Middle (n = 420)	Low (n = 340)	
Nutrition education effectiveness	3.9 ± 0.9	3.9 ± 0.9	3.8 ± 0.9	0.495[1)]	3.9 ± 0.9[b]	3.9 ± 0.8[b]	3.7 ± 0.9[a]	0.003[2)]
Nutritional education experience within 3 months				0.004[3)]				0.144[3)]
Yes	296 (26.5)	265 (26.6)	31 (26.0)		93 (26.1)	122 (29.1)	81 (23.8)	
No	635 (56.9)	579 (58.1)	56 (47.1)		201 (56.5)	242 (57.6)	192 (56.5)	
Not sure	185 (16.6)	153 (15.3)	32 (26.9)		62 (17.4)	56 (13.3)	67 (19.7)	

Mean ± SD.
[1)]*P*-value was determined by t-test.
[2)]*P*-value was determined by ANOVA.
[3)]*P*-value was determined by Chi-square test.
[a,b]Values with different superscripts within each row are significantly different at $P < 0.05$, as determined by Duncan's multiple comparison test.

Table 7. Desired nutrition education topics for preschool children

Variable	Total (n = 1,116)	Region		Household income		
		Urban (n = 997)	Rural (n = 119)	Upper (n = 356)	Middle (n = 420)	Low (n = 340)
Nutrition education on healthy eating[1)]	654 (20.8)	587 (21.0)	67 (19.2)	213 (21.0)	253 (21.5)	188 (19.7)
Sensory education	606 (19.3)	544 (19.4)	62 (17.8)	186 (18.3)	211 (18.0)	209 (21.9)
Food hygiene	581 (18.5)	516 (18.4)	65 (18.7)	202 (19.9)	219 (18.6)	160 (16.7)
Unbalanced diet	499 (15.9)	449 (16.1)	50 (14.4)	164 (16.2)	184 (15.7)	151 (15.8)
Sustainable diet	330 (10.5)	290 (10.4)	40 (11.5)	103 (10.2)	129 (11.0)	98 (10.2)
Cooking	252 (8.0)	222 (7.9)	30 (8.6)	76 (7.5)	97 (8.2)	79 (8.3)
Traditional food culture	209 (6.6)	178 (6.4)	31 (8.9)	67 (6.6)	75 (6.4)	67 (7.0)
Others	14 (0.4)	11 (0.4)	3 (0.9)	3 (0.3)	7 (0.6)	4 (0.4)
Total	3,145 (100)	2,797 (100)	348 (100)	1,014 (100)	1,175 (100)	956 (100)

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

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behaviors are strongly influenced by their primary caregivers. This study thus examined preschoolers' NQ-P scores and the association thereof with caregivers' food literacy, social support, food environment, and nutrition education needs.

The findings indicate that the mean NQ-P score was 52.3, with scores for the balance domain of 48.6, moderation domain of 40.4, and practice domain of 59.5. Compared to previous nationwide studies [21], these scores were generally lower, likely due to the inclusion of preschoolers aged 0–1 year, who typically exhibit less independent dietary behaviors. Regional disparities were observed, as preschoolers in rural areas exhibited significantly lower total NQ-P scores ($P < 0.05$) and balance domain scores ($P < 0.01$) than did their urban counterparts. These differences may be attributed to limited access to diverse nutritious foods and disparities in the availability of nutrition education in rural settings. Additionally, higher household income was associated with significantly better dietary quality, as indicated by higher total NQ-P ($P < 0.001$), balance domain ($P < 0.001$), and practice domain ($P < 0.05$) scores, consistent with previous studies demonstrating the influence of socioeconomic factors on preschoolers' dietary behaviors [28, 29]. These findings highlight the need for targeted interventions to reduce disparities between nutrition education and food environments.

The mean food literacy score of the primary caregivers was 62.3, with domain scores of 54.0 for production, 59.0 for selection, 69.0 for preparation and cooking, 62.6 for intake, and 68.6 for disposal. Urban caregivers had significantly higher food literacy scores than did rural caregivers ($P < 0.01$), and high-income groups exhibited significantly higher food literacy scores than did middle- and low-income groups ($P < 0.001$), which was consistent with the findings of previous research [30, 31] on the importance of parental food literacy in preschoolers' nutritional status. The mean social support score was 4.0, with higher scores observed in high-income groups ($P < 0.01$), consistent with prior findings that low-income households tend to have lower social support and inadequate food environments at home [32]. Given the critical role of the home food environment in child development, government intervention for economically disadvantaged households is necessary. Food environment analysis revealed significant differences across urban–rural locations and across income levels. Urban caregivers reported significantly higher food environment scores across all domains ($P < 0.001$), while a higher monthly income was significantly associated with greater food environment scores ($P < 0.001$). These findings align with those of previous studies [33, 34] that reported challenges in accessing fresh food and food desert phenomena in low-income and rural areas.

Analysis of the factors influencing preschoolers' nutritional status showed that primary caregivers' social support ($P < 0.001$), food literacy ($P < 0.001$), income status ($P < 0.01$), and food environment ($P < 0.05$) significantly affected preschoolers' NQ-P scores (adjusted $R^2 = 0.188$, $P < 0.001$). Primary caregivers play a pivotal role in preschoolers' dietary habits and meal patterns as caregivers' food choices and home food environments directly influence their nutritional status [10, 17]. Differences in access to nutritional information, the ability to purchase healthy food, and opportunities to participate in health programs appear to be particularly prominent in high-income households and urban areas. Therefore, nutrition education programs should be tailored to caregivers' characteristics, and regional and economic circumstances. Specifically, policy support and expanded nutrition education programs are essential for low-income and rural populations, along with concrete measures to enhance fresh food purchasing conditions and to improve access to nutritional information. Previous studies have demonstrated that government-led nutrition support programs, such as the Nutrition Plus program, effectively improve the nutritional status of preschoolers and caregivers [35-37]. Sustained policies and support are needed, including increased financial support and the expansion of nutrition assistance programs, such as Nutrition Plus, food banks, and food vouchers.

Additionally, the development and continuous operation of nutrition education programs involving collaboration among childcare centers, home environments, and children's food service management support centers should be ensured. For rural areas, policy interventions, such as mobile markets and fresh food delivery services, should be considered to enhance fresh food purchasing environments.

Regarding preferred nutrition education topics, primary caregivers prioritized healthy eating education (20.8%), sensory education using food ingredients (19.3%), food hygiene education (18.5%), and picky eating management (15.9%). These preferences align with previous research [17, 18] and reflect an increased awareness of food hygiene owing to the COVID-19 pandemic. These findings underscore the importance of identifying the nutrition education needs of primary caregivers and developing well-structured, sustainable nutrition education programs.

Limitations

This cross-sectional study based on proxy reporting by primary caregivers and self-administered online surveys using convenience sampling has limitations in establishing clear causal relationships. Additionally, as the existing NQ-P was developed for preschoolers aged 3–5 years, the NQ-P criteria may not be applicable to children aged 0–2 years. Furthermore, the survey's reliance on primary caregivers' subjective assessments may not accurately reflect preschoolers' dietary habits and nutritional status. To address this, objective data collection methods (e.g., meal observations and food intake frequency surveys) should be incorporated. Finally, given that both NQ-P scores and diet-related factors (food literacy, social support, and food environment) showed differences according to monthly household income and residential areas, further research is needed to develop strategies to reduce socioeconomic disparities. Despite these limitations, this study provides valuable baseline data for a comprehensive understanding of preschoolers' dietary environments and nutritional status, as well as for policy development and support.

Conclusion

This study examined the associations of primary caregivers' food literacy, social support, and food environment with preschoolers' NQ-P. These findings indicate that caregivers' nutritional knowledge, social environment, and access to healthy foods significantly affect preschoolers' dietary behaviors, underscoring the importance of caregiver-focused nutrition education interventions.

CONFLICT OF INTEREST

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

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DATA AVAILABILITY

Research data is available from the corresponding author upon request.

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Research Article

Understanding the characersitics and types of single-person households based on food purchase frequencies in Korea: a cross-sectional study using the 2023 Consumer Behavior Survey for Foods

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Objectives: This study investigated the differences in food purchase frequency among single-person households by gender and age group and explored the characteristics of single-person household groups according to their food purchase patterns.

Methods: Utilizing data from the 2023 Consumer Behavior Survey for Foods conducted by the Korea Rural Economic Institute, this study examined food purchase frequencies among 966 single-person households. Data were analyzed using Rao-Scott chi-square tests, ANCOVA, ANOVA, and K-modes hierarchical cluster analysis.

Results: Significant differences were observed in the food purchase frequencies of single-person households for fresh and convenient food. Women displayed higher purchase frequencies for fish, vegetables, and fruits, whereas men showed higher purchase frequencies for convenient foods ($P < 0.01$). Single-person households aged 39 years and younger exhibited lower purchase frequencies for vegetables ($P < 0.005$) and fish ($P < 0.001$) and substantially higher frequencies of convenient food purchases ($P < 0.001$). Additionally, this study identified three distinct single-person household groups based on food purchase pattern: the "nutrition-conscious" group, which exhibited high purchase frequency for fresh foods; the "convenience-seeking" group, which showed high purchase frequency for all types of convenient foods; and the "passive food consumer" group, which displayed relatively low purchase frequency for both fresh foods and convenient foods. The socio-demographic characteristics of single-person households differed significantly across these three groups, with the "passive food consumer" group and "convenience-seeking" group exhibiting lower healthy eating competency ($M_{N(\text{nutrition-conscious group})} = 3.68$, $M_{P(\text{passive-food-consumer group})} = 3.40$, $M_{C(\text{convenience-seeking group})} = 3.52$, $P < 0.001$), safe eating competency ($M_N = 3.87$, $M_P = 3.57$, $M_C = 3.77$, $P < 0.001$), and satisfaction ($M_N = 3.36$, $M_P = 3.23$, $M_C = 3.25$, $P = 0.04$) than the "nutrition-conscious" group.

Conclusion: This study underscores the need for targeted nutrition programs to address the unique needs of single-person households depending on their characteristics. Specifically, this study highlights the importance of targeted interventions for "convenience-seeking" and "passive food consumer" to promote dietary competency and encourage healthy dietary behavior.

Keywords: family characteristics; foods; dietary habit; consumer behavior

INTRODUCTION

The proportion of single-person households in South Korea has steadily increased, reaching 35.5% of all households in 2023, making these the most prevalent type of household [1]. The country has experienced a continuous rise in the number of single-person households largely due to rapid aging and an increasing number of young people delaying marriage. In the past, single-person households primarily comprised the elderly. Recently, the age composition of single-person households has become more diverse, with those aged 70 and over accounting for the largest share of single-person households at 19.1%, followed closely by individuals in their 20s at 18.6%, those in their 60s at 17.3%, and those in their 30s at 17.3% by 2023 [1].

The increase in single-person households has triggered new trends in dietary behaviors [2]. In terms of dietary behavior, single-person households are more likely to consume home meal replacements (HMRs), processed/instant foods, frozen foods, and delivery/takeout foods than multiple-member households [3-6]. Furthermore, their dietary habits exhibit a high propensity for skipping meals and eating alone [7-9]. The unhealthy dietary behaviors observed among single-person households are primarily attributed to their convenience-seeking lifestyle [4, 10]. However, this may also stem from structural issues within the food market environment that make it challenging for single-person households to purchase fresh food in small quantities [11, 12].

The reliance of single-person households on HMRs, processed/instant foods, fast foods, and delivery/takeout foods hinders their ability to maintain a balanced diet, leading to significant disparities in nutrient intake, including excessive caloric intake and high consumption of fats and sodium [7, 11, 13-15]. Single-person households are known to experience a lack of nutrients, such as calcium, vitamin A, vitamin B2, thiamine, riboflavin, niacin, and vitamin C [7, 16, 17], and excessive sodium intake [18, 19]. In addition, assessments of dietary quality based on nutrient adequacy ratios, average nutrient adequacy ratios, and the nutritional quality index indicate that the quality of meals in single-person households was significantly lower than those in multiple-member households in a recent study [16]. Furthermore, previous studies have shown that poor dietary patterns and imbalanced nutrient intake significantly increase the risk of prevalence of diseases. Wang *et al.* [20] demonstrated that adherence to a healthy diet is generally associated with a lower risk of major chronic diseases, including cardiovascular disease, type 2 diabetes, and cancer, whereas the consumption of foods with lower dietary salt has been shown to help reduce blood pressure and decrease the risk of cardiovascular diseases [21]. Additionally, research indicates that a healthy diet is linked to lower levels of depressive symptoms [22] and various mental health issues [23-25]. Therefore, promoting a healthy diet among single-person households is important for improving their health.

In single-person households, it can be reasonably assumed that any food that is purchased or acquired is consumed by the household. Therefore, by investigating the food purchase frequencies of single-person households across various food groups, this study aims to understand the food consumption patterns of these households and derive insights targeting those who engage in unhealthy food consumption practices. According to previous studies, the dietary behaviors and disparities in nutrient intake may vary by the characteristics of single-person households [16, 26-30]. In a comprehensive literature review, Hanna & Collins [31] identified significant differences in food and nutrient intake between adults living alone and those cohabiting with others. Notably, their findings indicated that men living alone are more susceptible to poor dietary intake than their women counterparts. Jae *et al.* [26] and Hong & Kim [27] have demonstrated that differences exist across age groups in single-person households' dietary behaviors of eating out, delivery/take-out, and meal skipping. Lee [16] also showed that nutrient intake disparities manifest differently depending on the age of the single-person households. Thus, as the characteristics of single-person households become increasingly diverse, it is essential to consider these characteristics to effectively understand their needs and behaviors.

The specific research objectives are as follows: First, this study aimed to investigate the differences in food purchase frequencies for fresh and convenient food groups among single-person households by gender and

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age group. Second, by clustering single-person households according to their food purchase frequencies, this study aimed to identify the food purchase types of single-person households and explore sociodemographic characteristics, dietary competency, and dietary satisfaction across these groups.

METHODS

Ethics statement

This study was exempted from review by the Research Ethics Committee under Article 2 of the Bioethics and Safety Act and its Enforcement Rules, as it uses data collected directly by the government for public welfare.

1. Study design

This cross-sectional study was conducted using national panel data and was described with reference to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) reporting guidelines (https://www.strobe-statement.org/).

2. Data and subjects

This study used raw data from the 2023 Food Consumption Behavior Survey conducted by the Korea Rural Economic Institute. The Food Consumption Behavior Survey, conducted annually, comprises responses from the main purchasers, adult household members, and youth household members. An interview survey is conducted with the main food purchasers of the sampled households and with all the adult household members who are aged 19 or older. The Food Consumption Behavior Survey collects information regarding households' purchasing and consumption behaviors for diverse food categories, dietary habits and lifestyles, consumer dietary competency index, consumer dietary satisfaction, and consumers' perceptions of food-related policies and programs. This study analyzed the responses of 966 single-person households out of the 3,176 households that participated in the survey.

3. Food purchase frequency

To examine the food purchase behaviors of single-person households, this study analyzed the purchase frequency of fresh food and the purchase frequency of convenient food. For the purchase frequencies of fresh food groups, data were collected on how often specific food items were purchased or obtained from other sources. Specifically, the study focused on the frequency of purchase of meat (beef, pork, and chicken), fish, eggs, vegetables, fruits, and milk. The purchase frequency of convenient foods, such as fresh-cut products, ready-to-eat foods, ready-to-cook foods, and meal kits, was measured based on how often the primary purchaser purchased these items directly.

The purchase frequencies of fresh food and the purchase frequencies for convenient foods were measured using eight categories: 1 = daily, 2 = 4–6 times a week, 3 = 2–3 times a week, 4 = once a week, 5 = once every two weeks, 6 = once a month, 7 = less often than once a month, and 8 = none. The frequency variables were categorized into two levels based on the 50th percentile response of the frequency distribution of food items. According to this criterion, the variables were classified as follows: the purchase frequencies of meat (beef, pork, and chicken) and fish were categorized as 0 for "one a month or less" and 1 for "once every two weeks or more." For egg, vegetables, fruits, and milk, the frequencies were categorized as 0 for "once every two weeks or less," and 1 for "once a week or more." Additionally, the purchase frequencies of convenient foods were classified as 0 for "less often than once a month," and 1 for "once a month or more."

4. Dietary competency and satisfaction

To examine the dietary competency and satisfaction of single-person households, this study utilized the "healthy eating competency" and "safe eating competency" components from the agri-food consumer competency index. Each competency measurement consisted of 10 detailed items, and the average score of the responses to these 10 items was used for the analysis. Respondents rated their level of agreement with the 10 items in each competency component using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The specific dietary competency items are presented in Appendix 1. Dietary satisfaction is a single-item scale that was measured on a 5-point Likert scale (1 = very dissatisfied, 5 = very satisfied), where respondents rated their level of satisfaction with their dietary behaviors.

5. Statistical analysis

The survey data were analyzed using R version 2023.06.1. All the analyses accounted for the complex sample design of the Consumer Behavior Survey for Food 2023, including stratification variables, cluster variables, and weights.

Descriptive statistical analysis was conducted to explore respondents' characteristics. Rao-Scott chi-square tests were performed to examine the differences in food purchase frequencies among single-person households based on gender and age. To examine whether there exists a significant difference in dietary competency and satisfaction by age group, an analysis of covariance (ANCOVA) was conducted. The confounding effect associated with gender was controlled for by including gender as a covariate. Similarly, to explore the differences in dietary competency and dietary satisfaction by gender, an ANCOVA was conducted with a covariate of age group, and Scheffe's method was used for multiple comparisons. Next, K-modes hierarchical cluster analysis was applied to classify single-person households based on their food purchase frequencies. This method is particularly suitable for categorical variables such as the frequency of fresh and convenient food purchases. Chi-square tests and analysis of variance (ANOVA) were conducted to explore the profile of each group of single-person households and assess the differences in dietary competency and satisfaction across these groups. Statistical significance was determined at a threshold of $P < 0.05$.

RESULTS

1. Descriptive statistics of the sample

Among the heads of single-person households analyzed in this study, 40.9% were men and 59.1% were women (Table 1). In terms of age groups, 39.5% of the sample were aged 20–39 years, 24.3% were aged 40–59 years, and 36.2% were aged 60 years or older. A total of 281 single-person households reported a household income higher than KRW 3 million, which was the average monthly income of single-person households in South Korea in 2023 [32], corresponding to 40.3% of the study sample. Conversely, 685 households reported a household income of KRW 3 million or less, accounting for 59.7% of the sample. Additionally, 394 single-person households reported their average monthly food expenditure as less than KRW 400,000, which was the average monthly food expenditure of single-person households in South Korea in 2023 [32]. In addition, 572 households reported a monthly average food expenditure of KRW 400,000 or higher, representing 60.2% of the sample population. Among the study sample, 16.6% had completed middle school or lower, 33.2% had completed high school, and 50.2% had completed college or higher. In terms of residence, 334 households (63.3%) resided in urban areas, while 38.7% of the sample resided in rural areas.

2. Food purchase frequency among single-person households

1) Differences in food purchase frequency among single-person households by gender and age group

The differences in the food purchase frequencies of food groups in single-person households by gender

Table 1. Socio-demographic characteristics of respondents

Characteristic	Single-person households (n = 966)
Gender	
Men	203 (40.9)
Women	763 (59.1)
Age group (year)	
20–39	189 (39.5)
40–59	323 (24.3)
≥ 60	454 (36.2)
Average monthly income (10,000 KRW)	
< 300	685 (59.7)
≥ 300	281 (40.3)
Average monthly food expenses (10,000 KRW)	
< 40	394 (39.8)
≥ 40	572 (60.2)
Education	
Middle school or below	227 (16.6)
High school	410 (33.2)
College or higher	329 (50.2)
Residence	
Urban	334 (63.3)
Rural	632 (38.7)

n (%).
All weighted models accounted for the complex sampling design of the Consumer Behavior Survey for Food 2023.

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are shown in Table 2. The analysis found significant differences in the purchase frequencies of fish, vegetables, and fruits as well as the purchase frequencies of convenient foods by gender ($P < 0.01$). Regarding the purchase frequency of fish, a higher proportion of "once every two weeks or more" responses was found among women while a higher proportion of "once a month or less" responses was reported among men. In terms of the purchase frequencies of vegetables and fruits, a higher proportion of "once a week or more" was reported among women while "once every two weeks or less" was more frequently reported among men. Regarding convenient foods including fresh-cut products, ready-to-eat foods, ready-to-cook foods, and meal kits, men were more likely to report purchasing convenient food "once a month or more," while women are more likely to answer "less often than once a month" across all sub-categories. These findings suggest that women tend to consume more fish, vegetables, and fruit than men, whereas men tend to consume more convenient foods than women.

The differences in the food purchase frequencies of various food groups by age group among single-person households are also presented in Table 2. Significant differences were observed in the purchase frequencies of fish and vegetables as well as the purchase frequency of convenient food, across different age groups. For fish, the proportion of "once every two weeks or more" was highly reported in the 60 and older age group, while the proportion of "once a month or less" was higher in the 20–39 age group ($P < 0.001$). In the case of vegetables, the proportion of "once every two weeks or less" was higher in the 20–39 age group, whereas the proportion of "once a week or more" was higher in the 40–59 and 60 and older age groups ($P < 0.05$). All four types of convenient foods, including fresh-cut products, ready-to-eat foods, ready-to-cook foods, and meal kits, the 20–39 age group showed a higher proportion of "once a month or more" responses than other age groups ($P < 0.001$).

2) Differences in dietary competency and satisfaction among single-person households by gender and age group

A comparison of dietary competency and satisfaction by gender and age group are presented in Table 3. Neither dietary competency and satisfaction were significantly different by gender or age group. For all respondents of the study sample, the average score for healthy eating competency was 3.56 ± 0.52, and the average score for safe eating competency was 3.76 ± 0.52. The respondents' mean dietary satisfaction score was 3.29 ± 0.52.

3. Characteristics of single-person household groups based on food purchase frequency

1) Single-person household groups based on food purchase frequency

Single-person households were classified into three clusters based on food purchase frequency (Table 4). Cluster 1, named the "nutrition-conscious" group, exhibited higher fresh food purchase frequency and lower convenient food purchase frequency compared to other groups. Cluster 2, named the "passive food consumer" group, showed a relatively low purchase frequency for both fresh and convenient foods. In cluster 3, the purchase frequencies for all four types of convenient foods were high compared to the other clusters. A single-person household in this cluster showed higher purchase frequencies of pork, vegetables, fruits, and milk but lower purchase frequencies of beef, chicken, fish, and eggs compared to other groups. Based on these characteristics, cluster 3 was named the "convenience-seeking" group.

2) Socio-demographic characteristics across single-person household groups

Significant differences in demographic characteristics were observed across the three different groups in terms of gender, age, average monthly income and average monthly food expenses, education level ($P < 0.001$), and place of residence ($P = 0.03$) (Table 5). The demographic characteristics of the "nutrition-conscious" and the "passive food consumer" groups are highly similar, with the exception of differences observed in their residential areas. Specifically, both groups had a higher proportion of women aged 60 years and older and individuals with an education level of middle school or below. Also, individuals in both groups are more likely to have relatively lower average monthly income and lower average monthly food expenses compared to "convenience-seeking" group. With regard to residence, indi-

Table 2. Food purchase frequency among single-person households by gender and age group

Food group	Frequency	Total (n = 966)	Gender			Age group (year)			
			Men (n = 203)	Women (n = 763)	*P*-value[1)]	20–39 (n = 189)	40–59 (n = 323)	60 or more (n = 454)	*P*-value[1)]
Beef	Once a month or less	653 (66.6)	140 (65.6)	513 (67.3)	0.738	130 (65.3)	210 (67.2)	313 (67.6)	0.858
	Once every two weeks or more	313 (33.4)	63 (34.4)	250 (32.7)		59 (34.7)	113 (32.8)	141 (32.4)	
Pork	Once a month or less	332 (37.3)	69 (36.0)	263 (38.2)	0.656	76(40.5)	116 (40.0)	140 (31.9)	0.161
	Once every two weeks or more	634 (62.7)	134 (64.0)	500 (61.8)		113 (59.5)	207 (60.0)	314 (68.1)	
Chicken	Once a month or less	648 (68.7)	134 (67.4)	514 (69.7)	0.620	127 (66.8)	205 (68.1)	316 (71.2)	0.625
	Once every two weeks or more	318 (31.3)	69 (32.6)	249 (30.3)		62 (33.2)	118 (31.9)	138 (28.8)	
Fish	Once a month or less	536 (61.3)	135 (70.8)	401 (54.7)	0.001	143 (75.1)	198 (65.2)	195 (43.6)	< 0.001
	Once every two weeks or more	430 (38.7)	68 (29.2)	362 (45.3)		46 (24.9)	125 (34.8)	259 (56.4)	
Egg	Once every two weeks or less	572 (60.1)	117 (59.7)	455 (60.4)	0.888	111 (59.7)	172 (56.2)	289 (63.1)	0.463
	Once a week or more	394 (39.9)	86 (40.3)	308 (39.6)		78 (40.3)	151 (43.8)	165 (36.9)	
Vegetable	Once every two weeks or less	302 (37.4)	88 (45.8)	214 (31.5)	0.004	80 (45.5)	87 (32.8)	135 (31.6)	0.018
	Once a week or more	664 (62.6)	115 (54.2)	549 (68.5)		109 (54.5)	236 (67.2)	319 (68.4)	
Fruit	Once every two weeks or less	428 (49.1)	121 (60.8)	307 (41.0)	< 0.001	93 (51.5)	119 (45.2)	216 (49.1)	0.557
	Once a week or more	538 (50.9)	82 (39.0)	456 (59.0)		96 (48.5)	204 (54.8)	238 (50.9)	
Milk	Once every two weeks or less	461 (46.9)	109 (51.1)	352 (44.0)	0.174	82 (44.6)	140 (45.1)	239 (50.6)	0.402
	Once a week or more	505 (53.1)	94 (48.9)	411 (56.0)		107 (55.4)	183 (54.9)	215 (49.4)	
Convenient food									
Fresh-cut product					0.001				< 0.001
	Less often than once a month	570 (48.0)	95 (38.8)	475 (45.4)		61 (25.7)	161 (46.1)	348 (73.5)	
	Once a month or more	396 (52.0)	108 (61.2)	288 (45.6)		128 (74.3)	162 (53.9)	106 (26.5)	
Ready-to-eat food					< 0.001				< 0.001
	Less often than once a month	492 (38.7)	65 (22.7)	427 (49.7)		38 (15.5)	138 (36.3)	316 (65.6)	
	Once a month or more	474 (61.3)	138 (77.3)	336 (50.3)		151 (84.5)	185 (63.7)	138 (34.4)	
Ready-to-cook food					< 0.001				< 0.001
	Less often than once a month	518 (426)	64 (24.8)	454 (54.9)		46 (19.4)	145 (41.2)	327 (68.7)	
	Once a month or more	448 (57.4)	139 (75.2)	309 (45.1)		143 (80.6)	178 (58.8)	127 (31.3)	
Meal kit					< 0.001				< 0.001
	Less often than once a month	557 (47.4)	89 (33.5)	468 (57.0)		55 (25.5)	166 (43.3)	356 (74.0)	
	Once a month or more	389 (52.6)	114 (66.5)	275 (43.0)		134 (74.5)	157 (56.7)	98 (20.0)	

n (%).

All weighted models accounted for the complex sampling design of the Consumer Behavior Survey for Food 2023.

[1)]The *P*-values were estimated using χ^2-test.

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Table 3. Dietary competency and satisfaction among single-person households by gender and age group

Dietary competency & satisfaction	Total (n = 966)	Gender			Age group (year)			
		Men (n = 203)	Women (n = 763)	*P*-value[1)]	20–39 (n = 189)	40–59 (n = 323)	60 or more (n = 454)	*P*-value[2)]
Healthy eating competency[3)]	3.56 ± 0.52	3.46 ± 0.06[2)]	3.55 ± 0.03	0.221	3.46 ± 0.08	3.54 ± 0.05	3.55 ± 0.03	0.375
Safe eating competency[4)]	3.76 ± 0.52	3.71 ± 0.58	3.75 ± 0.03	0.343	3.73 ± 0.07	3.78 ± 0.04	3.70 ± 0.04	0.611
Dietary satisfaction[5)]	3.29 ± 0.52	3.28 ± 0.05	3.25 ± 0.03	0.444	3.24 ± 0.05	3.28 ± 0.04	3.28 ± 0.03	0.300

Mean ± SE.
[1)]The *P*-values were estimated using ANCOVA with gender as a covariate.
[2)]The *P*-values were estimated using ANCOVA with age groups as a covariate.
[3)]Calculated as the average score of 10 items, including balanced nutrient intake and portion size control, measured on a 5-point Likert scale (1 = strongly disagree, 3 = neutral, 5 = strongly agree).
[4)]Calculated as the average score of 10 items, including safe food storage methods and checking for food safety incidents, measured on a 5-point Likert scale (1 = strongly disagree, 3 = neutral, 5 = strongly agree).
[5)]Respondents rated their level of satisfaction with their dietary behaviors on a 5-point Likert scale (1 = very dissatisfied, 3 = neutral, 5 = very satisfied).

Table 4. Typology of single-person households based on food purchase frequency

Food group	Nutrition-conscious group (n = 223)	Passive food consumer group (n = 296)	Convenience-seeking group (n = 447)
Beef	Once a month or less	Once a month or less	Once a month or less
Pork	Once every two weeks or more	Once a month or less	Once every two weeks or more
Chicken	Once every two weeks or more	Once a month or less	Once a month or less
Fish	Once every two weeks or more	Once a month or less	Once a month or less
Egg	Once a week or more	Once every two weeks or less	Once every two weeks or less
Vegetable	Once a week or more	Once every two weeks or less	Once a week or more
Fruit	Once a week or more	Once every two weeks or less	Once a week or more
Milk	Once a week or more	Once every two weeks or less	Once a week or more
Convenient food			
Fresh-cut product	Less often than once a month	Less often than once a month	Once a month or more
Ready-to-eat	Less often than once a month	Less often than once a month	Once a month or more
Ready-to-cook	Less often than once a month	Less often than once a month	Once a month or more
Meal kit	Less often than once a month	Less often than once a month	Once a month or more

The frequency of purchase of food group.

viduals in the "passive food consumers" group are more likely to reside in urban areas compared to the "nutrition-conscious" and "convenience-seeking" groups. The "convenience-seeking" group showed a higher proportion of men and individuals aged 39 or younger. This group also had a higher percentage of individuals with college degree education and exhibited a relatively higher average monthly income and food expenses compared to the other groups.

3) Dietary competency and satisfaction across single-person household groups

The results of the analysis of the differences in dietary competency and satisfaction across the three different groups of single-person households by food purchase frequency are presented in Table 6. The analysis revealed significant differences in healthy and safe eating competencies across the three groups. The levels of healthy eating competency ($M_{N(\text{nutrition-conscious group})} = 3.68 \pm 0.04$, $M_{P(\text{passive-food consumer group})} = 3.40 \pm 0.03$, $M_{C(\text{convenience-seeking group})} = 3.52 \pm 0.04$, $P < 0.001$) and safe eating competen-

Table 5. Socio-demographic characteristics across single-person household groups

Characteristics	Nutrition-conscious group (n = 223)	Passive food consumer group (n = 296)	Convenience-seeking group (n = 447)	*P*-value[1)]
Gender				< 0.001
Men	26 (23.3)	42 (26.4)	135 (52.1)	
Women	197 (76.7)	254 (73.6)	312 (47.9)	
Age group (year)				< 0.001
20–39	14 (14.2)	26 (18.0)	149 (55.8)	
30–59	75 (24.3)	72 (22.4)	176 (25.2)	
≥ 60	134 (61.5)	198 (60.0)	122 (19.0)	
Average monthly income (10,000 KRW)				< 0.001
< 300	177 (78.8)	242 (74.1)	266 (48.1)	
≥ 300	46 (21.2)	54 (25.8)	181 (51.9)	
Average monthly food expenses (10,000 KRW)				< 0.001
< 40	116 (56.4)	163 (52.8)	115 (29.4)	
≥ 40	107 (43.6)	133 (47.2)	332 (70.6)	
Education				< 0.001
Middle school or below	66 (32.6)	124 (33.6)	37 (4.8)	
High school	118 (45.9)	125 (40.3)	167 (26.6)	
College or higher	39 (21.4)	47 (26.1)	243 (68.6)	
Residence				0.030
Urban	145 (57.8)	211 (69.6)	273 (58.6)	
Rural	78 (42.2)	85 (30.4)	174 (41.4)	

n (%).
All weighted models accounted for the complex sampling design of the Consumer Behavior Survey for Food 2023.
[1)]The *P*-values were estimated using χ^2-test.

Table 6. Dietary competency and satisfaction across single-person household groups

Group	Nutrition-conscious group (n = 223)	Passive food consumer group (n = 296)	Convenience-seeking group (n = 447)	*P*-value[1)]
Healthy eating competency[2)]	3.68 ± 0.04[b]	3.40 ± 0.03[a]	3.52 ± 0.04[ab]	< 0.001
Safe eating competency[3)]	3.87 ± 0.04[c]	3.57 ± 0.04[a]	3.77 ± 0.03[b]	< 0.001
Dietary satisfaction[4)]	3.36 ± 0.04[c]	3.23 ± 0.03[a]	3.25 ± 0.04[b]	0.042

Mean ± SE.
All weighted models accounted for the complex sampling design of the Consumer Behavior Survey for Food 2023.
[1)]The *P*-values were estimated using ANOVA with age group as a covariate.
[2)]Calculated as the average score of ten items, including balanced nutrient intake and portion size control, measured on a five-point Likert scale (1 = strongly disagree, 3 = neutral, 5 = strongly agree).
[3)]Calculated as the average score of ten items, including safe food storage methods and checking for food safety incidents, measured on a five-point Likert scale (1 = strongly disagree, 3 = neutral, 5 = strongly agree).
[4)]Respondents rated their level of satisfaction with their dietary behaviors on a 5-point Likert scale (1 = very dissatisfied, 3 = neutral, 5 = very satisfied).
[a, b, c]a < b < c: Scheffe.

cy (M_N = 3.87 ± 0.04, M_P = 3.57 ± 0.04, M_C = 3.77 ± 0.03, P < 0.001) were lowest in the "passive food consumer" group and those were highest in the "nutrition-conscious" group. Also, significant differences were found in dietary satisfaction (M_N = 3.36 ± 0.04, M_P = 3.23 ± 0.03, M_C = 3.25 ± 0.04, P = 0.04), which was low in the "passive food consumer" group and the high in the "nutrition-conscious" group.

DISCUSSION

Understanding the challenges faced by single-person

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households is critical for developing policies that address unique imbalances in dietary practices and promote healthy eating habits. In the context of single-person households, it can be assumed that the primary purpose of food purchase is personal consumption; thus, the food purchased or acquired by the household is ultimately consumed by the individual. Therefore, this study considers the food purchase patterns of single-person households as a blueprint for their food consumption patterns with the aim of deriving insights into their dietary behaviors.

Previous research has indicated that single-person households tend to consume fewer fruits [7, 11] and vegetables [7, 11] and less fish [11], whole grains [33], and milk [7] than multiple-person households. Additionally, they prefer eating out, eating alone, and eating takeout and convenient foods [7, 14, 33] compared to multiple-person households. Preparing meals for eating alone is often perceived as cumbersome, which possibly results in single-person households' propensity for simpler meal options [17]. Moreover, the lack of family members makes single-person households less informed about nutritional and dietary information [15]. Sometimes, the need to purchase fresh food in small quantities or the high cost of individually packaged fresh products present barriers for single-person households in acquiring fresh food [11, 12]. Unbalanced dietary practices in single-person households may also lead to unbalanced nutrition.

Furthermore, this study found significant differences in the purchase frequencies of fish, vegetables, fruit, and convenient foods among the groups. Specifically, women procured fish, vegetables, and fruits more frequently than men, whereas men purchased all types of convenient foods more frequently than women. This finding suggests that men exhibit a higher propensity for convenient dietary habits than women do. Furthermore, fresh-cut products such as salads and washed fruits were more frequently purchased by men than by women, which is an interesting observation considering that women generally consume more fresh fruits and vegetables than their men counterparts. Lee & Shin's [34] interpretation that women-headed households dine out less frequently than men-headed households because of their lower income raises important questions regarding this finding. Specifically, it may also be possible that economic constraints faced by women-headed single person households may limit the affordability of convenient foods. Additionally, this study identified significant differences in food purchase frequency across age groups.

Taken together, these findings suggest that even single-person households, particularly younger men, exhibited a lower purchase frequency of fish and vegetables, demonstrating a pronounced inclination toward purchasing convenient foods more often than other age groups. While there is strong awareness regarding the importance of fruit and vegetable intake, it has been reported that very few countries achieve adequate intake levels of fruits and vegetables for a healthy diet [35]. Previous studies have linked insufficient fruit and vegetable intake to an increased risk of cardiovascular diseases, type 2 diabetes, and various mental health conditions [35]. Thus, it is essential to develop strategies to promote the consumption of vegetables and fruit among single-person households headed by younger men. In addition, fish contain high-quality protein, as well as other essential nutrients of metabolic and hormonal importance and is usually recommended as part of a healthy balanced diet in most dietary guidelines. However, only 18.9% of the global population meets the recommended intake of at least 250 mg per day [36]. According to this study, young men in single-person households are less likely to eat a sufficient amount of fish, indicating the need for initiatives to promote the consumption of fish for these demographics. The risks associated with reliance on convenient foods should be noted. Choi *et al.* [10] reported a positive correlation between the consumption of instant foods and salty eating habits. Thus, a strong preference for convenient food among younger men in single-person households indicates a potential risk of elevated sodium intake, warranting the need to improve their dietary habits.

This study revealed that while single-person households headed by young men utilized fewer fresh vegetables and fish and relied substantially more on convenient foods than other groups, they responded to healthy eating competency items, such as consumption of the five basic food groups for nutritional balance, knowledge of healthy food choices, and consumption

of ample vegetables, fruits, and whole grains, as high as other gender or age groups. This observation may indicate that these individuals undervalue the importance of balanced nutrient intake and healthy dietary habits or subjectively overestimate the nutritional quality of their dietary practices. These speculations raise the need for a comprehensive examination of the perceptions and behaviors related to dietary habits among young men in single-person households. Structured and targeted nutrition education interventions that can provide meaningful support in promoting healthier eating patterns within this demographic are needed.

In addition, this study found no differences in food consumption regarding beef, pork, and chicken according to the gender and age group of single-person households. Kang & Jung [7] indicated that single-person households are more likely to consume pork, whereas multiple-person households consume diverse types of meat. Given the differences in the nutrient composition of beef, pork, and poultry, diversifying the meat consumption patterns of single-person households is helpful in promoting a healthy diet.

Based on variations in food purchase frequency among single-person households, this study identified three distinct single-person household groups based on their food purchase patterns. The three groups are as follows: the "nutrition-conscious" group, characterized by a high frequency of fresh food purchase; the second group identified is the "passive food consumer" group, which demonstrated low frequency for both fresh food purchase and convenient food purchase; and the "convenience-seeking" group demonstrated a strong preference for convenient foods and exhibited the lowest consumption of beef, chicken, fish, and eggs compared to other groups. Significant differences in socio-demographics were found across these three groups in terms of gender, age, educational attainment, region, income level, and food expense level. This finding highlights the diversity within single-person households and underscores the need for further research to explore this diversity in the context of promoting healthy dietary behaviors.

The "nutrition-conscious" and "passive food consumer" groups were very similar in terms of socio-demographics, except for region. They are notably characterized by a higher proportion of women aged 60 years and older with low education levels and lower household income and food expenditure. Those in the "passive food consumer" group are more likely to reside in urban areas compared to those in the "nutrition-conscious" group. However, significant differences were observed between the two groups in dietary competency and satisfaction. While the "nutrition-conscious" group showed the highest level of dietary competency and satisfaction, the "passive food consumer" group showed the lowest level of dietary competency and satisfaction. These findings support the positive relationship between healthy dietary behaviors and competency in single-person households. Thus, educational initiatives aimed at increasing the dietary competency of the "passive food consumer" group would provide opportunities to improve their dietary behaviors and satisfaction.

The "convenience-seeking" group primarily consisted of men, with a significant proportion aged 39 years and younger. In addition, this group demonstrated higher levels of educational attainment as well as higher average household income and average monthly food expenditure. Single-person households headed by younger individuals often lack knowledge related to grocery shopping, meal preparation, and food storage, leading to an increased reliance on dining out, delivery services, and convenient foods [7]. This study also indicated a pronounced inclination toward convenience-oriented dietary habits, particularly among men aged 39 years and younger with higher educational and income levels. At the same time, this group reported lower levels of dietary competency and satisfaction compared to the "nutrition-conscious" group. Although they engaged in a convenient dietary lifestyle, the low levels of dietary satisfaction observed suggest that there is an opportunity to enhance their knowledge and skills related to healthy and safe eating to facilitate a healthier diet through education.

Limitations

This study examined the food consumption behaviors of single-person households by measuring the frequency of fresh and convenient food purchases. This study is limited because it did not employ direct food intake data. It is generally assumed in this study that the food acquired in a single-person household is ultimately

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consumed by that household itself. However, dietary recommendations based solely on the frequency of food purchases have limited efficacy. Second, this study did not consider eating out or takeout as options for various dietary behaviors, which limits a holistic understanding of the comprehensive picture of single-person households' food consumption patterns. Finally, the study was unable to directly address whether the differences in the consumption of convenient or fresh food were influenced by individual preferences or determined by constrained economic resources.

Conclusion

Educational initiatives aimed at enhancing knowledge about nutrient intake and healthy dietary behaviors are suggested as essential steps towards improving overall dietary health within single-person households. This study highlighted the diverse food consumption behaviors and nutrient intake among single-person households in South Korea. Single-person households showed distinct food purchase frequencies of fresh and convenient food based on their characteristics, including gender and age group. Based on these findings, there is a need for tailored nutritional policies and interventions to address the unique needs of different single-person households. This study underscored the necessity for the tailored interventions to promote healthier dietary behaviors and dietary competency especially for the "convenience-seeking" and "passive food consumer" group.

CONFLICT OF INTEREST

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

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None.

DATA AVAILABILITY

Data supporting the findings of this study are available upon request from the Consumer Behavior Survey for Food 2023 at https://www.krei.re.kr/foodSurvey/index.do.

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Appendix 1. Measurement of dietary competency

Healthy eating competency
1. Breakfast helps you stay healthy and avoid overeating.
2. I tend to eat breakfast and eat regularly.
3. Eating with family members is an important part of diet.
4. I eat with my family (some or all of my family) at least once a day.
(For single-person households, respond about meals with immediate family members who do not live with you)
5. You must control your portion sizes because you need to maintain a healthy weight to be healthy.
6. I eat the amount of food I need without overeating.
7. I try to eat the five basic food groups at every meal for nutritional balance.
*Basic food groups: grains, vegetables, fruits, meat/fish/eggs, and milk and dairy products
8. I eat a variety of foods for adequate nutrition.
9. I know healthy food choices, such as vegetables, fruits, and whole grains.
10. I usually eat a lot of vegetables, fruits, and whole grains.
Safe eating competency
1. When purchasing food, it is necessary to check the expiration date on the packaging.
2. I throw away frozen food after the expiration date.
3. It is important to know how to safely store each type of agricultural food product.
4. I check the packaging and expiration dates when buying food.
5. Sanitizing cookware is important when preparing food.
6. I clean my utensils before cooking food and sanitize them often.
7. It is important to have the information to avoid risk in the event of a food safety incident, such as bird flu.
8. I identify hazardous information and act accordingly in the event of a food safety incident.
9. It is necessary to avoid eating food that appears to be spoiled to prevent foodborne illness.
10. I do not eat food that is suspected to be spoiled or otherwise potentially harmful even if I am reluctant to do so.

Source: The Consumer Behavior Survey for Food 2023.

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Research Article

Effects of a multi-component program based on partially hydrolyzed guar gum (Sunfiber®) on glycemic control in South Korea: a single-arm, pre-post comparison pilot clinical trial

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Objectives: The aim of this study was to assess the impact of a multi-component program, including partially hydrolyzed guar gum (PHGG, Sunfiber®) supplementation, on glycemic control, gut health, and nutritional status to support diabetes prevention and management among Korean adults.

Methods: A single-arm trial was conducted with 29 adults (aged 20-55 years) with fasting plasma glucose (FPG) ≥ 100 mg/dL. Over a six-week period, participants engaged in a multi-component program that incorporated the supplementation of PHGG (Sunfiber®, 12.5 g/day), weekly nutritional coaching, and the use of continuous glucose monitoring devices. The program's effectiveness was evaluated by measuring FPG and glycated hemoglobin (HbA1c) levels through blood tests conducted before and after the intervention. Improvements in gut health were gauged using the Korean Gut Quotient Measurement Scales, while enhancements in nutritional status were assessed using the Nutrition Quotient (NQ) and surveys that evaluated improvements in gut health and nutritional status.

Results: Participants' average age was 43.89 years, with approximately 80% being male. Most participants (about 75%) were classified as overweight or obese. After six-weeks, 17 participants who adhered closely to the program (meeting certification criteria) exhibited significant reductions in key blood glucose markers. FPG levels decreased from 113.06 ± 23.16 mg/dL to 106.24 ± 16.33 mg/dL ($P < 0.05$), and HbA1c levels decreased from 6.08% ± 0.81% to 5.87% ± 0.53% ($P < 0.05$). The NQ evaluation revealed significant increases in comprehensive nutrition scores, and in the balance and practice domain scores for all participants ($P < 0.05$). Furthermore, in the gut health survey, approximately 82.1% of all participants reported experiencing positive changes.

Conclusion: Among adults with elevated FPG levels, a multi-component intervention program that included PHGG (Sunfiber®) supplementation, structured dietary management, and the use of health-monitoring devices showed significant benefits in improving glycemic control, overall nutritional status, and gut health.

Trial Registration: Clinical Research Information Service Identifier: KCT0010049.

Keywords: multi-component program; partially hydrolyzed guar gum; glycemic control; nutritional status; diabetes mellitus, type 2

INTRODUCTION

Diabetes mellitus, recognized by the World Health Organization (WHO) as one of the four major non-communicable diseases, has seen a steady rise in both incidence and patient numbers in recent decades [1]. As of 2017, diabetes was responsible for approximately 4 million deaths, and by 2020, it was estimated that 460 million people worldwide were affected. This figure is projected to increase to 629 million by 2045 [2].

As per the *Diabetes Fact Sheet in Korea 2024*, published recently by the Korean Diabetes Association, as of 2022, one in seven adults (14.8%) aged 30 and above had diabetes mellitus. The prevalence increased to three in ten (28.0%) among those aged 65 and above [2]. This is nearly double the 3.2 million diabetes mellitus patients reported in 2010. Moreover, the prevalence of prediabetes suggests that four in ten adults (41.1%) aged 30 and above, and nearly half (47.7%) of the elderly population aged 65 and above, were in a prediabetic state. These statistics emphasize a higher prevalence of prediabetes among the elderly and highlight the growing importance of diabetes prevention and management in an aging society [2-4].

Dietary fiber intake plays a vital role in managing diabetes due to its effects on gut health and glycemic control [5, 6]. Research has shown that dietary fiber positively impacts metabolic health through several mechanisms, including promoting beneficial gut bacteria, improving bowel movements, suppressing postprandial blood glucose elevation, and enhancing blood cholesterol profiles [7, 8]. Specifically, in cases of type 2 diabetes, where poor dietary habits are a primary cause, dietary interventions, such as dietary fiber supplementation, are considered more effective core management strategies than exercise interventions [9].

Gut health is essential for blood glucose regulation and diabetes management. An imbalance in the gut microbiota can trigger inflammatory responses, which are significant factors in increasing insulin resistance and reducing glycemic control [10]. Dietary fiber intake is known to encourage the growth of beneficial gut bacteria, thereby enhancing the intestinal environment and contributing to the suppression of blood glucose and improved insulin sensitivity [5, 11]. This approach, centered on gut health, is believed to have positive effects on glycemic control and overall metabolic health.

Comprehensive lifestyle modifications are essential for fundamental diabetes prevention and management. These modifications include changes in dietary habits, physical activity, weight management, and stress control [12-14]. Regarding physical activity, a minimum of 150 minutes of moderate-intensity exercise per week is recommended. Research suggests that programs aiming for a 5% weight reduction over six months, combined with dietary control, are effective [13]. Modifications in dietary habits require caloric restriction, appropriate nutrient distribution, and ongoing nutritional management, supported by follow-up monitoring and telephone consultations [14]. Moreover, combining dietary intervention and exercise is a critical approach for preventing type 2 diabetes and reducing complications [15, 16].

Recent research has underscored the necessity and effectiveness of multi-component programs for diabetes prevention and management. These programs incorporate diet, exercise, physical activity, blood glucose monitoring, medication, medical examinations, and smoking cessation [17-19]. Studies have also demonstrated the effectiveness of IT-based monitoring, which combines medical and information technology convergence services with direct counseling and education to improve lifestyle habits [20]. These multi-component programs suggest that diabetes management can be enhanced through multifaceted approaches, including nutritional coaching and IT-based monitoring, beyond mere lifestyle modifications [21].

Therefore, this study aims to assess whether a multi-component program that combines dietary fiber supplementation, weekly nutritional coaching, and continuous glucose monitoring (CGM) can improve glycemic control, gut health, and nutritional status. The study focuses on adults aged 20 and above with fasting plasma glucose (FPG) levels of 100 mg/dL or higher who want to improve their blood glucose control.

METHODS

Ethics statement

All participants provided written informed consent for the study. The study procedures and protocols were approved by the Institutional Review Board (IRB) of the Public Bioethics Committee, recognized by the Minister of Health and Welfare (IRB No.: P01-202406-01-007), and the Clinical Research Information Service (approval number: KCT0010049).

1. Study design

This study was a single-arm, pre-post comparison pilot clinical trial, reported in accordance with the CONSORT (Consolidated Standards of Reporting Trials) 2010 extension guidelines for pilot and feasibility trials.

2. Study participants and recruitment

The study was conducted among employees of a single domestic corporation, targeting adults aged 20 to 55 who were interested in improving glycemic control. Participant recruitment was done through internal postings and emails, which provided information about the study's objectives, selection criteria, and schedule, followed by voluntary application submissions. The recruitment period was from June 3 to June 14, 2024. Of the 39 individuals recruited, eight were excluded due to FPG levels below 100 mg/dL, and two withdrew consent. One of the 29 participants who entered the program dropped out, resulting in a final analysis sample of 28 participants (Fig. 1).

The inclusion criteria were as follows: (1) adults aged 20–55 years; (2) individuals with FPG levels ≥ 100 mg/dL, which corresponds to impaired fasting glucose (IFG), an indicator of the borderline status between normal glycemic levels and diabetes mellitus [22]; and (3) individuals who provided written informed consent for study participation.

The FPG criterion of ≥ 100 mg/dL was based on the definition of IFG presented in the *2023 Clinical Practice Guidelines for Diabetes Mellitus* [22]. Using this criterion, the study aimed to evaluate the effectiveness of dietary fiber supplementation in early-risk groups classified as prediabetic.

Prospective participants submitted written consent forms to the researchers, who reviewed their health examination results from medical institutions within the past 12 months to verify compliance with the FPG criteria. Individuals with hypersensitivity to partially hydrolyzed guar gum (PHGG), a component of the dietary fiber supplement, or those with severe food allergy reactions, were excluded.

3. Intervention methods

The intervention program lasted six weeks and included dietary fiber supplementation, weekly nutritional coaching, and CGM. For dietary fiber supplementation, participants consumed PHGG, a type of soluble dietary fiber. Participants consumed 12.5 g of PHGG supplementation (Selex Sunfiber Guar gum Prebiotics [Sunfiber®], Maeil Health Nutrition Co., Ltd.) daily before meals. Compliance was monitored through a mobile application, where participants uploaded photos of their supplement intake and meal records at least twice daily. Researchers reviewed these records and provided personalized dietary feedback via a messaging platform.

Participants used the FreeStyle Libre (Abbott Diabetes Care Limited) CGM system to monitor real-time

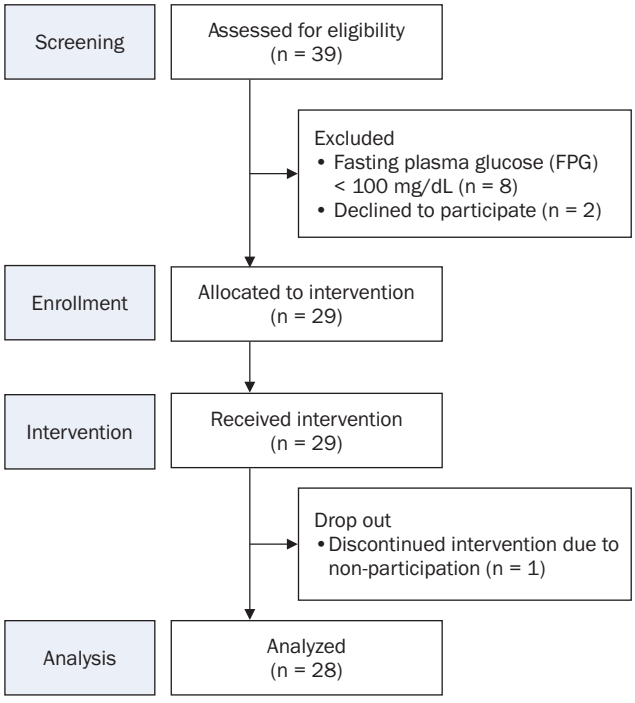

Fig. 1. Participant flowchart for the single-arm trial.

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glucose fluctuations. Weekly nutritional coaching sessions offered individualized dietary guidance based on participants' glycemic trends and meal records. This multi-component approach aimed to enhance self-awareness, optimize glycemic control, and foster sustainable dietary habits.

During the intervention period, study participants consumed a PHGG supplement (12.5 g once daily before meals). The supplement consisted entirely of PHGG (Sunfiber®), a standardized functional ingredient approved by the Food and Drug Administration for its potential benefits, including promotion of beneficial intestinal bacteria growth, improvement of bowel movements, suppression of postprandial blood glucose elevation, and improvement of blood cholesterol levels [23]. To enhance adherence and compliance, participants were required to upload daily photographs of their supplement consumption and dietary intake records (at least twice daily) via a mobile application (Selex, Maeil Health Nutrition Co., Ltd.) (Fig. 2). Researchers regularly reviewed these records and provided individualized feedback through the KakaoTalk open chat channels (Kakao Corp.), including weekly dietary consultations and personalized nutritional coaching to help participants maintain their planned intake goals. The nutritional coaching involved an evaluation of participants' dietary records, focusing on nutrient intake, caloric content, and dietary balance. This assessment facilitated the identification of nutritional deficiencies or excesses and the development of specific dietary modification strategies. Furthermore, personalized advice and motivation were provided to ensure consistent intake patterns throughout the study period, supporting improved nutritional status and the formation of healthy lifestyle habits.

Participants were equipped with CGM devices (FreeStyle Libre) to track real-time fasting and postprandial glucose variations. This self-monitoring system increased awareness of glycemic control and promoted autonomous management. Researchers used this data to indirectly evaluate the effectiveness of the intervention on glycemic control.

4. Outcome measures

The study assessed blood parameters (FPG, glycated hemoglobin [HbA1c]), nutritional indices through questionnaires, gastrointestinal health, and program satisfaction, with evaluations conducted pre- and post-intervention. Initially, baseline characteristics, including sex, age, height, weight, and medication status, were collected through preliminary questionnaires. Blood parameters were measured at designated medical facil-

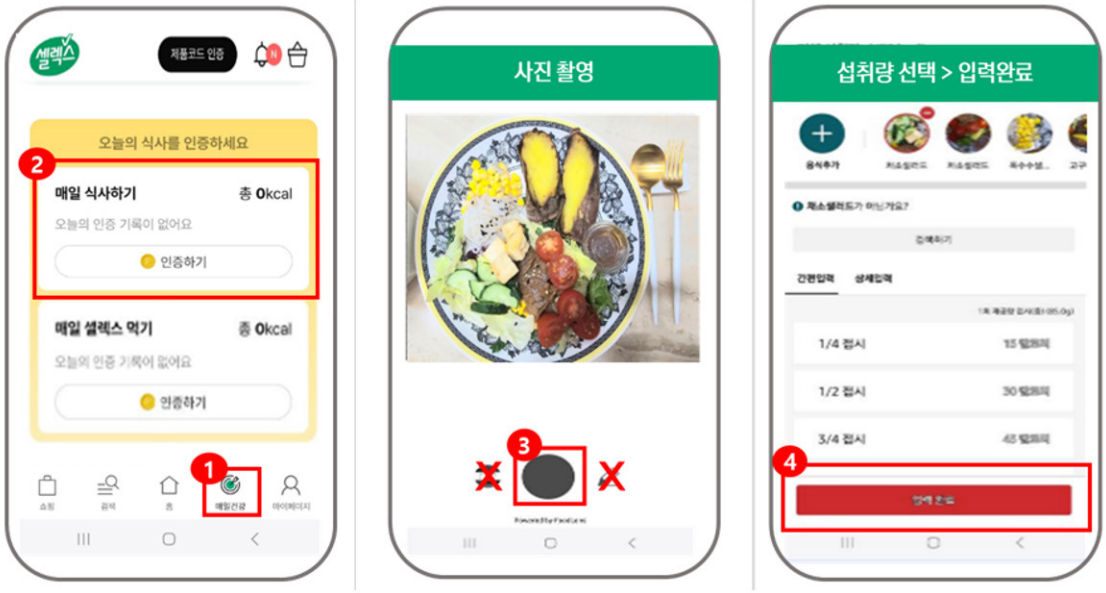

Fig. 2. Method for partially hydrolyzed guar gum (PHGG, Sunfiber®) supplementation and meal recording using the selex app.

ities. Participants underwent standardized testing after 8–10 hours of fasting to measure FPG and HbA1c levels.

Nutritional status was assessed using the Korean Nutrition Society's nutrition quotient (NQ) questionnaire [24]. This questionnaire comprises 20 items that evaluate dietary habits and nutritional status comprehensively. Results were analyzed across three primary domains: balance, moderation, and practice, to determine the program's impact in each area.

Gastrointestinal health was evaluated using the Korean Gut Quotient Measurement Scale, which consists of five items measuring defecation frequency, timing, volume, and stool characteristics [25]. A post-intervention question was added to assess subjective changes in gastrointestinal health. The Cronbach's alpha values for the NQ and Gut Quotient questionnaires were 0.680 and 0.437, respectively.

Finally, a satisfaction assessment was conducted post-intervention to evaluate participants' subjective perceptions of the program's effectiveness and components. The five-item questionnaire analyzed glycemic control, gastrointestinal health improvements, and the utility of nutritional coaching and CGM.

5. Statistical analysis

Program effectiveness was evaluated through pre- and post-intervention measurements of FPG, HbA1c, nutritional indices, and gastrointestinal health questionnaires. Statistical analyses were performed using SPSS® statistical software (version 22; IBM Co.). Categorical variables were presented as frequencies and percentages, while continuous variables were expressed as means and standard deviations. Participants were stratified into "high compliance" (≥ 70% dietary record participation and ≥ 80% supplement consumption verification) and "low compliance" groups, with additional analyses stratified by age (above/below 40 years) and sex.

Pre- and post-intervention differences for continuous variables were analyzed using paired t-tests or Wilcoxon's signed-rank tests following normality testing. Effect sizes were calculated using Cohen's d for paired t-tests and R-values for Wilcoxon's signed-rank tests. Changes in categorical variables were analyzed using McNemar's test following normality testing. All statistical tests were two-tailed, with significance set at $P < 0.05$. Statistically significant results were considered clinically meaningful.

RESULTS

1. Subject characteristics

The study included 28 participants with a mean age of 43.89 ± 6.80 years and a mean body mass index (BMI) of 26.64 ± 4.59 (data not shown in tables). The sample comprised 23 males (82.1%) and five females (17.9%), with the following age distribution: 20–29 (n = 1, 3.6%), 30–39 (n = 5, 17.9%), 40–49 (n = 16, 57.1%), and 50–55 years (n = 6, 21.4%), indicating a predominance of participants aged 40 and above (Table 1).

BMI was calculated using participants' height and

Table 1. Baseline characteristics of study participants

Variable	Subject (n = 28)
Sex	
Male	23 (82.1)
Female	5 (17.9)
Age group (year)	
20–29	1 (3.6)
30–39	5 (17.9)
40–49	16 (57.1)
50–55	6 (21.4)
Body mass index	
Underweight	0 (0.0)
Normal weight	7 (25.0)
Overweight	4 (14.3)
Obese	17 (60.7)
Diabetes status	
Diabetes present	6 (21.4)
Diabetes absent	22 (78.6)
Intake of health functional food for blood glucose control	
Yes	4 (14.3)
No	24 (85.7)
Medication type (multiple responses allowed)	
Antihypertensive agents	8 (28.6)
Lipid-lowering agents	7 (25.0)
Antidiabetic agents	2 (7.1)
Cholesterol-lowering agents	1 (3.6)
Alopecia treatment agents	1 (3.6)
Thyroid disorder medications	1 (3.6)
Benign prostatic hyperplasia medications	1 (3.6)

n (%).

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weight and classified according to the obesity criteria from the WHO for the Asia-Pacific region and the Korean Society for the Study of Obesity. The distribution showed 7 participants (25.0%) with normal weight (BMI 18.5–22.9 kg/m^2), 4 (14.3%) overweight (BMI 23.0–24.9 kg/m^2), and 17 (60.7%) obese (BMI ≥ 25.0 kg/m^2). Overall, 75.0% of participants were classified as overweight or obese (BMI ≥ 23.0 kg/m^2). Regarding diabetes status, six participants (21.4%) had diabetes mellitus, while 22 (78.6%) did not. Four participants (14.3%) reported using health functional foods for blood glucose control, whereas 24 (85.7%) reported no supplement use.

Medication use, assessed through multiple-response items, was reported by 13 participants (46.4%). These included antihypertensive agents (n = 8), lipid-lowering agents (n = 7), antidiabetic agents (n = 2), and singular cases of cholesterol-lowering agents, alopecia treatment agents, thyroid disorder medications, and benign prostatic hyperplasia medications.

2. Blood parameters (FPG and HbA1c)

Pre- and post-intervention blood test results for FPG and HbA1c are presented in Fig. 3. and Fig. 4. Overall, FPG levels decreased from 106.68 ± 21.56 mg/dL to 101.54 ± 16.79 mg/dL, though this change was not statistically significant. Compliance-based analysis showed that the high compliance group (n = 17) exhibited a significant reduction in FPG from 113.06 ± 23.16 mg/dL to 106.24 ± 16.33 mg/dL (t = 2.162, Cohen's d = –1.54, *P* = 0.039). The low compliance group (n = 11) showed a

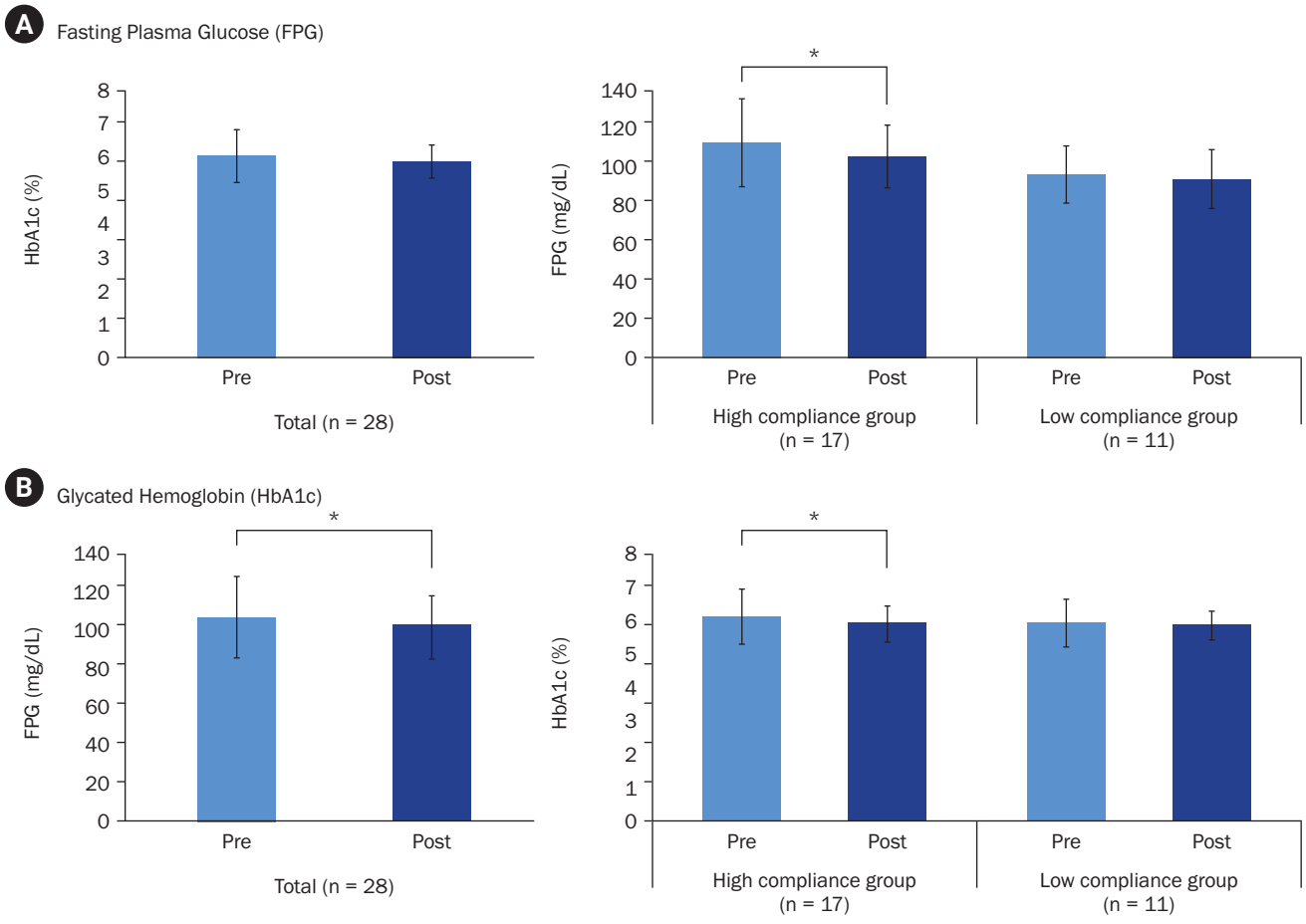

Fig. 3. Changes in (A) fasting plasma glucose and (B) glycated hemoglobin levels in among all participants and by compliance status. Mean ± SD.
*Indicates a significant difference at *P* < 0.05. *P*-values were determined using a paired t-test or Wilcoxon's signed-rank test, depending on normality.

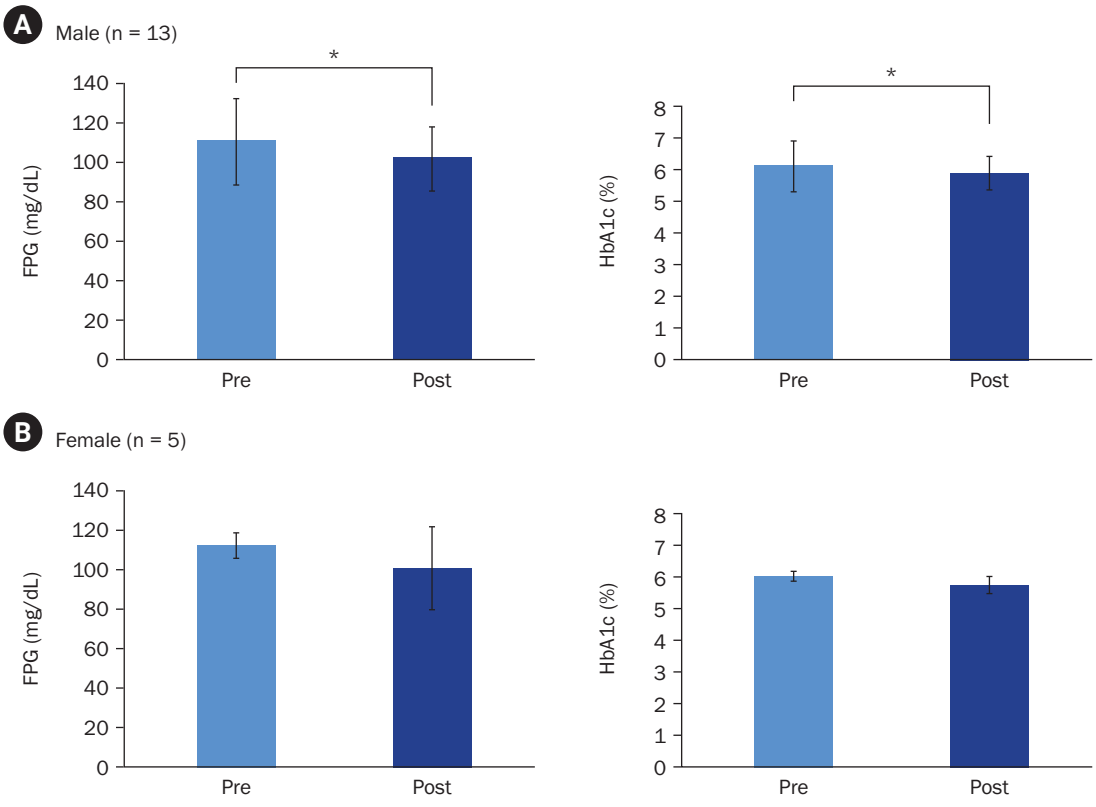

Fig. 4. Changes in fasting plasma glucose (FPG) and glycated hemoglobin (HbA1c) levels in (A) male and (B) female participants. Mean ± SD.
*Indicates a significant difference at $P < 0.05$. *P*-values were determined using a paired t-test or Wilcoxon's signed-rank test, depending on normality.

non-significant decrease from 96.82 ± 14.86 mg/dL to 94.27 ± 15.45 mg/dL (Fig. 3A).

HbA1c levels significantly improved in the total sample, decreasing from 6.01% ± 0.77% to 5.86% ± 0.49% (t = 2.114, Cohen's d = –0.31, $P = 0.044$). The high compliance group showed a significant reduction from 6.08% ± 0.81% to 5.87% ± 0.53% (t = 2.483, Cohen's d = –0.26, $P = 0.012$), while the low compliance group showed a non-significant decrease from 5.90% ± 0.72% to 5.84% ± 0.45% (Fig. 3B).

Additional stratified analyses were conducted, focusing on male participants (82%) and participants aged ≥ 40 years (78%) due to their high representation in the sample. Male participants, regardless of compliance level, demonstrated significant reductions in both FPG (110.35 ± 22.00 mg/dL to 101.74 ± 16.26 mg/dL; t = 2.597, Cohen's d = –1.97, $P = 0.014$) and HbA1c (6.11% ± 0.81% to 5.90% ± 0.52%; t = 2.496, Cohen's d = –0.41, $P = 0.015$) (Fig. 4A). Female participants showed no significant changes. Similarly, participants aged ≥ 40 years demonstrated significant reductions in FPG (110.68 ± 22.23 mg/dL to 104.27 ± 17.56 mg/dL; z = –1.979, r = –0.42, $P = 0.048$) and HbA1c (6.11% ± 0.84% to 5.90% ± 0.54%; z = –2.191, r = –0.47, $P = 0.028$), whereas those < 40 years showed no significant changes.

3. Nutrition quotient assessment

The overall NQ and subdomain scores (balance, moderation, and practice) are presented in Fig. 5. The total NQ score significantly improved from 47.80 ± 10.24 to 51.27 ± 10.65 (t = –2.585, Cohen's d = –1.11, $P = 0.004$). Subdomain analysis revealed significant improvements in balance (27.33 ± 12.02 to 31.24 ± 13.32; t = –3.505, Cohen's d = –1.08, $P = 0.002$) and practice (55.73 ± 13.89 to 60.78 ± 15.39; t = –2.585, Cohen's d = –1.39, $P = 0.015$), while moderation showed a non-significant increase

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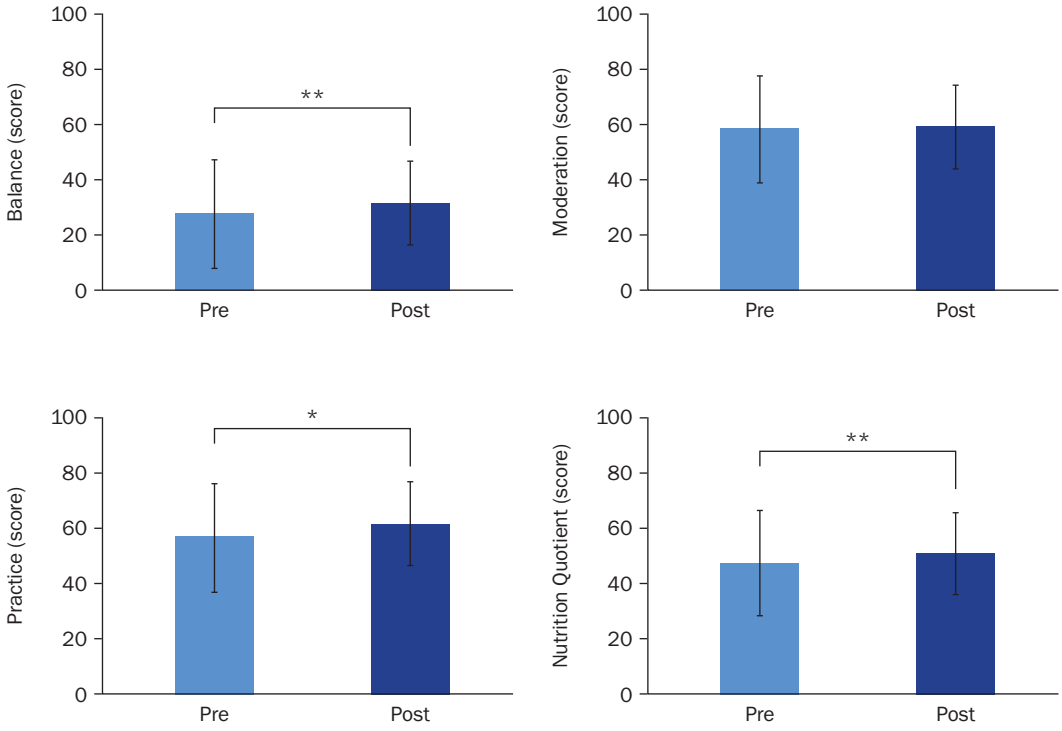

Fig. 5. Changes in nutrition scores based on nutrition quotient (NQ) assessment: balance, moderation, practice, and nutrition quotient (n = 28). Mean ± SD.
*Indicates a significant difference at $P < 0.05$ and **indicates a significant difference at $P < 0.01$. *P*-values were determined using a paired t-test or Wilcoxon's signed-rank test, depending on normality.

from 57.70 ± 13.09 to 58.61 ± 13.13.

4. Gastrointestinal health assessment

Pre- and post-intervention gastrointestinal health indicators are presented in Table 2. The number of participants reporting "no symptoms" increased from nine to 12, while those reporting "mild symptoms" increased from 11 to 14. Participants reporting "severe symptoms" decreased from eight to two, indicating overall improvement. Stool consistency assessments showed stable numbers for "very hard" and "hard, pellet-like" responses (n = 1 both pre- and post-intervention), while those reporting "smooth, sausage-like" increased from nine to 11, suggesting normalization of stool consistency. Analysis of defecation frequency showed a slight decrease in the number of participants with daily bowel movements, from 17 before the program to 14 after. In contrast, the number of participants with a bowel movement frequency of five to six times per week increased from five to nine. Defecation duration remained relatively stable for those completing within 5 minutes, with a reduction in those requiring 10–15 minutes or longer. Stool volume increased, with more participants reporting "1–2 cups" (16 to 21) and fewer reporting "less than 1 cup" (4 to 1). However, these changes were not statistically significant.

Post-intervention satisfaction survey results (Table 3) indicated that 82.1% of participants (n = 23) reported positive changes in gastrointestinal health, with three reporting "greatly improved," six "improved," and 14 "slightly improved." Three participants reported "no change," two reported "slightly worse," and none reported "worse" or "much worse."

5. Satisfaction survey

Table 4 presents the program satisfaction survey results. Of the participants, 13 reported being "very satisfied," 12 "satisfied," and three "neutral." No participants reported

Table 2. Changes in gut health and bowel movement characteristics before and after the program

Category	Pre (n = 28)	Post (n = 28)	x^2	*P*-value
Gut health condition				
No issues	9 (32.1)	12 (42.9)	-	-
Mild issues	11 (39.3)	14 (50.0)		
Severe issues	8 (28.6)	2 (7.1)		
Stool consistency				
Pellet-like, very hard	1 (3.6)	1 (3.6)	-	-
Hard pellets but forms a lump	1 (3.6)	0 (0.0)		
Like a sausage with cracks on the surface	7 (25.0)	4 (14.3)		
Like a smooth and soft sausage	9 (32.1)	11 (39.3)		
Soft, lumpy pieces	7 (25.0)	9 (32.1)		
Mushy, scattered in the toilet bowl	2 (7.1)	3 (10.7)		
Watery	1 (3.6)	0 (0.0)		
Defecation frequency				
Daily	17 (60.7)	14 (50.0)	2.80	0.423
5–6 times/week	5 (17.9)	9 (32.1)		
3–4 times/week	6 (21.4)	5 (17.9)		
1–2 times/week	0 (0.0)	0 (0.0)		
Less than 3 times/month	0 (0.0)	0 (0.0)		
Time spent on defecation				
Immediately	4 (14.3)	3 (10.7)	4.533	0.475
Within 5 minutes	12 (42.9)	13 (46.4)		
5–10 minutes	6 (21.4)	9 (32.1)		
10–15 minutes	3 (10.7)	1 (3.6)		
15–30 minutes	3 (10.7)	2 (7.1)		
More than 30 minutes	0 (0.0)	0 (0.0)		
Stool volume				
Less than 1 cup	4 (14.3)	1 (3.6)	-	-
1–2 cups	16 (57.1)	21 (75.0)		
2–3 cups	7 (25.0)	5 (17.9)		
3–4 cups	0 (0.0)	1 (3.6)		
More than 5 cups	1 (3.6)	0 (0.0)		
Unknown due to watery stool	0 (0.0)	0 (0.0)		

n (%).
P-values were determined using a McNemar's test.

Table 3. Assessment of gut health status changes among participants post-program

Category	Subject (n = 28)
Gut health change	
Significantly worsened	0 (0.0)
Worsened	0 (0.0)
Slightly worsened	2 (7.1)
No change	3 (10.7)
Slightly improved	14 (50.0)
Improved	6 (21.4)
Significantly improved	3 (10.7)

n (%).

Table 4. Participant satisfaction with overall program

Category	Subject (n = 28)
Overall program satisfaction	
Very satisfied	13 (46.4)
Satisfied	12 (42.9)
Neutral	3 (10.7)
Dissatisfied	0 (0.0)
Very dissatisfied	0 (0.0)

n (%).

being "dissatisfied" or "very dissatisfied." The 83.3% positive response rate and absence of negative responses indicate high overall program satisfaction.

Satisfaction with specific program components was evaluated as follows (Table 5). Regarding blood glucose management through PHGG supplementation, four participants responded "strongly agree," 15 "agree," seven "neutral," and two "disagree." For nutritional coaching's impact on blood glucose management, nine responded "strongly agree," 15 "agree," and four "neutral." All participants positively evaluated the utility of CGM for self-management, with 15 responding "strongly agree" and 13 "agree." Regarding PHGG supplementation's contribution to gastrointestinal health improvement, nine responded "strongly agree," 13 "agree," and six "neutral."

DISCUSSION

This pilot study investigated the effects of a six-week multi-component program combining PHGG supplementation, nutritional coaching, and CGM on glycemic control among adults aged 20–55 years with FPG levels ≥ 100 mg/dL. Of the 29 initially enrolled participants who met the selection criteria, 28 completed the study, with one withdrawal. The participant cohort was pre-

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Table 5. Evaluation of participant perceptions on the effectiveness of interventions for blood glucose and gut health management

Questions	Subject (n = 28)
Do you think that consuming 'Selex Sunfiber Guar gum Prebiotics (Sunfiber®)' helped with blood glucose management?	
Strongly agree	4 (14.3)
Agree	15 (53.6)
Neutral	7 (25.0)
Disagree	2 (7.1)
Strongly disagree	0 (0.0)
Do you think that nutritional coaching on dietary intake was helpful for blood glucose management?	
Strongly agree	9 (32.1)
Agree	15 (53.6)
Neutral	4 (14.3)
Disagree	0 (0.0)
Strongly disagree	0 (0.0)
Do you think that the use of continuous glucose monitoring was helpful for blood glucose management?	
Strongly agree	15 (53.6)
Agree	13 (46.4)
Neutral	0 (0.0)
Disagree	0 (0.0)
Strongly disagree	0 (0.0)
Do you think that consuming 'Selex Sunfiber Guar gum Prebiotics (Sunfiber®)' contributed to gut health improvement?	
Strongly agree	9 (32.1)
Agree	13 (46.4)
Neutral	6 (21.4)
Disagree	0 (0.0)
Strongly disagree	0 (0.0)

n (%).

dominantly male (≤ 80%) and had a mean age of 43.89 years, with over 75% aged 40–50. Approximately 60% were classified as overweight or obese based on their BMI.

Post-intervention assessment revealed significant reductions in both FPG and HbA1c among high compliance participants, with significant HbA1c improvements observed across the entire cohort. Despite the relatively brief six-week intervention period, these improvements likely resulted from the synergistic effects of pre-meal PHGG supplementation, twice-daily meal documentation, CGM, and weekly nutritional coaching, which collectively enhanced glycemic control awareness and self-management.

Previous research has demonstrated strong correlations between dietary fiber intake and glycemic control [26-28], with inverse associations between fiber intake and cardiovascular disease and stroke risk factors [29-31]. The Korea Disease Control and Prevention Agency recommends adequate dietary fiber intake, citing its role in moderating nutrient absorption rates and reducing cholesterol levels, thereby supporting glycemic control and cardiovascular disease prevention [32]. However, since the 1970s, the westernization of Korean dietary patterns has led to increased caloric and fat intake while reducing plant-based food consumption, resulting in fiber deficiency and rising chronic disease rates, including diabetes mellitus [33, 34]. Dietary supplements may, therefore, be beneficial when dietary fiber intake is insufficient. Among approximately six dietary fiber sources designated by the Food and Drug Administration, PHGG is registered as a functional ingredient [23]. Vuorinen-Markkola *et al.* [35] reported that patients with diabetes receiving 20 g daily of PHGG for six weeks showed 19.5% and 7.2% reductions in FPG and HbA1c, respectively. Similar benefits were observed in healthy individuals consuming 30 g daily, with a 6.25% reduction in FPG and a 7.3% reduction in blood cholesterol [36].

The integration of CGM with daily dietary recording and weekly personalized nutritional coaching via mobile platforms provided real-time feedback and individualized support, enhancing dietary compliance and self-management capabilities. Healthcare devices enabling real-time data monitoring have positively impacted dietary adherence and physical activity [37]. Mobile-based nutritional coaching has gained prominence post-COVID-19, utilizing digital technologies for remote interaction, video education, virtual consultations, and messaging [16, 38].

Beyond glycemic control, the study evaluated overall nutritional status and gastrointestinal health improvements. PHGG supplementation aids not only glycemic regulation but also promotes intestinal motility, prevents constipation, and supports dietary compliance through enhanced satiety [26]. Survey results demon-

strated significant improvements in overall NQ scores, particularly in the balance and practice domains. Gastrointestinal health showed general improvement across defecation frequency, duration, volume, and consistency.

These findings suggest that effective chronic disease prevention and glycemic control in prediabetic and diabetic individuals require comprehensive management strategies addressing multiple modifiable lifestyle factors rather than singular interventions. Such multi-component approaches demonstrate potential benefits not only for primary health concerns but also for related health outcomes.

Limitations

This study has several limitations. First, the single-group pre-post design may affect internal validity due to potential confounding variables. Second, participant recruitment from a single institution and the relatively small sample size may limit the generalizability of the findings. Nevertheless, despite these limitations, this study provides valuable preliminary evidence suggesting that a multi-component program combining consistent PHGG supplementation, nutritional coaching-based dietary management, and health device utilization (CGM) can benefit not only FPG and HbA1c management but also overall health status, including nutritional status and gastrointestinal health, among prediabetic and diabetic individuals.

Conclusion

Comprehensive and proactive management strategies incorporating PHGG supplementation, dietary management, and health device utilization may be more effective for diabetes prevention and management than single-intervention approaches. The results of this study provide foundational evidence supporting the potential applicability of such multi-component approaches in community-based chronic disease management. Building upon these findings, we recommend conducting larger-scale studies to verify the efficacy of PHGG-based multi-component programs for diabetes prevention and management, with the goal of establishing this approach as a viable strategy for community-based chronic disease prevention.

CONFLICT OF INTEREST

This study was conducted using Selex Sunfiber Guar gum Prebiotics (Sunfiber®) from Maeil Health Nutrition Co., Ltd. However, there are no financial or other issues that might lead to a conflict of interest.

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None.

DATA AVAILABILITY

Research data is available upon request to the corresponding author.

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Research Article

근거 기반 나트륨 저감 건강 식생활 프로그램의 리빙랩 모델 적용

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Application of a living lab model to an evidence-based reduced-sodium healthy eating practice program in Korea: a pre-post study

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Objectives: To apply a healthy dietary program with reduced sodium intake, developed using data from the Korea National Health and Nutrition Examination Survey (KNHANES), focusing on the sodium intake level and eating patterns.

Methods: The program was implemented using a living lab model, an open innovation ecosystem for user-centered problem-solving. Analysis of the KNHANES data revealed that older age groups had a low energy intake but a high sodium intake, particularly among those who frequently dined out. The program was designed to improve sodium-reduction literacy and enhance practical competency. Over four weeks, 40 participants tracked their dietary intake and worked with a clinical nutritionist through a process of diagnosis, experience, improvement, and expansion. A self-administered survey was conducted before and after the program to assess effectiveness.

Results: Participants were four teenagers (10%), 26 in their twenties (65%), and 10 aged ≥ 30 years (25%), with eight males (20%) and 32 females (80%). Post-program analysis showed significant improvements in sodium-related nutrition knowledge ($P < 0.01$), with increased agreement on adopting low-sodium intake practices (e.g., interest in sodium content, choosing lower-sodium foods). Nutrient intake analysis showed a decrease in energy, carbohydrates, lipids, and proteins ($P < 0.001$), with sodium intake decreasing from 3,382.37 mg/d to 2,119.05 mg/d ($P < 0.001$).

Conclusion: The community-based, living lab model for the sodium-reduction program effectively improved participant sodium-reduction literacy and practical competency, suggesting that step-by-step, autonomous learning, can reduce sodium intake and promote healthier eating habits.

Keywords: evidence-based practice; diet, sodium-restricted; living-lab model

INTRODUCTION

만성질환은 우리나라 전체 진료비 지출의 41%를 차지하고 사망원인의 약 80%를 차지할 정도로 국가 재정에 부담을 주며 국민보건에 미치는 영향이 크다[1]. 우리나라는 향후 급격한 인구 고령화로 인해 질병 부담이 더욱 가중될 것으로 예측되고 있어 종합적이고 체계적인 만성질환의 예방관리가 필요하다[1]. 고혈압, 뇌졸중, 관상동맥질환 등 만성질환에는 여러 인자들이 복합적으로 관여하는데, 과도한 나트륨 섭취를 비롯한 다양한 영양관련 요인은 만성질환의 위험을 높일 뿐 아니라 사망률을 증가시키는 주요한 위험요인이다[2-4]. 따라서 신체적, 생리적 변화로 인하여 고혈압 등 만성질환의 위험이 증가하는 중장년층에서는 질병 예방과 삶의 질 향상을 위해 나트륨 섭취 저감 등의 건강 식생활이 공중보건 측면에서 반드시 실행되어야 한다[5].

국민건강영양조사가 시작된 1998년 우리나라 만 19세 이상 성인의 나트륨 섭취량은 4,975.0 mg으로 매우 높은 수준이었지만, 이후 꾸준히 감소하여 2022년에는 세계 주요 국가와 비슷한 수준인 3,178.9 mg까지 낮아졌다[6, 7]. 그럼에도 불구하고, 한국인 영양소 섭취 기준[8]의 나트륨 충분섭취량인 1,500 mg과 만성질환 위험감소를 위한 섭취기준인 2,300 mg에 비하면 아직도 크게 높은 수준이며, 특히 만 30–49세 중년층의 나트륨 섭취량은 3,361.0 mg으로 전체 연령층 중 가장 높다. 더구나 경제협력개발기구(Organization for Economic Cooperation and Development, OECD) 국가 중 가장 빠른 증가 추세를 보이고 있는 1인 가구[9]는 높은 외식률과 배달 음식 등으로 인해 짜게 먹는 식습관이 특징적인 열악한 영양, 식생활 행태를 가지고 있어 국민보건에 부정적인 영향을 미치는 또 다른 요인이 되고 있다[10].

과거에는 만성질환 예방과 관리를 위한 생활 습관 개선이 단순히 개인 수준의 문제로 여겨졌지만 최근 들어 전문가가 관여하는 관리의 중요성이 점차로 부각되고 있으며, 여러 국가들에서 국가 및 지역사회 차원에서 나트륨 저감을 포함하는 건강 식생활 프로그램이 정책적으로 실시되고 있다[11]. 우리나라는 국가 차원에서 질병의 사전 예방과 국민 건강증진을 목적으로 『국민건강증진종합계획』과 『국민영양관리기본계획』 등 중장기 계획을 수립하고 『지역사회 통합 건강증진사업』을 통해 각 지방자치단체 실정에 맞는 구체화된 프로그램을 운영하고 있다. 이 중 영양 분야의 지역사회 건강증진사업인 '건강위험요인 개선을 위한 맞춤 영양관리사업'은 만 19–64세 건강위험군 또는 질환관리군을 대상으로 건강위험요인 개선을 위한 프로그램을 실시하고 있는데, 대부분이 당뇨, 고혈압, 비만 등 건강위험요인별 집단 영양교육의 형태로 이루어지고 있어[12] 대상자의 지속적인 참여와 행동 변화를 이끌어내기에는 한계가 있다는 지적이 있어왔다[13]. 한편, 지역 간 건강 격차 해소, 취약계층의 건강 수준 향상, 예방적 건강관리에 대한 수요 충족을 목표로 하는 '모바일 헬스케어' 사업이 영양관리사업과 연계하여 운영되고는 있으나 낮은 인지율과 참여율 및 높은 중도 탈락률은 사업의 효율성을 낮추는 문제점으로 지적되고 있다[13, 14]. 지역사회 건강증진 프로그램이 실제 참여자의 식생활 변화를 유도하여 질병의 예방과 삶의 질 향상이라는 결과를 지속적으로 이끌어내기 위해서는, 건강위험요인별로 이루어지는 포괄적인 식습관 중재보다는 식생활 진단에 따라 대상자별로 세분화된 목표를 설정하고 생활 속에서 실천할 수 있는 형태로 시행되는 프로그램이 요구된다.

리빙랩(living lab)은 사용자가 수동적으로 참여하는 구조가 아닌 문제 해결에 적극적으로 관여하는 방식이라는 측면에서 기존의 운영 체계들과 차별성이 있는 방법론이다[15]. 리빙랩을 구성하는 다섯 가지 핵심 요소인 다중 방법 접근법(multi-method approach), 사용자 참여(user engagement), 다양한 이해관계자(multiple stakeholders), 실제 환경(real-life settings), 혁신을 위한 환경의 공동 조성(co-creation of an environment for innovation) 등은 수용적이고 수동적인 역할에 국한되었던 사용자로 하여금 주도적으로 개방형 혁신의 역할을 하도록 촉진할 수 있다[15, 16]. 이와 같은 특징으로 인하여, 건강 식생활 프로그램의 지역사회 실행에 리빙랩 형식이 활용될 경우 당사자들의 실제 생활 욕구를 더 잘 반영할 수 있고, 이해관계자들 간 상호작용을 통해 실효성 있는 정책 및 시스템을 구축할 수 있기 때문에 효과성과 지속성을 높이는 강점으로 작용할 수 있을 것으로 기대된다.

본 연구는 근거에 기반하여 나트륨 저감 건강 식생활 실천 프로그램과 운영지침을 개발하고, 리빙랩 모델을 이용하여 대상자에게 적용 후 그 효과를 검증하고자 하였다. 본 연구에서 채택한 리빙랩 방식은 전통적인 실험실 기반의 연구와 달리 사용자 중심의 실제 환경에서 변화를 시험하는 새로운 시도로서 활용되었다.

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METHODS

Ethics statement

The written informed consent was obtained from all participants and or/the guardians for the survey. The survey procedures and protocols were approved by the Institutional Review Board of Pai Chai University (IRB No. 2-1040766-AB-N-01-C-2020-14).

1. 연구설계

본 연구는 사전-사후 연구 및 설문조사 연구로서 자발적 참여자를 대상으로 한 편의표본(convenience sampling)을 사용하였으며, STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) 보고지침(https://www.strobe-statement.org/)을 참고하여 기술하였다.

2. 연구대상 및 기간

다양한 인구통계학적 특성이 있는 일반인을 대상으로 연구 목적 및 방법 등에 대해 설명한 후 연구 참여에 자발적으로 동의한 가구 단위별 대상자를 전국 단위로 모집하였다. 프로그램은 2020년 6월 26일부터 7월 29일까지 총 4주에 걸쳐 운영되었으며, 프로그램에 참여한 48명 중 프로그램의 수행 전과 수행 후 설문에 모두 답한 40명을 최종 분석 대상으로 하였다. 연구대상자는 총 10개 팀으로 나뉘어 임상영양사가 관리하였다. 대상자의 성별, 나이, 가구원수, 직업분류, 소득, 체질량지수(body mass index)는 프로그램 시작 전에 조사하였다. 체질량지수에 의한 비만도 분류는 대한비만학회의 비만 진료지침에 따라 18.5 kg/m^2 미만은 저체중, 18.5 kg/m^2 이상, 23 kg/m^2 미만은 정상군, 23 kg/m^2 이상, 25 kg/m^2 미만은 과체중, 25 kg/m^2 이상은 비만군으로 분류하였다.

3. 연구내용 및 방법

1) 근거 기반 나트륨 저감 건강 식생활 실천 운영지침 개발 및 프로그램 구축

2016-2022년 국민건강영양조사의 원시자료를 이용한 영양소 및 나트륨 섭취 수준 분석 결과를 근거로, 식습관 유형별 컨설팅 등 식생활 개선 가이드라인, 나트륨 섭취 저감을 위한 식생활 개선 지침, 레시피 책자 등 개인별 맞춤형 자료를 개발하였다. 이를 전국 단위로 모집된 307명에게 리빙랩 모델을 이용하여 적용한 후 수정·보완하는 과정을 거쳐 최종 운영지침으로 마련하였고, 다시 리빙랩 모델을 기반으로 하는 나트륨 저감 건강 식생활 프로그램으로 설계하였다.

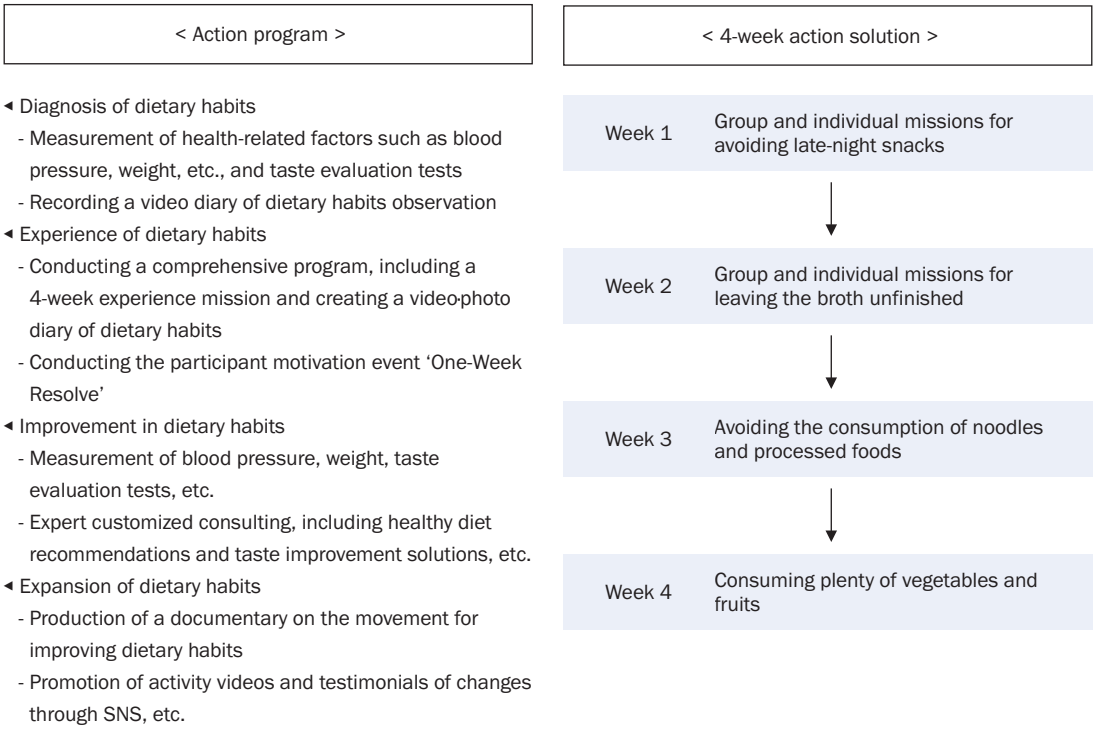

Fig. 1. Structure and practical steps of the reduced-sodium healthy eating practice program.

2) 나트륨 저감 건강 식생활 실천 프로그램의 리빙랩 모델 적용 및 효과 평가

프로그램은 임상영양사와 함께 진단, 체험, 개선, 확산 순으로 단계별 실천 솔루션을 제공하는 4주간의 미션으로 구성되었는데, 1주차에는 야식 먹지 않기 및 조별/개인 미션을 진행하였으며, 2주차에는 국물 남기지 않기 및 조별/개인 미션을 진행하였다. 3주와 4주차에는 각각 면류 및 가공식품 섭취하지 않기, 채소 과일 충분히 섭취하기를 실천하도록 하였다(Fig. 1). 프로그램 참여 전 개인별로 평소 식습관 관찰을 실시하였고, 팀별 임상영양사를 통한 개별 식습관 평가를 실시하였다. 프로그램의 진행 중에는 28일간 식사일지 작성, 영상일기 촬영, 식습관 조사지 활용 등을 이용하여 미션의 수행 여부를 팀별 임상영양사가 관리하였다.

프로그램 참여 전과 후 식품/음식섭취빈도조사와 자기기입 방식의 설문조사를 이용하여 나트륨 섭취량과 함께 나트륨 섭취 관련 영양 지식, 나트륨 저감 실천 의지, 나트륨 섭취 관련 식사 행동을 조사하여 프로그램의 효과를 평가하였다. 식품/음식섭취빈도조사 도구는 국민건강영양조사의 분석 결과를 근거로 섭취 빈도 및 선호도가 높은 동시에 나트륨 함량이 높은 음식/식품으로 구성된 설문지를 이용하였다[17]. 크론바흐알파(Cronbach's alpha) 값은 나트륨에 대한 영양 지식 설문 0.89, 나트륨 저감 실천 의지 0.89, 나트륨 섭취 관련 식사 행동 0.90 등이었다. 나트륨에 대한 영양 지식 설문은 나트륨 섭취와 건강 간의 관련성, 나트륨 저감 조리 방법, 저 나트륨 식품 선택 등에 대한 19개의 문항으로 구성하였으며[17, 18], 정답은 1점, 오답은 0점을 부여하여 점수를 산정하였다. 나트륨 저감 실천 의지 측정을 위해서는 17개 문항을 선정하였고, 나트륨 섭취 관련 식사 행동 측정을 위해서는 23개 문항을 선정하여[17, 18] 자기기입 방식을 이용한 Likert 5점 척도로 조사하였다. 프로그램 참여 전과 후 신체검사 등 임상검사도 실시하였다.

4. 자료 분석

수집된 자료는 SPSS Statistics ver. 26.0 (IBM Co.)을 이용하여 분석하였다. 연구대상자의 일반사항에 관한 응답 결과는 빈도와 백분율로 제시하였고, 실천 의지, 식사 행동 및 지식, 섭취 영양소 조사 결과는 평균값 ± 표준편차(standard deviation)로 표시하였다. 프로그램 실시 전후 차이는 대응표본 t-검정(paired t-test)을 이용하여 분석하였다. 모든 통계적 결과의 유의성은 양측검정으로 하였고, 기준은 0.05를 사용하였다.

RESULTS

1. 연구대상자의 일반사항

리빙랩 모델을 이용하여 나트륨 저감 건강 식생활 프로그램을 적용한 연구대상자의 일반사항은 Table 1과 같다. 남성은 8명(20.0%), 여성은 32명(80.0%)이었고, 연령 구성은 20대가 26명(65.0%)으로 가장 많았고, 다음으로 50대 이상 5명(12.5%), 10대 4명(10.0%), 40대 3명(7.5%), 30대 2명(5.0%)의 순이었다. 가족 구성은 4인 가족에 속한 대상자가 17명(42.5%)으로 가장 많

Table 1. General characteristics of the participants (n = 40)

Characteristics	Classification	Frequency
Sex	Male	8 (20.0)
	Female	32 (80.0)
Age group (year)	10s	4 (10.0)
	20s	26 (65.0)
	30s	2 (5.0)
	40s	3 (7.5)
	50+	5 (12.5)
Family size	1	6 (15.0)
	2	1 (2.5)
	3	7 (17.5)
	4	17 (42.5)
	≥ 5	8 (20.0)
	N/A	1 (2.5)
Occupation	Service and sales	1 (2.5)
	Clerical	6 (15.0)
	Self-employed	1 (2.5)
	Professionals	2 (5.0)
	Others	15 (37.5)
	None	15 (37.5)
Income range (million KRW)	< 1	6 (15.0)
	1–2	4 (10.0)
	2–3	0 (0.0)
	3–4	9 (22.5)
	4–5	8 (20.0)
	≥ 5	12 (30.0)
	N/A	1 (2.5)
Education level	Elementary school graduate	3 (7.5)
	Middle school graduate	0 (0.0)
	High school graduate	21 (52.5)
	University graduate	11 (27.5)
	Graduate school or higher	3 (7.5)
	N/A	2 (5.0)
Obesity degree	Underweight[1)]	4 (10.0)
	Normal weight[2)]	23 (57.5)
	Overweight[3)]	8 (20.0)
	Obese[4)]	5 (12.5)

n (%).
N/A, not available.
[1)]Body mass index (BMI) of <18.5 kg/m^2.
[2)]18.5 ≤ BMI <23 kg/m^2.
[3)]23 ≤ BMI <25 kg/m^2.
[4)]BMI of ≥ 25 kg/m^2.

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았고, 다음으로 5인 이상 가족에 속한 대상자 8명(20.0%), 3인 가족에 속한 대상자 7명(17.5%) 순으로 많았으며, 1인 가구도 6명(15.0%)에 해당하였다.

2. 나트륨 저감 건강 식생활 실천 운영지침 개발 및 프로그램 구축

2016–2022년 국민건강영양조사의 원시자료를 이용하여 성별, 연령층, 가구소득 분위, 건강 및 식생활 관련 요인 등에 따른 영양소 및 나트륨 섭취 수준을 분석한 결과, 연령이 높을수록 1일 에너지 섭취량이 감소함에도 불구하고 나트륨 섭취량은 높은 수준을 유지하였다. 또한 외식을 거의 하지 않는 집단에 비해 하루 1회 이상 또는 주 3–6회 외식하는 집단의 에너지 대비 나트륨 섭취량과 칼륨 대비 나트륨 섭취비가 높았다. 가구소득 분위, 주관적 건강 인지 상태, 비만도, 흡연 여부, 음주 경험, 식생활 형편, 아침 식사 빈도, 외식 빈도, 영양표시 이용 여부, 식이요법 여부, 영양교육 경험 여부 등도 나트륨 섭취와 유의한 상관관계가 있는 것으로 나타났다(data not presented).

이와 같은 결과를 근거로 하여 계층별로 식행동을 관리하고 식습관의 변화 정도를 진단하는 등의 내용으로 구성된 나트륨 저감 건강 식생활 실천 운영지침을 개발하였고, 리빙랩 모델을 이용하여 시범 적용하는 과정을 통해 수정 및 보완한 최종 나트륨 저감 건강 식생활 프로그램을 구축하였다(Table 2). 구축된 프로그램은 일상생활 속에서 연구대상자의 참여와 소통 및 수정 과정을 통해 이해·인지(literacy)를 증진하고 실천 역량(competency)을 강화하는 두 가지 목표를 설정하였다. 이해·인지 증진 부분에서는 아침 식사 중심의 균형 잡힌 끼니 섭취, 과일 및 채소 섭취 향상 실천, 외식 빈도 감소 등에 대한 내용을 담았고, 실천 역량 강화 부분에서는 '나트륨 섭취 감소를 위한 식재료 선택', '나만의 조리법과 방법', '어제보다 오늘이 더 건강한 건강 메뉴 실천' 등의 내용을 담았다.

3. 프로그램 수행에 따른 식생활 변화

1) 나트륨 관련 영양 지식 및 나트륨 저감 실천 의지

나트륨 관련 영양 지식 조사 결과(Fig. 2), 영양 지식의 총점은 프로그램 참여 전 14.76점에서 참여 후 16.32점으로 상승하였다($P < 0.01$). 나트륨 저감을 위한 실천 의지 측정 결과(Table 3), '식품과 음식에 들어있는 나트륨 양에 관심을 가진다' 항목은 프로그램 참여 전 3.78점에서 참여 후 4.43점으로 상승하였으며($P < 0.001$), '저염식을 실천하면 나의 건강이 개선될 것이다' 항목은 참여 전 4.53점에서 참여 후 4.73점($P < 0.05$), '외식할 때 싱겁게 해달라고 요구하겠다' 항목은 참여 전 2.90점에서 참여 후 3.60점($P < 0.001$), '맵고 짠 음식 대신 식품 고유의 맛과 향을 살린 음식을 선택할 것이다' 항목은 참여 전 3.75점에서 참여 후 4.30점($P < 0.001$)으로 상승하는 등 나트륨 저감 실천 의지 측정을 위한 17개 조사 항목 중 4개 항목이 통계적으로 유의하게 상승한 것으로 나타났다.

2) 나트륨 저감 식사 행동

프로그램 참여 전과 후의 나트륨 섭취 관련 식사 행동은 Table 4와 같다. 총 23개 문항으로 구성된 나트륨 섭취 관련 식사 행동의 설문 결과, '국, 찌개, 국수, 라면 종류의 국물을 남김없이 먹는다' ($P < 0.01$), '간장으로 조려 간이 적당히 밴 조림 음식을 좋아한다' ($P < 0.01$), '외식이나 배달 음식을 일주일에 2회 이상 먹는다' ($P < 0.01$), '인스턴트식품(햄, 소시지)이나 레토르트식품(예: 3분 요리), 라면을 좋아한다' ($P < 0.01$), '식품구매나 외식할 때 영양표시의 나트륨 함량을 확인하는 편이다' ($P < 0.001$) 등 19개 식사 행동이 프로그램 참여 후 긍정적으로 변화되었다.

3) 영양소 섭취 상태

Table 5에는 프로그램 참여 전과 후의 영양소 섭취 상태를 제시

Table 2. Goals and content structure of the evidence-based reduced-sodium healthy eating practice program

Goal 1: 'Literacy' enhancement for sodium reduction
◂ Emphasize balanced meal intake centered on breakfast
◂ Intend to improve fruit and vegetable consumption
◂ Intend to reduce the frequency of eating out
Goal 2: 'Competency' strengthening for sodium reduction
◂ Choose ingredients to reduce sodium intake
◂ Practice your own recipes and methods
◂ Practice healthier menus today than those from yesterday

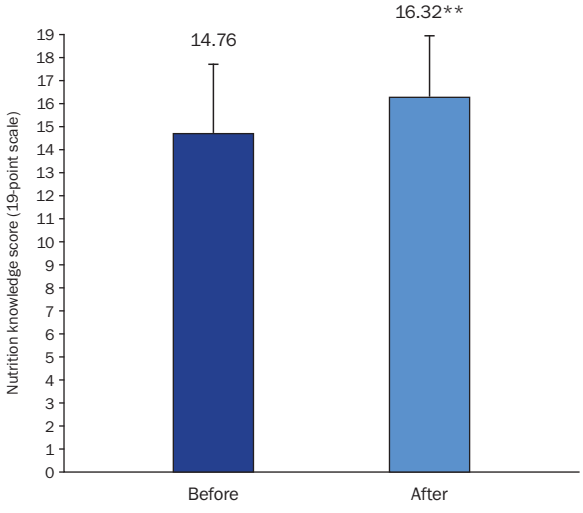

Fig. 2. Change in nutrition knowledge before and after the reduced-sodium healthy eating practice program (n = 38). Mean ± SD; paired t-test; $^{**}P < 0.01$.

Table 3. Intentions to reduce sodium before and after the reduced-sodium healthy eating practice program (n = 40)

Classification	Before[1)]	After[1)]	t-value[2)]	*P*-value[2)]
I will be interested in the amount of sodium in foods and ingredients.	3.78 ± 0.92	4.43 ± 0.68	−4.106	< 0.001
I will practice a low-sodium diet to improve my health.	4.53 ± 0.64	4.73 ± 0.55	−2.243	0.031
I will purchase fresh foods rather than processed and instant foods.	4.18 ± 0.68	4.43 ± 0.84	−1.706	0.096
I will ask for food to be prepared with less salt when dining out.	2.90 ± 1.06	3.60 ± 1.03	−4.149	< 0.001
I will choose dishes that preserve the natural flavors of ingredients rather than spicy and salty foods.	3.75 ± 0.67	4.30 ± 0.61	−5.135	< 0.001
I will pay attention to cooking methods that support a low-sodium diet.	4.33 ± 0.66	4.28 ± 0.72	0.361	0.720
I will believe that attempts and interest in reducing sodium intake can lead to social change.	4.28 ± 0.72	4.50 ± 0.55	−1.940	0.060
I will choose low-sodium versions of pickled foods and kimchi.	3.85 ± 0.77	4.18 ± 0.87	−2.010	0.051
I will opt for steamed or grilled dishes instead of braised dishes.	4.20 ± 0.65	4.30 ± 0.72	−0.752	0.457
I will leave the broth and focus on the solid ingredients when eating soup, stew, or ramen.	4.50 ± 0.75	4.68 ± 0.62	−1.639	0.109
I will reduce the amount of gochujang or seasoning in bibimbap by half.	4.03 ± 0.86	4.33 ± 0.83	−1.669	0.103
I will gradually reduce the amount of soup base in ramen and cook with half the recommended amount.	3.75 ± 1.19	3.93 ± 1.23	−0.943	0.352
I will consume fresh vegetables and fruits.	4.83 ± 0.38	4.80 ± 0.52	0.274	0.785
I will not use table salt separately.	4.60 ± 0.59	4.65 ± 0.62	−0.467	0.643
I will consciously try to eat food with less seasoning and sauces.	4.60 ± 0.55	4.68 ± 0.57	−0.684	0.498
I will check the nutrition labels of processed foods to choose products with lower sodium content.	4.40 ± 0.63	4.43 ± 0.64	−0.206	0.838
I will refer to “low-sodium recipes” for guidance when cooking.	4.05 ± 0.93	4.23 ± 0.73	−1.267	0.213

Mean ± SD.
[1)]1 = Strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree.
[2)]Paired t-test.

하였다. 에너지와 탄수화물, 지질, 단백질, 나트륨, 칼륨 등 대부분의 영양소 섭취가 감소한 것으로 나타났고($P < 0.001$), 일일 나트륨 섭취량도 평균 3,382.37 mg에서 2,119.05 mg으로 유의하게 감소하였다($P < 0.001$).

DISCUSSION

본 연구는 건강 식생활 프로그램의 적용 연구로서, 근거를 기반으로 하여 개인별 맞춤형 프로그램을 구축하고 리빙랩 환경에서 적용함으로써 진단, 체험, 개선, 확산의 과정을 통해 대상자에게 나트륨 저감 등 식생활 개선을 유도하는 데 목적이 있었다. 프로그램의 근거 마련을 위하여 분석한 2016–2022년 국민건강영양조사에서 30–40대까지는 연령이 증가할수록 나트륨 섭취량이 증가하였고, 하루 1회 이상 또는 주 3–6회 외식하는 경우 나트륨 섭취량이 높았으며, 가구소득 분위, 주관적 건강인지 상태, 비만도, 흡연 여부, 음주 경험, 식생활 형편, 아침 식사 빈도, 외식 빈도, 영양표시 이용 여부, 식이요법 여부, 영양교육 경험 여부 등이 나트륨 섭취와 유의한 상관관계가 있었다. 이와 같은 결과는, 외식횟수가 많거나 월평균 가구 소득이 높을수록 나트륨 섭취량이 많으며, 45–49세까지는 연령 증가에 따라 나트륨 섭취량이 증가한다는 다른 연구 결과들과 일치하는 것이다[19–21]. 나트륨 저감 등 생활습관 개선을 포함하는 임상지침은 질병의 치료 및 관리에 관한 권고 사항으로서 관련 분야 전문가 집단을 중심으로 무작위임상시험 연구 등 과학적 신뢰도가 높은 문헌에 대한 체계적 고찰과 전문가 의견을 기반으로 하여 수립된다[22, 23]. 지역사회에서 수행되는 보건사업 역시 질병예방서비스위원회를 통한 체계적 문헌고찰 등 프로그램의 효과성 검토 후 착수하고 있지만, 실제 대부분의 지역사회 만성

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Table 4. Dietary behaviors for reducing sodium before and after the reduced–sodium healthy eating practice program (n = 40)

Classification	Before[1)]	After[1)]	t-value[2)]	*P*-value[2)]
I eat all the broth in soups, stews, noodles, and ramen.	3.30 ± 1.29	4.00 ± 0.88	−3.264	0.002
I feel that if food is bland, something is missing, and I am not satisfied.	2.57 ± 1.12	3.43 ± 0.93	−5.237	< 0.001
I enjoy dishes like donburi, fried rice, bibimbap, and curry rice.	2.05 ± 0.88	2.59 ± 0.90	−3.651	0.001
I like simmered dishes that are seasoned just right with soy sauce.	2.25 ± 0.94	2.86 ± 0.90	−3.588	0.001
I prefer Japanese or Chinese food over Western food.	2.81 ± 0.91	3.22 ± 0.92	−2.852	0.007
I like kimchi more than fresh vegetables.	2.95 ± 1.27	3.16 ± 1.14	−1.091	0.282
I enjoy snacks with a salty taste, like potato chips and crackers.	2.73 ± 1.37	3.27 ± 1.07	−3.424	0.002
I dine out or order takeout at least twice a week.	2.49 ± 1.15	3.32 ± 1.20	−3.484	0.001
I like dried fish or salted mackerel.	3.14 ± 1.11	3.57 ± 1.01	−2.665	0.011
I feel incomplete if there are no fermented fish products, like salted cod roe, on the table.	4.08 ± 1.12	4.38 ± 0.86	−1.766	0.086
I enjoy spicy and salty foods as snacks while drinking alcoholic.	2.70 ± 1.33	3.49 ± 1.19	−4.886	< 0.001
I like spreading butter or margarine generously (100% of the bread surface) on bread.	2.53 ± 1.42	3.58 ± 1.32	−7.666	< 0.001
I usually use homemade soy sauce rather than regular soy sauce.	3.51 ± 1.26	3.24 ± 1.21	1.822	0.077
I habitually add salt or soy sauce before meals.	3.97 ± 1.26	4.38 ± 0.76	−2.579	0.014
I immediately add salt or soy sauce at the table if dishes like vegetables or soups are bland.	3.19 ± 1.49	4.19 ± 0.89	−4.743	< 0.001
I feel that if there is less salt in food, it doesn't taste good.	2.69 ± 1.12	3.53 ± 1.03	−5.916	< 0.001
I often use mayonnaise or salad dressing when cooking.	3.19 ± 1.17	3.47 ± 1.06	−1.303	0.201
I frequently eat soybean paste soup.	2.95 ± 1.05	3.49 ± 1.02	−2.941	0.006
I dip pancakes, fried foods, or sashimi generously in soy sauce (enough to submerge the food).	3.15 ± 1.25	3.92 ± 0.98	−4.629	< 0.001
I like instant foods (like ham and sausages) or ready-to-eat foods (like 3-minute meals), and ramen.	2.61 ± 1.24	3.08 ± 0.91	−3.070	0.004
I eat vegetables with every meal.[3)]	2.97 ± 0.96	3.46 ± 0.97	−2.714	0.010
I eat fruit more than twice a day.[3)]	2.54 ± 1.17	3.00 ± 1.05	−2.471	0.018
I usually check the sodium content on nutrition labels when purchasing food or dining out.[3)]	2.44 ± 1.41	3.33 ± 1.08	−4.634	< 0.001

Mean ± SD.
[1)]1 = Strongly agree; 2 = agree; 3 = neutral; 4 = disagree; 5 = strongly disagree.
[2)]Paired t-test.
[3)]Reversed scale (1 = strongly disagree; 2 = disagree; 4 = agree; 5 = strongly agree).

질환 예방관리 프로그램들이 1년 단위로 수행됨에 따라 일정상 충분한 검토가 이루어지기가 어렵다[24]. 본 연구에서는 이러한 현실을 고려하여, 개인의 상황에 따른 나트륨 저감 건강 식생활 프로그램이 될 수 있도록 분석된 결과를 개발에 활용하였고, 리빙랩을 이용한 시범 운영을 거쳐 수정·보완함으로써 근거를 기반으로 한 개인별 맞춤형 프로그램이 될 수 있도록 최종 구축하였다. 만성질환의 주요 위험요인 중 하나이며[4] 영양소 섭취 기준에 비해 여전히 많은 양 섭취하고 있는 나트륨 저감을 위해 지난 수십 년간 국가 및 지역사회 수준에서 여러 프로그램들이 운영되어 왔으나[7], 위험 집단을 선별적이고 효과적으로 관리할 수 있는 전략은 충분하지 않았다. 본 연구의 프로그램은 건강위험요인별 포괄적 형태의 식습관 중재 대신 식생활 진단에 따라 대상자를 유형화하고 세분화된 목표를 설정하여 생활 속에서 실천할 수 있는 내용을 제시하는 가이드라인의 형태로 시행되었다. 식사패턴의 분석 결과를 바탕으로 실제 일상 식생활에서 구체적인 개선방안을 제시함으로써 나트륨 저감의 실효성을 높일 수 있도록 프로그램을 구축하였고, 채소와 과일의 섭취를 권장함으로써 건강 식생활을 유도할 수 있도록 지침을 마련하였다. 단순한 나트륨 제한이 아닌 영양소 균형을 고려한 건강 식생활의 형태로 나트륨 저감이 수행될 때 고혈압을 비롯한 만

Table 5. Nutrient intake levels before and after the reduced-sodium healthy eating practice program (n = 40)

Classification	Before	After	t-value[1)]	*P*-value[1)]
Energy (kcal)	2,000.71 ± 912.59	1,450.27 ± 711.18	4.286	< 0.001
Carbohydrate (g)	271.44 ± 113.51	205.04 ± 107.31	4.025	< 0.001
Lipid (g)	58.45 ± 29.66	41.55 ± 21.48	4.059	< 0.001
Protein (g)	72.35 ± 34.47	53.21 ± 26.44	3.999	< 0.001
Dietary fiber (g)	23.39 ± 12.11	18.20 ± 10.03	2.826	0.007
Vitamin A (ugRAE)	307.18 ± 118.17	233.63 ± 109.61	4.012	< 0.001
Vitamin D (ug)	3.64 ± 2.97	2.52 ± 2.27	2.278	0.028
Vitamin E (mg)	15.89 ± 8.13	12.46 ± 7.84	3.400	0.002
Vitamin K (ug)	113.65 ± 67.20	113.47 ± 88.82	0.013	0.990
Vitamin C (mg)	87.91 ± 41.89	87.58 ± 50.86	0.047	0.963
Thiamin (mg)	1.95 ± 0.92	1.39 ± 0.69	4.315	< 0.001
Riboflavin (mg)	1.63 ± 0.69	1.18 ± 0.56	4.988	< 0.001
Niacin (mg)	9.99 ± 5.28	7.52 ± 3.73	3.365	0.002
Ca (mg)	549.32 ± 209.32	401.47 ± 216.09	4.801	< 0.001
P (mg)	1,107.18 ± 482.17	822.28 ± 414.82	4.285	< 0.001
Na (mg)	3,382.37 ± 2,345.57	2,119.05 ± 1,326.63	4.082	< 0.001
K (mg)	2,301.83 ± 1,021.15	1,845.01 ± 898.53	2.956	0.005
Fe (mg)	13.44 ± 6.28	10.72 ± 5.23	3.035	0.004
Zn (mg)	12.26 ± 8.74	8.03 ± 3.78	3.211	0.003
Cholesterol (mg)	334.06 ± 186.12	236.38 ± 132.69	4.283	< 0.001

Mean ± SD.
[1)]Paired t-test.

성질환의 예방관리 효과가 더욱 크다는 사실은 이미 여러 연구를 통해 증명된 바 있다[25, 26]. 특히 식생활 개선 지침은 집밥, 외식, 배달, 간식 등 식사 형태별로 구체적인 나트륨 저감 방법을 안내하여 일상적으로 섭취하는 식사에서 나트륨 저감을 실천할 수 있도록 현장 적용성을 높였다. 레시피 책자에는 나트륨 저감 조리 방법을 상세히 제시하여 집밥을 준비할 때 활용할 수 있도록 하였고, 누구나 쉽게 따라 할 수 있도록 영상 자료를 별도로 제작하여 제공하였다. 한편, 30대 이상 중장년층에서는 질병 예방과 삶의 질 향상을 위해 나트륨 섭취 저감 등의 건강 식생활이 반드시 실행되어야 하지만[5], 짜게 먹는 식습관은 쉽게 교정되기 어려운 습관이므로 만성질환 예방을 위해 청년기부터 나트륨 저감을 실천할 수 있도록 전략적으로 프로그램을 구성하였다. 나트륨 저감 건강 식생활 프로그램의 구축 과정에서는 인지, 생활 습관, 생물학적 및 인구학적 요인이 동기, 자기효능감, 결과에 대한 기대치, 행동 수행 능력 등을 통해 최종 식품 선택에 영향을 미칠 수 있다는 생태학적 접근 방법을 활용하였다[27].

보건소 건강증진사업은 직접 방문으로 인한 불편 때문에 주민 참여도가 매우 낮다는 문제가 오랫동안 지적되어 왔는데[12]. 이에 대한 해결책으로서 정부는 2024년부터 '모바일 헬스케어 사업'을 별도 사업으로 신설하고 기존의 성인 대상 만성질환 관리사업과 연계하여 운영하고 있다[12]. 영양 분야와 연계한 '모바일 헬스케어 사업'은 '채움건강' 앱을 이용하여 건강정보를 수집하고 보건소 영양사가 개인별 맞춤형 상담, 교육, 정보를 제공하는 형식으로 운영되고 있지만 높은 중도 탈락률이 지적된 바 있다[13, 14]. 식생활 코칭 앱과 스마트밴드 등 정보통신기술을 활용한 다른 영양 중재 연구에서도 시간에 따른 대상자의 중도 탈락률 증가가 문제로 보고된 바 있어[28], 정보통신기술을 이용한 건강증진사업에서 대상자의 지속 참여율을 높이기 위한 창의적인 전략이 요구된다. 본 연구에서는 임상영양사와 대학의 연구자 등 영양교육 전문가가 개발한 근거기반의 프로그램 운영지침을 리빙랩 모델을 이용하여 수정·보완한 후 다시 전국을 기반으로 한 가구 단위 구성원에게 리빙랩의 형식으로 적용하는 등 개발과 적용의 과정에 리빙랩 모델을 활용하였다. 리빙랩은 2000년 민간기업이 정보통신기술 개발에 이용한 실제 실험 환경으로서 시장에 처음 등장하였다[29]. 리빙랩의 개념은 이미 1990년대에 학계 논의에 등장했지만 실제로 리빙랩 프로젝트가 학술적인 기반을 가지고 시작된 것은 2006년이다[30]. 리빙랩은 지금까지 시행된 다양한 혁신모델과는 다른 특징을 가지고 있는데, 기존의 연구실험실이나 테스트베드 사업과는 상이하게 사용자가 혁신의 대상에서 주체로 변화되어 아이디어 제안, 경험 공유, 피드백 제공 등 일상생활의 문제해

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결 과정에 기여하기 때문에 프로그램에 대한 이해도가 높고 참여 지속성이 높으며 만족도가 높다는 우수성을 가진다[31, 32]. 실효성 있고 지속 가능한 해결책을 도출할 수 있을 뿐만 아니라, 사용자 중심의 실천적이고 현장성 있는 프로그램을 개발할 수 있다는 점에서 교육 및 정보 전달을 일방적으로 실시하던 기존의 연구 방법과 다른 차별성을 가지기 때문에 리빙랩 프로젝트는 새로운 제품과 서비스를 공동으로 창출할 수 있는 혁신생태계로서뿐 아니라 혁신을 위한 정책 도구로서 최근 그 활용이 크게 증가하고 있다. 그러나 실제로 적용의 효과와 성과를 측정한 연구는 드물며[32, 33], 영양, 식생활 분야에서 활용 효과에 대한 연구보고는 거의 없다.

리빙랩은 참여 주체를 기준으로 사용자, 공급자, 조력자, 활용자 주도 형태로 분류될 수 있는데[34], 본 연구에서 사용한 리빙랩의 모델은 공급자 즉, 연구기관 주도형으로 볼 수 있다. 연구기관 주도형 리빙랩에서는 대학, 연구소, 고등교육기관과 같이 연구 기능을 가진 공급자가 전문가 간 협력을 통해 개발한 기술 혁신을 중재에 통합함으로써 혁신 활동을 주도한다[35]. 실제로 본 연구의 참여 대상자는 일상생활 속에서 진행되는 프로그램의 수정, 개선 과정과 요구도 확인 및 문제 해결 과정에 직접 참여하면서 자연스럽게 식생활 교육에 노출되고 나트륨 저감 건강 식생활에 대한 이해·인지 증진 및 실천 역량 강화 효과를 얻을 수 있었다. 이러한 점에서는 혁신 활동이 사용자가 주도하는 상향식(bottom-up) 방식으로 이루어지는 사용자 주도 리빙랩의 형태도 일부 가미되었다고 볼 수 있다[35]. 한편, 참여자와 상호작용을 통해 교육 내용, 운영과정, 전달법을 수정하고 최종 성과물로서 교육프로그램을 설계하였다는 내용 측면에서는 건강 식생활 정보와 지식을 전달하고 보급하는 교육 리빙랩의 성질을 띠고 있다고도 볼 수 있다[36]. 교육 내용의 구성 과정에 대상자가 자발적으로 참여하는 방식은 사용자 중심에서 실천적이고 현장성 있는 내용을 담을 수 있기 때문에 맞춤형의 프로그램 설정이 가능하다는 장점이 있다[36].

리빙랩을 활용한 본 프로그램은 나트륨 섭취와 건강 간의 관련성, 나트륨 저감 조리 방법 등 나트륨 관련 영양 지식의 상승 효과가 있었으며, 식품과 음식 구매 시 또는 조리 시 나트륨 저감화와 관련한 행동 실천 의지도 상승시켰다. 총 23개 문항으로 구성된 나트륨 섭취 관련 식사 행동 설문에서는 대부분인 19개의 식사 행동이 긍정적으로 변화하였는데 특히 과량의 나트륨 섭취와 밀접하게 연관된 국물 섭취와 조림류 선호 행동이 개선되거나, 외식과 배달 음식 및 인스턴트식품, 레토로트식품, 라면 등의 섭취 빈도가 감소하는 효과가 나타났다. 또한 식품의 구매 단계에서 영양표시 확인 등 나트륨 저감 행동도 증가한 것으로 나타났으며, 과일과 채소 섭취 빈도가 증가하는 등 전반적인 식생활의 개선 효과가 나타났다. 영양 지식과 행동 실천 의지의 상승 및 식사 행동의 개선 결과를 통해, 본 프로그램의 수행이 나트륨 저감 건강 식생활의 이해·인지 정도 상승 및 실천 역량의 강화 등 긍정적인 효과를 이끌어 낸 것으로 추정된다.

Limitations

본 연구에서 사용된 근거 기반의 나트륨 저감 건강 식생활 프로그램은 국민건강영양조사의 원시자료 분석 결과를 기반으로 하고 시범 적용을 거쳐 개발되었다. 대부분의 근거 기반 지침들이 관련 분야 전문가 집단을 중심으로 편향이 적고 신뢰도가 높은 무작위임상시험 연구들에 대한 종합적 검토를 바탕으로 수립되고 있다는 점에서, 본 연구 프로그램은 문헌 검토 측면에서 방법론적 한계를 가진다. 한편, 리빙랩 모델 적용의 차별성을 검증할 수 있도록 기존 운영 방식과의 비교 조사가 수행되지 않은 점은 연구 설계 측면에서의 제한점이다. 본 프로그램은 단순히 나트륨 섭취 감소만이 아닌 전반적인 식습관 개선이라는 목표를 가지고 진행되었기 때문에 프로그램 적용 후 대상자에서 나트륨과 총 지방 및 에너지 섭취의 감소가 있었지만, 더불어 지용성 및 수용성 비타민, 칼슘, 철, 식이섬유 등 필수 영양소의 섭취도 감소하여 추후 프로그램 구성에 대한 세밀한 검토와 개선이 필요할 것으로 사료된다.

Conclusion

임상영양사와 대학의 연구자 등이 주도하는 동시에 문제 해결 과정에 대상자가 직접 참여하는 리빙랩 모델을 활용한 나트륨 저감 건강 식생활 프로그램은 수요자 중심의 영양관리사업 구축의 계기를 마련하고 지역사회 주민의 참여율 향상 및 중도 탈락률 저하를 통한 지속성을 제고하는 해결 수단이 될 수 있을 것이다.

CONFLICT OF INTEREST

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

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DATA AVAILABILITY

Research data is available upon request to the corresponding author.

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Research Article

장애인사회복지시설 입소·이용자를 대상으로 한 영양교육 프로그램 개발 및 적용성 평가

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Development and applicability evaluation of a nutrition education program for residents and users of disability social welfare facilities in Korea: a mixed-methods study

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Objectives: This study aimed to develop a nutrition education program based on social cognitive theory to promote the health of individuals using facilities for people with disabilities. It also sought to evaluate the applicability of the educational materials through assessments by counselors at the Social Welfare Food Service Management Support Center.

Methods: A group of six experts developed the program based on a needs assessment of nutrition education in facilities for individuals with disabilities. Applicability was evaluated through an online survey of 26 counselors from Social Welfare Food Service Management Support Centers nationwide in July 2023, and the results were analyzed.

Results: The nutrition education program includes a basic course on personal hygiene, dining etiquette, picky eating prevention, and obesity management. The advanced course covers dietary management for chronic diseases, such as meal planning for hypertension, diabetes management, and dietary principles for dysphagia. Additionally, lecture PPTs, individual activity sheets, and experiential teaching aids were developed. Applicability evaluations showed high scores, with the teaching-learning plan and PPT averaging 4.15 and the experiential teaching aids scoring 4.17, all above 4.0.

Conclusion: This study is significant in that it developed a nutrition education program that can be applied directly to the disabled in social welfare facilities and suggested the need to further strengthen nutrition management support for social welfare for the disabled. In addition, the developed nutrition education program is valuable in that it reflects the results of the applicability evaluation of counselors who visit social welfare facilities for the disabled to provide nutrition education. Therefore, it is expected that the nutrition education program developed through this study can be actively used as a way to revitalize nutrition education in social welfare facilities for the disabled.

Keywords: welfare facility; disabled persons; nutrition education

INTRODUCTION

「장애인복지법」에서 장애인은 '신체적·정신적 장애로 오랫동안 일상생활이나 사회생활에서 상당한 제약을 받는 자'로 정의되며[1], 비장애인에 비해 취약한 건강 상태인 경우가 많다. 2015년 장애인의 건강권 보장을 지원하는 '장애인 건강권 및 의료접근성 보장에 관한 법률'이 제정됨에 따라 '건강권'의 권리 중 영양개선을 통한 건강 상태를 유지할 권리가 포함하였다[2]. 이후 국가와 지자체가 장애인의 적절한 영양섭취 및 올바른 식생활 개선을 통해 건강을 유지할 수 있도록 하는 시책을 강구하도록 하는 등의 일부 개정법률안이 발의되었다[3]. 2022년 보건복지부 통계는 국내 등록장애인 인구는 전체 인구의 5.1%로 꾸준히 증가하는 추세이며[4], 2023년에는 장애인도 '영양취약계층'에 포함되는 국민영양관리법 일부 개정안이 통과되며, 각종 영양관리사업의 혜택을 받을 수 있게 되었다[5]. 이처럼 장애인의 영양과 건강에 대한 관심도는 높아지고 있지만[6], 식품의약품안전처의 2021년 조사에서 전국의 노인 · 장애인 사회복지시설 12,995곳 중 78.8% (10,238곳)가 영양사 없이 운영되는 실정이며[7], 현행법상 1회 급식인원이 100인 미만 산업체는 영양사 채용의 의무가 없기 때문에[8], 관리의 사각지대가 발생하였다. 이러한 취약한 관리 실태는 비장애인에 비해 상대적으로 이른 나이에 만성질환이 발병하는 원인이 된다[9]. 한국보건사회연구원의 장애인과 비장애인의 보건의료 및 건강수준 격차와 시사점 보고에서는 비만율과 당뇨병 · 고혈압 유병률 모두 장애인이 더 높으며 18세 이상 성인기준 만성질환 유병률이 비장애인과 장애인의 격차가 39.75%인 것으로 나타났다[10]. 국외 선행연구[11, 12]도 장애인은 비장애인보다 만성질환 유병률이 높고, 그로 인한 합병증이나 수명감소도 비장애인에 비해 심각한 것으로 나타났다. 따라서 장애인의 건강증진을 위한 만성질환 관리의 일환으로 영양관리가 필요하며 식사 제공, 식품 위생 등 관리 및 영양교육이 제공되어야 한다. 장애인은 비장애인에 비해 만성질환의 위험에 더 크게 직면하며, 비장애인과는 다른 양상을 나타내기도 한다. 심혈관질환과 당뇨병을 비롯한 만성질환은 영양과 관련되며, 중증장애인은 특히 비만하거나 혹은 적절한 식습관이 동반되지 않는 경우 더 안 좋은 건강 결과를 나타내게 된다[13]. 미국의 1963년 커뮤니티 정신 건강법을 근거로 장애 분야에서 운영되고 있는 Association of University Centers on Disabilities에서는 Nutrition is for Everyone이라는 파일럿 프로젝트(2016–2018)를 통해 과일 · 채소 소비량이 가장 적은 4개 주에 걸쳐 장애인과 지역사회 구성원에게 직접적인 교육을 수행하였으며, 과일 · 채소 소비량 증가, 장애인의 비만률 감소, 장애인을 위한 영양 지원자와 교육자의 네트워크 구성을 목적으로 운영된다[14]. 또한 미국은 각 주의 보건복지부에서 장애인 영양교육을 지원하며, 특히 아이오와주는 장애 아동을 위한 '5-2-1-0 Healthy Choices Count!' 활용 키트를 개발하여 장애아동 맞춤형 식생활 교육을 위한 자료를 제공하고, 장애 아동이 건강한 삶을 영위할 수 있도록 영양교육 프로그램을 장애아동 맞춤형으로 개발해 운영한다[15]. 호주도 장애인은 1년에 5번 공인된 영양사와의 면담을 통해 평소 식단을 분석하고 관리 지원을 무료로 받을 수 있으며[16], 영국은 장애인 스스로 본인의 건강을 능동적으로 관리할 수 있도록 영양교육을 포함한 건강관리계획 수립 및 실천, 건강관련 정보획득 등에 관한 무료 교육·훈련이 운영되고 있다[17]. 우리 정부는 2022년 7월 노인 · 장애인 등 사회복지시설의 급식 안전을 지원하는 법률을 제정하고, 노인·장애인 등의 영양취약계층을 위한 영양관리 정책으로 '사회복지시설급식관리지원센터'를 설립하였다[18]. 사회복지급식관리지원센터는 노인·장애인사회복지시설 내 급식소의 위생·영양 방문지도, 건강상태에 맞춘 맞춤 식단 제공과 대상자 별 영양교육을 지원한다[19]. 이러한 변화로 국내에서는 발달장애인의 건강증진을 위한 식생활 정보 제공 및 운동 교육 프로그램[20], 발달장애 청소년의 장애유형과 비만도에 따른 식습관 및 당류식품섭취 패턴[21], 재가 장애인을 대상으로 하는 식생활 영양교육[22, 23] 등 장애인을 위한 영양교육에 대한 연구가 소수 이루어져 왔다. 또 다른 선행연구[24, 25]는 장애인사회복지시설의 급식 실태를 확인하거나 영양사의 직무만족도를 연구한 바 있으나, 사회복지시설을 이용하거나 입소해 있는 장애인의 영양관리를 목적으로 한 영양교육 프로그램에 대한 연구는 매우 미비하다. 따라서 본 연구에서는 장애인사회복지시설 현장 요구도를 반영한 입소 및 이용 장애인 대상 영양교육 프로그램을 개발하고 그 적용 가능성을 평가하고자 하였다.

METHODS

Ethics statement

The written informed consent was obtained from all participants and or/the guardians for the survey. The survey procedures and protocols were approved by the Institutional Review Board of Chungnam National University (approval number: 202303-SB-048-01). Obtainment of informed consent was exempted by the institutional review board.

1. 연구설계

본 연구는 장애인사회복지시설 입소자 및 이용자를 위한 영양교육 프로그램 개발 및 설문조사를 수행하였으며, STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) 보고지침에 따라 기술하였다(https://www.strobe-statement.org/).

2. 영양교육 프로그램 개발

1) 연구절차

본 연구는 장애인사회복지시설의 입소자 및 이용자를 위한 영양교육과정안 개발 연구로 문헌 검토, 교육 주제 선정, 교육 자료 및 교수학습안 개발, 적용성 평가 및 수정, 최종 프로그램 개발의 다섯 단계로 이루어졌다(Fig. 1).

2) 영양교육이론 적용

다양한 영양교육 이론 중, 장애인사회복지시설 장애인의 건강한 식생활을 위한 영양교육을 위한 교수학습법에 적절한 영양교육 이론으로 사회인지이론을 선정하였다. 이 이론은 한 개인이 행동을 이행하기 위해서는 개인, 행동, 환경이 학습을 통해 서로 상호작용해야 한다는 삼원론적이고 역동적인 상호주의를 바탕으로 주요 구성 원칙의 상호결정론을 제안한다[26]. 또한 사회인지이론을 토대로 하는 건강증진 프로그램은 대상자의 동기부여 강화 활동과 수행능력 촉진, 행동 변화의 방향을 구성하는데 유용하여 널리 사용되고 있다[27]. 영양교육 프로그램 개발 전 진행된 사전연구에서 장애인 입소·이용자의 교육 이해 가능 수준이 6–10세로 언급된 바 있다. 이에 해당 연령과 유사한 미취학 아동을 대상으로 한 선행연구[28]가 사회인지이론을 근거로 식습관 형성 프로그램을 개발하고 효과를 평가한 결과 영양과 식습관 지식에서 효과가 있었던 것을 근거로 본 개발에도 효과적일 것으로 예상해 채택되었다.

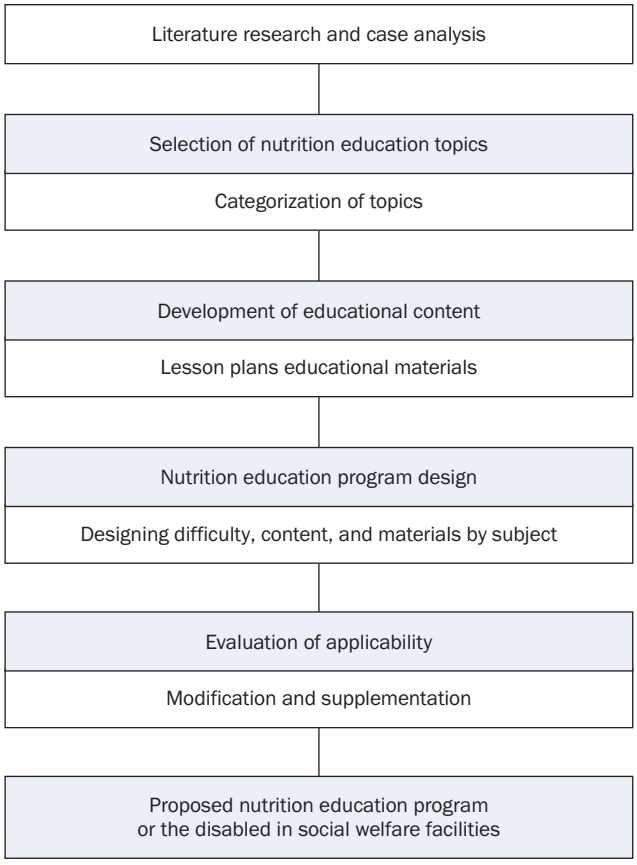

Fig. 1. Research design.

3) 교육 주제 선정

본 연구의 영양교육 프로그램 개발에 앞서 진행된 질적 및 양적 연구를 통해 도출된 국내 장애인사회복지시설의 영양교육 과정에 대한 요구도를 기반으로 하였으며[29, 30], 영양교육 전문가 1인, 임상영양사 4인, 사회복지급식관리지원센터 팀장 1인의 전문가 그룹이 논의하여 주제를 선정하였다. 교육 주제는 위생관리와 식생활 관리의 2개 대주제로 구분하였으며, 위생관리 영역에서는 개인위생에 대한 1개 주제, 식생활 관리 영역에서는 균형있는 식생활, 적정 섭취 및 배식량, 저염식, 당뇨식, 연하곤란식의 관리에 대한 5개 주제를 선정하였다.

4) 맞춤형 교구 개발

발달장애인의 비율이 절대적으로 높은 장애인사회복지시설의 특징을 고려하여[29, 30] 흥미 유발 및 유지가 가능한 활동 중심으로 개발하였으며, 교육자료는 화려한 색감의 그림을 적극적으로 활용하였다. 따라서 실제적인 대면 교육을 위한 교수학습과정안, PPT 자료 및 체험교구를 개발하였다. 선행연구[30]는 장애인사회복지시설의 입소·이용자들을 대상으로 한 영양교육 자료는 대상자들의 지적 능력을 고려하여 초등학교 저학년 이하에서 유치원 정도의 난이도가 적합하다고 하였으며, 이에 6–10세 수준의 교육과정을 기초로 하여 교수학습과정안과 교구를 개발하였다. 따라서 글을 최소화하고 글씨를 크게 작성하며, 화려한 색을 활용한 그림 위주의 정보를 제공하고자 하였으며, 대상자의 집중도를 고려하여 활동 중심의 30–40분 교육으로 구성하였다. 또한 반복교육의 중요성[29]이 제시된 것을 고려하여, 동일한 주제를 다른 방법으로 접근하여 반복 제공하고자 하였다. 각 주제에 대한 교수학습안은 도입-전개-정리의 형식으로 구성하였고, 교수학습안에서 제시된 교육을 재현할 수 있는 PPT 자료, 개인활동지, 체험교구 세트로 구성하여 개발하였다.

3. 영양교육 프로그램 적용성 평가

1) 평가 대상자

조사일(2023년 7월) 기준 장애인사회복지시설에 급식관리를 지원 중인 전국 사회복지급식관리지원센터 24개소의 상담자를 대상으로 적용성을 평가하였다. 사회복지시설 장애인을 대상으로 한 영양교육 프로그램의 효과적인 적용성을 묻는 설문 URL과 개발된 영양교육 자료 일체를 각 센터의 대표 이메일 주소로 송부하였다. 2023년 7월 한 달간 설문조사를 진행하였으며, 최종

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적으로 설문에 응답한 26명의 응답을 대상으로 통계분석을 수행하였다.

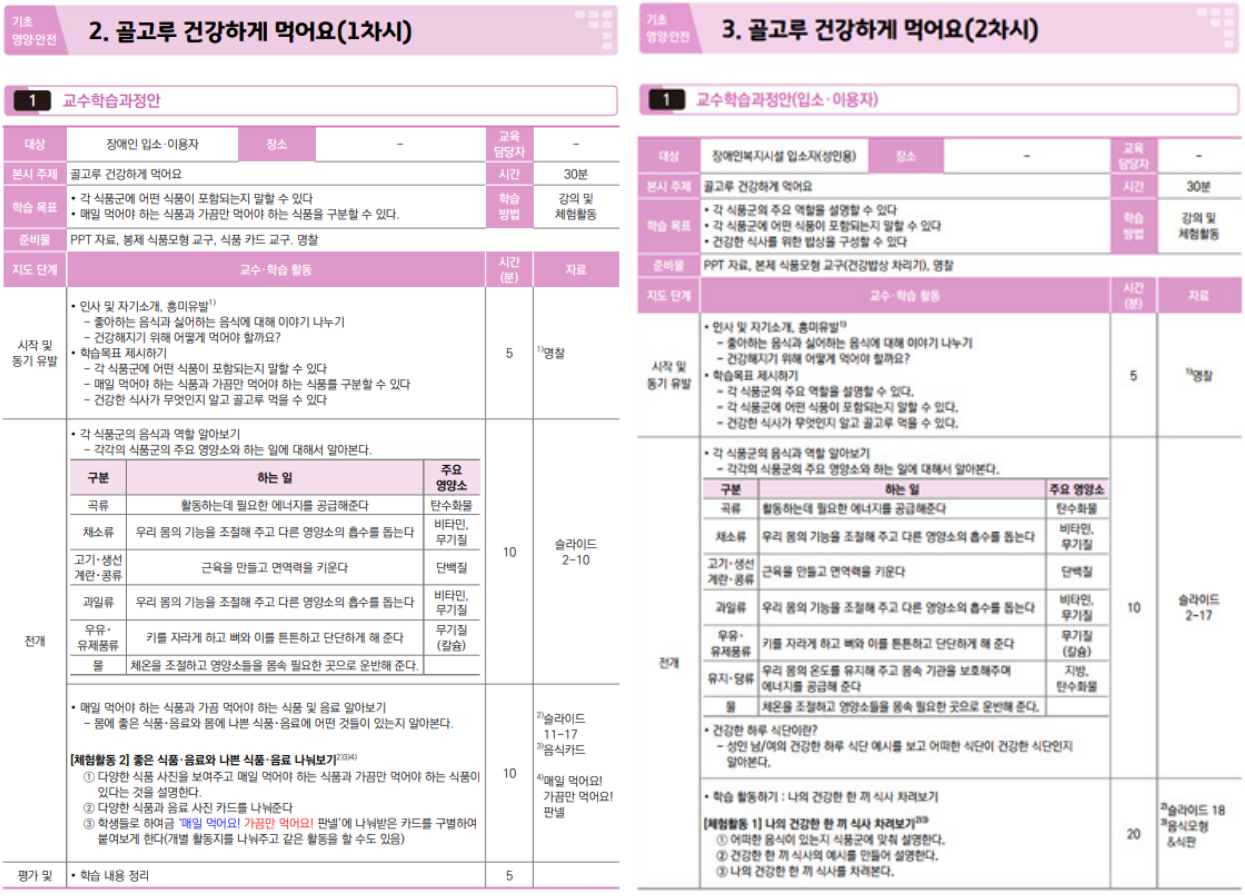
2) 평가도구 및 통계분석

설문지는 응답자 일반사항과 적용성 평가로 구성하였다. 일반사항은 조사대상자의 사회복지시설급식관리지원센터 근무 기간과 임상영양사 여부, 적용성 평가 항목은 각 교구별로 구성만족도, 활용성, 만족도, 대상자 학습능력에 대한 고려 등을 조사하였다. 총 24문항으로 각 문항은 5-Point Likert 척도를 사용하여 적용 가능 정도를 측정하였으며, 매우 그렇지 않다(1점)–매우 그렇다(5점)로 응답하도록 하였다. 개발된 영양교육 자료의 적용성을 평가를 확인하기 위해 IBM Statistical Package for Social Science (SPSS) ver. 26.0 (IBM Co.)을 이용하여 분석하였다. 응답자들의 일반적인 특성을 조사하기 위해 빈도분석(frequency analysis)을 사용하였으며, 영양교육 교구의 효과성을 평가하기 위해 기술통계를 사용하였다.

RESULTS

1. 교수학습과정안과 PPT 자료 개발

교수학습과정안의 구성은 Fig. 2와 같이 교육 주제와 교육 대상, 학습 목표, 강의 시간 및 준비할 교구에 대한 안내를 포함하였으며, 수업이 진행되는 순서와 교육 시 언급해야 하는 내용에 대해 제시하였다. 장애인사회복지시설의 입소 · 이용자를 대상으로 하는 교육과정을 구성하는데 기초와 심화단계의 2가지 난이도로 구성하였다. 기초단계에서는 대상자의 질환 유무와 관계없이 공통적으로 요구되는 개인위생관리와 균형 잡힌 식사를 위한 기초적인 영양지식과 식사법 교육을 구성하였으며, 심화단계에서는 대상자의 질환에 따른 건강 문제별 식사 관리법을 교육할 수 있도록 당뇨식과 저염식, 연하곤란 식사 관리를 위한 교육안을 마련하였다. 또한 개발된 교수학습과정안 관련 PPT를 개발하여 교육 시 활용할 수 있는 기초자료로 제공하였다(Fig. 3). 개발된 PPT는 대부분의 장애인사회복지시설 교육환경의 열악함으로 인해 PPT 화면을 작게 보는 경우를 고려하여 슬라이드 내 글씨 크기를 28포인트 이상이 되도록 하였다. 사회복지시



기초 영양안전 **2. 골고루 건강하게 먹어요(1차시)**

1 교수학습과정안

대상	장애인 입소·이용자	장소	-	교육 담당자	-
본시 주제	골고루 건강하게 먹어요			시간	30분
학습 목표	• 각 식품군에 어떤 식품이 포함되는지 말할 수 있다 • 매일 먹어야 하는 식품과 가끔만 먹어야 하는 식품을 구분할 수 있다.			학습 방법	강의 및 체험활동
준비물	PPT 자료, 봉제 식품모형 교구, 식품 카드 교구, 명찰				

지도 단계	교수·학습 활동	시간 (분)	자료
시작 및 동기 유발	• 인사 및 자기소개, 흥미유발[1] – 좋아하는 음식과 싫어하는 음식에 대해 이야기 나누기 – 건강해지기 위해 어떻게 먹어야 할까요? • 학습목표 제시하기 – 각 식품군에 어떤 식품이 포함되는지 말할 수 있다 – 매일 먹어야 하는 식품과 가끔만 먹어야 하는 식품을 구분할 수 있다 – 건강한 식사가 무엇인지 알고 골고루 먹을 수 있다	5	[1]명찰
전개	• 각 식품군의 음식과 역할 알아보기 – 각각의 식품군의 주요 영양소와 하는 일에 대해서 알아본다. 구분 / 하는 일 / 주요 영양소 곡류 / 활동하는데 필요한 에너지를 공급해준다 / 탄수화물 채소류 / 우리 몸의 기능을 조절해 주고 다른 영양소의 흡수를 돕는다 / 비타민, 무기질 고기·생선 계란·콩류 / 근육을 만들고 면역력을 키운다 / 단백질 과일류 / 우리 몸의 기능을 조절해 주고 다른 영양소의 흡수를 돕는다 / 비타민, 무기질 우유·유제품류 / 키를 자라게 하고 뼈와 이를 튼튼하고 단단하게 해 준다 / 무기질 (칼슘) 물 / 체온을 조절하고 영양소들을 몸속 필요한 곳으로 운반해 준다.	10	슬라이드 2–10
	• 매일 먹어야 하는 식품과 가끔 먹어야 하는 식품 및 음료 알아보기 – 몸에 좋은 식품·음료와 몸에 나쁜 식품·음료에 어떤 것들이 있는지 알아본다. **[체험활동 2] 좋은 식품·음료와 나쁜 식품·음료 나눠보기**[2][3][4] ① 다양한 식품 사진을 보여주고 매일 먹어야 하는 식품과 가끔만 먹어야 하는 식품이 있다는 것을 설명한다. ② 다양한 식품과 음료 사진 카드를 나눠준다 ③ 학생들로 하여금 '매일 먹어요! 가끔만 먹어요! 판넬'에 나눠받은 카드를 구별하여 붙여보게 한다(개별 활동지를 나눠주고 같은 활동을 할 수도 있음)	10	[2]슬라이드 11–17 [3]음식카드 [4]매일 먹어요! 가끔만 먹어요! 판넬
평가 및	• 학습 내용 정리	5	

기초 영양안전 **3. 골고루 건강하게 먹어요(2차시)**

1 교수학습과정안(입소·이용자)

대상	장애인복지시설 입소자(성인용)	장소	-	교육 담당자	-
본시 주제	골고루 건강하게 먹어요			시간	30분
학습 목표	• 각 식품군의 주요 역할을 설명할 수 있다 • 각 식품군에 어떤 식품이 포함되는지 말할 수 있다 • 건강한 식사를 위한 밥상을 구성할 수 있다			학습 방법	강의 및 체험활동
준비물	PPT 자료, 본제 식품모형 교구(건강밥상 차리기), 명찰				

지도 단계	교수·학습 활동	시간 (분)	자료
시작 및 동기 유발	• 인사 및 자기소개, 흥미유발[1] – 좋아하는 음식과 싫어하는 음식에 대해 이야기 나누기 – 건강해지기 위해 어떻게 먹어야 할까요? • 학습목표 제시하기 – 각 식품군의 주요 역할을 설명할 수 있다. – 각 식품군에 어떤 식품이 포함되는지 말할 수 있다. – 건강한 식사가 무엇인지 알고 골고루 먹을 수 있다.	5	[1]명찰
전개	• 각 식품군의 음식과 역할 알아보기 – 각각의 식품군의 주요 영양소와 하는 일에 대해서 알아본다. 구분 / 하는 일 / 주요 영양소 곡류 / 활동하는데 필요한 에너지를 공급해준다 / 탄수화물 채소류 / 우리 몸의 기능을 조절해 주고 다른 영양소의 흡수를 돕는다 / 비타민, 무기질 고기·생선 계란·콩류 / 근육을 만들고 면역력을 키운다 / 단백질 과일류 / 우리 몸의 기능을 조절해 주고 다른 영양소의 흡수를 돕는다 / 비타민, 무기질 우유·유제품류 / 키를 자라게 하고 뼈와 이를 튼튼하고 단단하게 해 준다 / 무기질 (칼슘) 유지·당류 / 우리 몸의 온도를 유지해 주고 몸속 기관을 보호해주며 에너지를 공급해 준다 / 지방, 탄수화물 물 / 체온을 조절하고 영양소들을 몸속 필요한 곳으로 운반해 준다. • 건강한 하루 식단이란? – 성인 남/여의 건강한 하루 식단 예시를 보고 어떠한 식단이 건강한 식단인지 알아본다.	10	슬라이드 2–17
	• 학습 활동하기 : 나의 건강한 한 끼 식사 차려보기 **[체험활동 1] 나의 건강한 한 끼 식사 차려보기**[2][3] ① 어떠한 음식이 있는지 식품군에 맞춰 설명한다. ② 건강한 한 끼 식사의 예시를 만들어 설명한다. ③ 나의 건강한 한 끼 식사를 차려본다.	20	[2]슬라이드 18 [3]음식모형 &식판

Fig. 2. The examples of the developed lesson plans.

설 장애인을 대상으로 한 개인위생관리 내용으로 손 위생, 호흡기 질환 예방을 위한 예절을 세부 주제로 선정하여 손과 공기를 통한 질병 전파의 위험성을 교육하고 손 씻기와 기침 예절을 강조하여 질병예방을 강조하였다. 균형잡힌 식생활 및 편식 예방은 장애인사회복지시설의 현장 요구도 조사[29]에서 가장 높은 요구도를 보였으며, 이는 사회복지시설 장애인들의 비만율에 영향을 주는 것으로 판단하여 반복교육이 이루어질 수 있도록 하였다. 예를 들어, 식품구성자전거를 활용하여 식품군에 대한 이해, 적정 섭취량, 골고루 먹기의 중요성을 다루는 기초적인 교육안을 포함하였으며, 식품의 파이토케미컬(phytochemical)을 기반으로 한 다양한 색깔의 식품 섭취 올림픽, 해외에서 어린이 편식 교육에 제안되는 Food Chaining [31] 기법을 활용한 식품 꼬리잡기, 식품 원재료에 대한 거부감을 줄이기 위한 촉감놀이 교육안을 개발하여 다양한 방법으로 골고루 먹기 교육에 노출될 수 있도록 하였다. 또한 질환이 있는 장애인을 대상으로 하여 당뇨환자의 경우 나타날 수 있는 고혈당과 저혈당의 증상 및 대처법, 당뇨관리를 위한 건강식품과 멀리해야 하는 식품의 구분에 대한 교육안을 개발하였다. 고혈압 관리를 위해서는 싱겁게 먹는 식습관, 염분이 적은 식품 선택 방법을 교육안에 담았다. 저작·연하곤란자의 경우 뇌병변 장애 또는 복합장애를 가지고 있는 경우가 다수이며, 관련 지식을 가지고 있어도 장애인은 스스로 관리가 어렵다[29, 30]. 따라서 구체적인 관리방법보다는 저작·연하곤란에 대한 이해를 높이기 위한 기초적인 설명과 섭취에 주의해야 하는 식품을 소개하는 내용으로 교육안을 개발하였다.

2. 개인활동지

개인활동지는 장애인 입소·이용자가 글을 읽지 못하는 경우에도 흥미를 가지고 참여할 수 있도록 화려한 색깔의 그림 위주로 개발하고자 하였다(Fig. 4). 교육제공자가 PPT를 활용하여 교육을 제공한 후 대상자의 교육에 대한 이해도를 확인할 수 있는 내용으로 구성하였으며 카드 선택하기, 스티커 붙이기, 색칠하기 등 낮은 난이도의 활동지를 개발하였다.

3. 체험교구

골고루 먹기와 1인 1회 적정량을 교육하기 위한 봉제 식품모형을 개발하였다(Fig. 5). 인지능력이 낮은 어린이의 놀이 시 안전사고 조사[32]에 따르면 작은 장난감을 입에 넣어 발생하는 '삼킴'사고와 '부딪힘'사고가 가장 많이 발생하는 것으로 조사되었다. 이에 딱딱하고 무거운 플라스틱으로 제작되는 기존의 식품모형의 경우 인지능력이 낮은 장애인이 활용할 때 작은 조각을 음식으로 오인해 입에 넣거나 활동 시 던지거나 하는 등의 안전사고가 발생하는 것을 예방하기 위해 보다 안전한 봉제인형 형태의 식품모형을 개발하였다. 다만 봉제교구의 특성상 위생관리의 우려가 있어 주의가 필요하다. 식품모형은 6가지 식품군 중 영양섭취의 필요성, 섭취빈도, 선호도를 고려하여 밥류 6종, 국·찌개류 6종, 반찬 14종, 간식 10종의 뒷면에 자석이 붙어 있는 봉제 식품 모형과 모형을 붙여볼 수 있는 자석식판으로 구성하였다. 개발된 모형은 실제 음식 사진을 이용해 실물 사이즈로 제작하였으며 식판에 식품 모형을 붙여보며 식단을 구성해

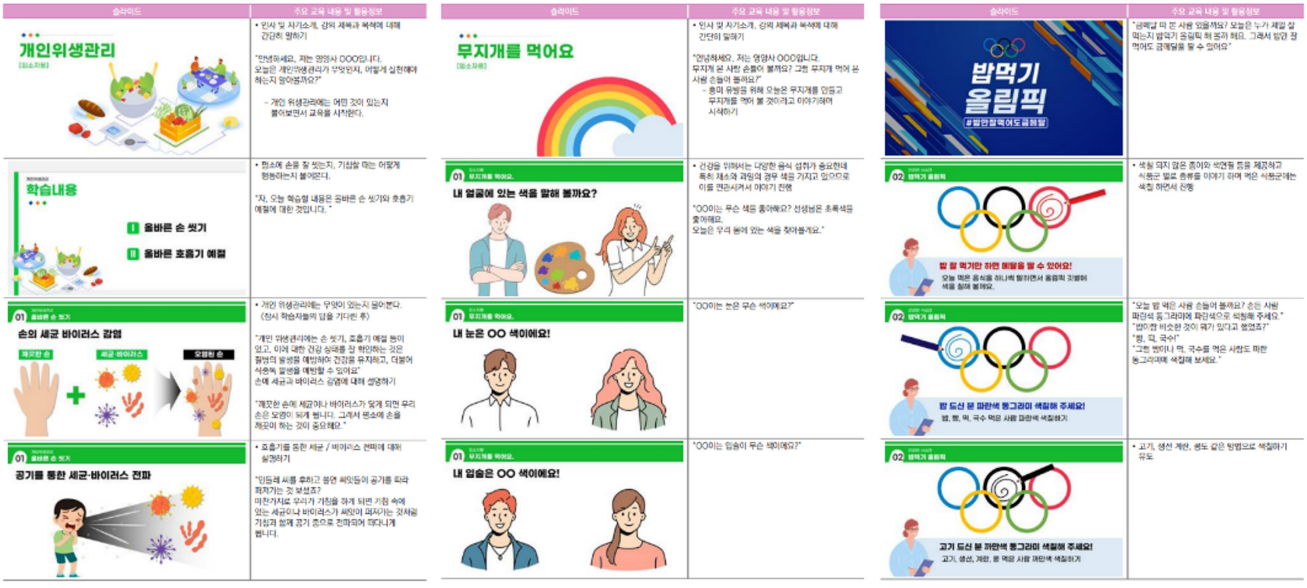


Fig. 3. The examples of the developed PPT materials.

https://doi.org/10.5720/kjcn.2025.00017

Fig. 4. Example of developed individual activity sheet.

Fig. 5. Examples of developed experiential learning tools.

보는 방식으로 "골고루 먹기" 주제 교육 시 사용될 수 있도록 하였으며, 각 모형의 크기를 확인하여 "1회 적정 식사량" 교육에도 활용할 수 있도록 하였다.

4. 적용성 평가

1) 평가자 일반사항

장애인사회복지시설을 대상으로 제공하고자 개발된 영양 프로그램의 적용성을 확인하고자 본 연구의 주제와 적합한 전국 24개소 사회복지급식관리지원센터의 상담사 26명을 대상으로 질문하였으며, 응답자 일반사항은 Table 1에 나타내었다.

2) 교수학습안과 PPT의 적용성 평가

교수학습안과 PPT에 대한 적용성을 평가한 결과를 Table 2에 나타내었다. 대상자에게 필요한 내용으로 구성되었는가에 대한 항목이 4.37점(±0.66)으로 적용성이 가장 높은 것으로 나타났으며, 전체 평균이 4.15점(±0.87)으로 높게 평가하였다. 그러나 학습능력에 대한 고려(4.00±1.00)와 현장 활용성(3.89±1.08) 면에서의 적용성이 상대적으로 낮게 조사되어 이에 대한 수정 및 보완의 필요성이 제기되었다.

3) 체험교구의 적용성 평가

체험교구에 대해서는 교육의 목적에 달성하기에 적합할지를 묻

Table 1. General information of respondents (n = 26)

Item	Classification	Frequency
Children/Social Welfare Meal Management Support Center (working period)	Less than 1 year	3 (11.54)
	1 year or more to less than 3 years	9 (34.62)
	3 years or more to less than 5 years	4 (15.38)
	5 years or more	10 (38.46)
Whether you are a clinical nutritionist	Yes	9 (34.62)
	No	17 (65.38)
Total		26 (100)

n (%).

Table 2. Applicability evaluation of teaching and learning plan and PPT (n = 26)

Type	Item	Score
Teaching and learning plan & PPT	Composition of necessary content	4.37 ± 0.66
	Ease of revision and supplementation	4.26 ± 0.69
	Effective delivery of teaching and learning methods	4.23 ± 0.82
	Willingness to use	4.22 ± 0.82
	Satisfaction	4.08 ± 0.96
	Consideration of learning ability	4.00 ± 1.00
	Applicability	3.89 ± 1.08
Average		4.15 ± 0.87

Mean ± SD.
The 5-point Likert scale (1: not at all, 5: very much).

는 항목이 4.30점(±0.69)으로 가장 높게 평가되었고 활용도에 대한 점수가 4.00점(±0.87)으로 상대적으로 낮게 나타났으나 평균점수 4.17점(±0.80)으로 적용성이 높을 것으로 평가되었다 (Table 3).

4) 최종 영양교육 프로그램의 개발

사회복지급식관리지원센터 상담자들을 대상으로 한 설문조사 분석 결과를 반영하여 개발된 영양교육 프로그램을 수정 및 보완하였으며, 최종적으로 사회복지시설 장애인을 대상으로 한 영양교육 프로그램을 제안하였다(Table 4). 적용성 평가 결과를 분석하여 교수학습과정안에 제시된 교육 내용을 보다 단순화하였으며, 개인활동지와 체험교구를 활용하는 데 소요되는 시간을 연장하여 이론교육 보다는 활동을 통한 교육의 비중을 높였다. 또한 교육 난이도를 6–10세 대상으로 하여 교육안을 개발하였으나, 연령대를 6–8세의 아동 교육을 기준으로 난이도를 조정하였다.

Table 3. Applicability evaluation of the experiential teaching tools (n = 26)

Type	Item	Score
Experiential teaching tools	Feasibility of achieving educational objectives	4.30 ± 0.69
	Willingness to use	4.26 ± 0.67
	Consideration of learning ability	4.19 ± 0.87
	Satisfaction	4.11 ± 0.84
	Applicability	4.00 ± 0.87
Average		4.17 ± 0.80

Mean ± SD.
The 5-point Likert scale (1: not at all, 5: very much).

DISCUSSION

본 연구는 사회인지이론을 바탕으로 장애인사회복지 시설을 이용 중인 장애인의 건강증진을 위해 영양교육 프로그램 개발을 목적으로 수행하였다. 개발된 영양교육 프로그램은 장애인 사회복지시설에서 영양교육을 제공하는 사회복지급식관리지원센터 상담사의 평가를 통해 영양교육 자료의 적용성을 확인하고 수정 및 보완하였다. 이에 사회복지시설 장애인을 대상으로 한 영양교육 프로그램 개발의 내용과 제언은 다음과 같다.

본 연구에서 개발한 교육 프로그램은 사회복지시설 입소·이용 장애인의 특성을 고려하여 대면교육 시 흥미위주의 활동적인 교육과정을 개발하는 데 중점을 두었다. 이를 위해 교육과정 개발 시 선행연구[29, 30]를 통해 도출된 교육의 요구도를 적극적으로 반영하여 각 교육 프로그램 주제별 활동 교구를 개발하였다. 시설종사자를 대상으로 심층면담을 실시한 연구[30]에서는 발달장애인의 비율이 높은 장애인사회복지시설 입소·이용자를 대상으로 한 영양교육의 효과를 높이기 위해서는 집중을 유발하고 유지시킬 수 있는 다양한 매체의 활용이 필요하다고 하였다. 또한 관련된 설문조사 연구[29]에서도 장애인사회복지시설의 발달장애인의 비율이 92.6%에 달하는 것으로 조사되었으며, 이들을 대상으로 한 영양교육 방법으로 활동을 포함한 대면교육에 대한 선호도가 높았다. 따라서 사회복지시설 장애인을 위한 영양교육 프로그램은 대면교육 중심으로 개발되었으며, 대상자의 특성을 고려하여 6–8세의 난이도로 내용을 구성하였다. 또한 반복교육을 강조한 선행연구 결과[30]를 반영하여 동일한 내용에 대해 새로운 PPT와 교구를 개발하여 반복교육 할 수 있도록 구성하였다. 체험교구의 경우 집중력 향상을 위해 화려한 색감의 사진을 사용하였으며, 1회 식사량을 보고 쉽게 익힐 수 있게 하려고 실제 음식 크기와 동일하게 제작하였다. 또한 인지능력이 낮은 발달장애인의 안전사고 예방을 위해 딱딱하지 않은 봉제인형을 모형 재질로 채택하였다. 학령 전 아동을 대상으로 진행된 영양교육 프로그램 연구 결과[33]에서

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Table 4. Education program planning for residents and users

Category	Area	Topic	Content	Educational theory components	Related educational materials
Basic	Hygiene · Safety	1. Personal hygiene management	1. Learn about personal hygiene management - Bacterial/viral infection through hands - Bacterial/viral infection through respiratory system - Importance of hand washing and respiratory etiquette 2. Learn about proper hand washing - Demonstration of hand washing method 3. Learn about proper respiratory etiquette - Practice etiquette when coughing or sneezing	Behavioral performance Observational learning Self-efficacy	Teaching and learning plan/PPT
	Nutrition · Safety	1. Eat a balanced and healthy (1st period)	Food and role of each food group Division of foods that should be eaten every day and foods that should be eaten only occasionally	Behavioral performance	Teaching and learning plan/PPT Food card & panel design Stuffed food model & magnetic plate
		2. Eat a balanced and healthy (2nd period)	Main role of each food group Example of a healthy daily diet report: track my meals and try it out	Behavioral performance Observational learning Outcome expectations	Teaching and learning plan/PPT Stuffed food model & magnetic plate Basics
		3. Eat the rainbow	Learn about rainbow-colored fruits and vegetables Eat the fruits of the colors you learned together Complete the rainbow by attaching stickers of the colors you ate for a week after the lesson	Behavioral performance Observational learning Self-efficacy	Teaching and learning plan/PPT Rainbow activity sheet Sticker design
		4. Food tagging	Good food points (e.g., nuts) Food Chaining through sight and touch	Behavioral performance Outcome expectations	Teaching and learning plan/PPT
		5. Tactile play	Good points of one vegetable/fruit Reducing food aversion through tactile play with the vegetables/fruits described	Behavioral performance Self-efficacy	Teaching and learning plan/PPT
		6. Eating well Olympics	Understanding food groups through food composition bicycles Fill in the circle by consuming all items in each food group	Behavioral performance Self-efficacy Outcome expectations	Teaching and learning plan/PPT Olympic activity sheet
		7. Food composition bicycle	Food composition bicycle description Making my one-meal bicycle	Behavioral performance Self-efficacy	Teaching and learning plan/PPT Food composition bicycle activity sheet
Advanced	Nutrition · Safety	1. What is diabetes?	Hyperglycemia symptoms/hypoglycemia symptoms and coping methods Diabetes and simple sugars Food selection for diabetes management	Behavioral performance Expected results	Teaching and learning plan/PPT
		2. Eat lightly	Blood pressure increases when eating high-salt meals Know the recommended daily salt intake Know high-salt foods/choose low-salt foods	Behavioral performance Expected results Self-efficacy	Teaching and learning plan/PPT
		3. Difficulty chewing and swallowing Dietary guidelines	Explanation of chewing and swallowing difficulties	Behavioral performance Expected results	Teaching and learning plan/PPT

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는 교육에 흥미를 유발하고 적극적으로 참여하도록 게임을 통해 아동 영양교육을 진행했을 때 교육의 효과가 높다고 하였다. 유아를 대상으로 영양교육 프로그램 개발 및 적용 효과를 확인한 선행연구[34]에서도 단순 PPT 슬라이드를 통한 강의식 교육보다 퍼즐과 스티커를 이용한 놀이 프로그램이 효과적이었으며, 이에 건강에 대한 동기유발과 교육의 반복적인 제공을 위해 다양한 게임 교구가 개발되어야 한다고 하였다. 독일의 식품 회사에서도 장애인을 위해 실용적이고 시각적인 장애인 영양교육(Ernährungsbildung für Menschen mit Behinderung) 프로그램을 개발한 바 있다[35]. 본 연구에서 수행한 적용성 평가에서도 개발된 교구가 영양교육 목적 달성에 도움이 될 것이라는 응답이 4.30점으로 높게 나타났으며, 그 외에도 교구에 대한 만족도 및 활용도, 활용의향의 모든 응답에서 4.0점 이상의 긍정적인 평가를 확인할 수 있었다. 따라서 장애인 대상 효과적인 영양교육 프로그램을 개발하기 위해서는 교육의 시작점부터 대상자의 흥미를 유발할 뿐만 아니라, 20–30분의 교육시간 동안 유발된 흥미를 유지할 수 있는 다채로운 활동 교구가 개발되어야 할 것이다. 또한 장애인사회복지시설의 경우 시설종사자 대상 영양교육 프로그램의 개발이 중요하다. 본 연구에서 개발한 영양교육 프로그램에 대한 적용성 평가 결과, 난이도와 활용성에 대한 평가가 상대적으로 낮았다. 이는 같은 발달장애인 일지라도 인지력이 다양한 입소 · 이용자로 구성된 사회복지시설의 특성상 동일한 영양교육 프로그램 내에서 효과를 기대하는 데에는 한계가 있기 때문으로 분석된다. 따라서 전문가를 활용하여 장애인을 대상으로 직접 교육을 하는 것도 중요하나, 돌봄의 주체자로서 가까이서 장애인을 만나는 시설종사자들을 대상으로 한 영양교육이 정기적으로 이루어진다면 간접적이지만 장기적으로 장애인의 식생활 개선에 긍정적인 영향을 줄 것으로 생각된다. 장애인사회복지시설의 영양교육에 대한 질적연구[30]에서는, 교육의 효과가 매우 제한되는 장애인을 대상으로 한 영양교육은 잦은 노출이 매우 중요하며 이를 위해서는 시설종사자를 대상으로 한 교육이 제공되어야 한다고 하였다. 장애인복지시설 종사자를 대상으로 한 설문조사 결과[29]에서도, 응답자들의 24.6%가 시설 입소자 · 이용자를 대상으로 한 영양교육이 필요하다고 응답한 반면, 시설종사자 대상의 교육이 필요하다고 답한 응답자가 23%에 달하였다. 그러나 장애인 돌봄 인력이 부족한 상황에서의 영양교육에 대한 부담을 느끼고 있었으며, 이러한 이유로 동영상, 유인물 등의 비대면 영양교육에 대한 요구도가 높았다. 최근 정부 및 지자체에서 수행하는 다양한 교육활동에서는 카드뉴스와 인포그래픽 등 비대면 교육자료의 제공방법이 다양해지고 있으며[36], 카드뉴스의 경우 디지털, 모바일을 익숙하게 접하는 현재의 생활환경에서 선호되는 매체 형식으로 지속적으로 활용될 것으로 전망된다. 장애인사회복지시설의 영양교육 주제에 대한 선행연구[29, 30] 결과에서 모든 대상자별 개인 위생관리의 필요성이 가장 높게 나타났으며, 입소 · 이용자의 다빈도 질환에 대해서는 비만, 고혈압, 당뇨 순으로 확인되었다. 따라서 비만 관리, 편식 예방 등 주제로 장애인사회복지시설의 영양교육 프로그램이 필요한 실정이며, 본 연구에서 입소자 · 이용자대상으로 개발한 영양교육 프로그램의 주제로 개인위생 관리가 포함된 식사 예절과 기초 식품군 교육을 통한 편식 예방과 비만 관리가 기초과정에 도출되었으며, 심화과정으로는 만성질환 관리를 위한 고혈압 식사관리, 당뇨 식사관리, 연하곤란 시 식사 원칙이 선정되었다. 본 연구의 결과는 현재 연구가 매우 미비한 사회복지시설 장애인을 대상으로 한 영양교육자료를 개발하였다는 점에서 큰 의미가 있으며, 향후 장애인 대상 영양교육 자료 개발의 기초자료로 활용될 수 있을 것이다. 특히 본 연구를 통해 개발된 영양교육 자료를 장애인주간보호센터, 장애인거주시설 등 다양한 장애인 관련 복지기관으로 확대하여 활용한다면 장애인의 건강증진과 삶의 질 향상에 기여할 수 있을 것이다.

Limitations

본 연구는 다음과 같은 제한점이 있다. 첫째, 장애인대상 영양교육 프로그램 적용성 평가를 전국의 사회복지급식관리지원센터 상담사 26명을 대상으로 실시되어 연구 결과를 전체 모든 경우로 일반화하기에 한계가 있다. 둘째, 장애의 종류가 신체 또는 정신적 상태에 따라 다양하게 분류될 수 있으나, 본 연구에서는 장애인사회복지시설의 발달장애인 비율을 고려하여 교육대상자를 발달장애인으로 한정하여 교육 프로그램을 개발하였다. 이에 예외사항이 존재할 가능성이 있다는 점에서 한계를 갖는다. 셋째, 사회복지시설의 장애인을 위한 교육자료 개발을 목적으로 하였으나, 시설의 협조와 교육이 가능한 시기 등과 같은 현실적인 어려움으로 인해 장애인을 대상으로 교육 프로그램의 효과를 확인하지 못하였다는 아쉬움이 있다. 따라서 향후연구를 통해 장애인을 대상으로 한 영양교육 프로그램을 운영하고 전-후 효과를 확인한다면 연구의 완성도를 높일 수 있을 것으로 기대된다.

Conclusion

본 연구는 현재 장애인 대상 영양교육 프로그램 연구 및 개발이 부족하다는 점을 확인하고, 장애인 사회복지지설을 위한 영양관리 지원을 더욱 강화할 필요성을 제시하였다는 점에서 의미가 있다. 또한 개발된 영양교육 프로그램이 장애인사회복지시설을 방문하여 영양교육을 시행하는 사회복지급식관리지원센터 상담사들의 실무적인 적용성 평가를 통해 수정 및 보완되었다는 점에서 가치가 있다. 따라서 본 연구를 통해 개발된 영양교육 프로그램이 장애인사회복지시설의 영양교육 활성화 방안으로 적극 활용되기를 기대한다.

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CONFLICT OF INTEREST

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

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DATA AVAILABILITY

Research data is available upon request to the corresponding author.

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Research Article

소비자 라이프스타일에 따른 돼지고기 소비 속성 요인 분석: 단면조사 연구

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Analysis of pork consumption attribute factors by consumer lifestyle in Korea: a cross-sectional study

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Objectives: This study aims to identify and analyze how different South Korean lifestyles impact attitudes towards pork consumption.

Methods: We implemented a cross-sectional survey targeting 705 adult consumers in South Korea using hierarchical and K-means cluster analyses. Respondents were classified into three relevant lifestyles: (1) domestic preference, (2) price-sensitive, and (3) quality-experience-oriented. The importance-performance analysis was employed to evaluate discrepancies between how they rated pork consumption using factors of “importance” and “satisfaction”. We employed Borich’s needs assessment and the Locus for Focus model.

Results: The research findings highlight that unpleasant odor (Q7) and hygiene (Q1) were common key areas for management across all consumer groups, emphasizing their importance in enhancing pork consumption satisfaction. Among the groups, the domestic preference group showed high importance-performance discrepancies in attributes like expiry date (D2), suggesting a need for strengthened trust in domestic pork distribution and information transparency. The price-sensitive group prioritized economic factors, with fat thickness (Q8) identified as an essential management area. The quality-experience-oriented group emphasized sensory qualities such as juiciness (Q6) and meat color (Q5), with off-flavors (Q7) displaying the largest discrepancy. These results show the significant role of sensory attributes in consumer satisfaction.

Conclusion: This study demonstrated the multidimensional nature of pork consumption behavior, emphasizing the need for tailored strategies across consumer groups. Managing hygiene (Q1) and reducing unpleasant odor (Q7) are critical for all segments, while group-specific strategies include managing sensory quality for the quality-experience-oriented group, providing product information (D2) to increase trust for the domestic preference group, and emphasizing value for money for the price-sensitive group.

Keywords: consumer behavior; life style; pork meat; food quality; food preferences

INTRODUCTION

소비자 라이프스타일은 개인의 가치관, 활동, 관심사 및 의견을 종합적으로 반영하며, 소비 행동과 제품 선호도를 이해하는 데 있어 필수적인 요인으로 작용하고 있다[1]. 라이프스타일은 소비자의 전반적인 생활 방식과 가치 체계를 반영하는 지표로서, 특정 제품군에 대한 태도와 소비 패턴에 중요한 영향을 미친다[2]. 특히, 식품 소비 분야에서는 건강 및 환경 지속 가능성 등의 가치가 소비자의 구매 의사결정 과정에서 점차 중요하게 부각되고 있으며[3], 이러한 변화는 소비자의 식품 선택 및 소비 행동에 변화를 가져오고 있다.

특정 식품군에 대한 라이프스타일별 소비 행태를 심층적으로 탐구하는 것은 소비자 행동의 이론적 근거를 강화하고, 마케팅 전략 수립을 위한 실증적 자료를 제공하는 데 유용하다[4-6]. 육류 식품군에 해당하는 돼지고기는 전 세계적으로 소비되는 주요한 식재료로, 그 영양적 가치와 다양한 조리 가능성으로 인해 많은 소비자들이 선호하는 식품이다. 특히 한국 시장에서는 한돈 브랜드를 중심으로 품질 관리와 소비자 만족도 향상을 위한 다양한 방법이 시도되고 있다[7]. 그러나, 돼지고기 소비에 대한 연구는 다른 식품군에 비해 절대적으로 부족하며, 특히 소비자의 라이프스타일에 따른 세분화된 분석은 거의 이루어지지 않았다[8, 9].

기존 연구들은 소비자 라이프스타일이 식품 선호도와 태도 형성에 미치는 영향을 중점적으로 분석하였다. Grunert & Wills (2007) [10]는 건강 중심적 라이프스타일이 식품표시 정보 활용 및 제품 선호도 형성에 미치는 영향을 보고하였고, Verbeke (2005) [11]는 건강기능성 식품 소비와 건강 지향적 태도 간의 관계를 분석하였다. 또한, Scholderer & Grunert (2005) [12]는 편리성을 중시하는 라이프스타일이 가공식품 소비 행동에 미치는 영향을 탐색하였다. 그러나, 돼지고기 소비를 대상으로 한 연구는 주로 소비 전반의 선호도와 일반적인 소비 행동패턴을 위주로 수행되었으며, 라이프스타일에 따른 소비 행태의 차이를 심층적으로 분석하지는 못하였다. 이러한 한계로 인해 돼지고기를 구매하는 소비자의 다양한 특성과 요구를 반영한 맞춤형 전략 수립에 필요한 과학적 근거를 충분히 제공하지 못하고 있다.

본 연구는 국내 돼지고기 소비와 관련된 소비자 라이프스타일 유형을 규명하고, 이러한 유형이 돼지고기의 중요도 및 소비자 만족도에 미치는 영향을 실증적으로 분석하는 것을 목적으로 한다. 특히, 기존 연구가 돼지고기 소비자의 전반적인 태도나 선호도를 설명하는 데 그쳤다면, 본 연구는 라이프스타일을 기반으로 소비자 그룹을 세분화하고, 각 그룹별 소비 행태 및 태도의 차이를 비교·분석하는 점에서 차별성을 갖는다. 이를 위해 본 연구에서는 군집 분석을 통해 소비자 유형을 도출하고, 군집별로 돼지고기 소비 동기와 태도의 차이를 심층적으로 분석하였다. 이러한 연구 접근법은 소비자의 라이프스타일에 따른 맞춤형 마케팅 전략 수립뿐만 아니라, 소비자의 만족도를 높이는 실질적인 방안을 도출하는 데 기여할 것이다. 또한, 본 연구 결과는 돼지고기 산업의 소비자 중심적 전략을 설계하는 데 필요한 과학적 근거를 제공할 뿐만 아니라, 향후 식품산업 전반에서 소비자 특성을 반영한 차별화된 마케팅 및 정책 수립에도 활용될 수 있을 것이다.

METHODS

Ethics statement

The written informed consent was obtained from all participants and or/the guardians for the survey. The survey procedures and protocols were approved by the Institutional Review Board of Kunsan National University (IRB No. 1040117-202209-HR-027-02).

1. 연구설계

본 연구는 단면연구로 설계되었으며, Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) 보고 지침을 참고하여 기술하였다(https://www.strobe-statement.org/).

2. 연구대상 및 기간

연구대상자는 대한영양사협회의 협조를 받아 산업체, 학교, 병원, 사회복지시설 등에서 근무하는 영양사를 통해 평소 돼지고기를 직접 구매하여 조리하는 대도시, 중소도시, 읍·면 지역 거주 성인 남녀(만 19세–64세)로 선정하였다. 연구대상자는 비확률표집 방법 중 하나인 눈덩이 표집법(snowball sampling)을 활용하여 모집하였으며, 연구의 목적에 부합하는 응답자를 중심으로 표본을 확장하였다. 대한민국 내 17개 시·도를 대상으로 실시하였으며, 참여자는 자발적으로 연구에 참여하였다. 연구의 대표성을 확보하기 위해 각 지역의 인구 비율이 특정 지역에 편중되지 않도록 응답자를 모집하였으며, 최종적으로 서울(130명, 18.4%), 경기도(104명, 14.8%), 울산(86명, 12.2%), 대구(54명, 7.7%), 부산(48명, 6.8%) 등에 거주자를 포함하여 총 705명의 연구대상자를 모집하였다. 조사의 대상은 만 18세 이상의 성인이었으며, 설문 링크를 전달하여 온라인 설문조사로 진행되었다. 참여자는 설문조사는 2022년 11월 11일부터 11월 23일까지 13일간 진행되었다. 총 885명이 설문에 참여하였고, 이 중 설문조사를 완료한 응답자는 705명으로, 중도 탈락률은 20.3%이다.

3. 연구내용 및 방법

1) 설문지 구성

본 설문지는 응답자의 인구통계학적 및 사회경제적 특성 등을

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파악하기 위한 질문을 포함하였다. 설문 내용은 성별, 연령, 직업 등의 문항으로 시작하여, 거주지의 형태와 지역에 대한 정보를 포함하여 연구대상자의 인구통계학적 특성을 조사하였다. 또한, 가구원수와 가구 월 소득 정보를 수집하고 대상자의 교육 수준에 대한 문항도 포함하여 사회경제적 특성을 파악하고자 하였다.

본 조사는 돼지고기 소비 관련 라이프스타일을 측정하기 위한 문항을 포함하며, 소비자의 돼지고기 구매와 소비 행동, 태도에 대한 다차원적인 정보를 수집하는 데 중점을 두었다. 설문지는 총 17개의 문항으로 구성되었으며, 모든 문항은 5점 Likert 척도를 사용하여 중요도를 평가하였다. 척도는 "전혀 중요하지 않다(1점)"에서 "매우 중요하다(5점)"까지로 구성되었다. 설문 문항은 소비자의 돼지고기 소비와 관련된 동기, 선호도, 태도, 및 행동을 반영하도록 개발되었으며, 크게 다섯 가지 범주로 구분된다[13-15]. 첫째, 맛과 품질에 대한 관심을 측정하는 문항으로 "맛있는 돼지고기를 구입하기 위해 찾아다닌다"라는 문항이 포함되었다. 둘째, 브랜드 및 신뢰도에 대한 태도를 측정하는 문항으로 "가급적이면 브랜드 돼지고기를 구입하려고 노력한다" 등이 있다. 셋째, 음식 경험과 탐구적 태도를 조사하는 문항으로 "새로운 돼지고기 요리를 먹어보는 것을 좋아한다"가 포함되었다. 넷째, 경제적 및 실용적 요인을 반영한 "좋아하는 부위가 있어도 가격 때문에 다른 부위를 살 때가 많다"라는 문항이 포함되었다. 마지막으로, 국내산과 수입산에 대한 선호도를 측정하기 위해 "수입 돼지고기는 왠지 먹기가 불안하다"라는 문항이 포함되었다.

본 연구의 설문지는 돼지고기 구매 시 소비자가 고려하는 주요한 요인을 파악하기 위한 항목으로 설계하였다. 설문 항목은 생산, 품질, 유통 및 표시, 구매 및 조리 관련 요인으로 구분되어 총 25개의 문항으로 구성되었으며, 각 항목은 5점 Likert 척도를 사용하여 중요도를 측정하였다. 항목의 응답 척도는 "전혀 중요하지 않다(1점)"에서 "매우 중요하다(5점)"까지로 구성되었다. 생산 관련 항목에서는 돼지고기의 안전성과 신뢰성을 측정하기 위해 '무항생제 여부', '국내산 돼지고기' 등이 포함되었다[16-18]. 품질 관련 항목은 돼지고기의 내·외적 특성을 반영하며, '위생상태', '연도(부드러운 정도)', '육즙', '지방의 두께' 등의 요소를 포함하였다[14, 19]. 유통 및 표시 관련 항목에서는 돼지고기의 보관 환경과 유통 과정의 신뢰성을 평가하기 위해 '보관 상태(냉장/냉동)', '유통기한' 등이 포함되었다[20, 21]. 마지막으로, 구매 및 조리 관련 영역은 '구매의 편리성'과 '조리의 다양성' 등의 문항으로 구성되었다[22].

만족도 평가 설문에서는 중요도와 동일한 구조의 문항을 사용하되, 국내산 돼지고기 구입 시 만족도에 대한 조사이므로 중요도 평가항목에 포함된 '국내산 돼지고기' 항목은 생략되었다. 이는 만족도 평가에서 특정 생산지에 대한 일반적 선호도를 직접적으로 측정하기보다는 개별 속성(예, 품질, 유통 등)과의 만족도를 보다 세분화하여 분석하고자 하였다. 이를 통해 소비자들이 국내산 돼지고기의 개별 속성에 대한 만족도를 더욱 구체적으로 파악할 수 있다.

2) 측정도구의 타당도 및 신뢰도 검증

본 연구에서는 돼지고기 소비 관련 라이프스타일 17개 문항의 타당도와 신뢰도를 검증하기 위해 요인분석과 신뢰도 분석을 실시하였다. 먼저, 요인분석의 적합성을 평가하기 위해 Kaiser-Meyer-Olkin (KMO) 검정과 Bartlett의 구형성 검정을 수행한 결과, KMO 값은 0.7 이상, Bartlett 검정의 유의확률(*P*-value)은 0.05 미만으로 나타나 요인분석이 적절한 것으로 확인되었다[23]. 요인분석은 주성분분석(principal component analysis)을 활용하여 수행하였으며, 고유값(eigenvalue) 1 이상인 요인만을 추출하였다. 요인 회전은 요인 간 상관을 최소화하고 보다 명확한 요인 구조를 도출하기 위해 직교회전 방법인 배리맥스(varimax) 회전을 적용하였다. 또한, 측정도구의 신뢰성을 평가하기 위해 Cronbach's α 계수를 활용하여 내적 일관성을 검토하였다. 신뢰도 분석 결과, Cronbach's α값은 0.764로 나타나 측정 항목 간 높은 신뢰도를 확인할 수 있었다. 분석을 통해 측정도구의 구성 타당도(construct validity)가 확보되었으며, 신뢰도 분석을 통해 도구의 내적 일관성(internal consistency)이 높은 수준임을 검증하였다.

3) 소비자 유형분류 및 군집분석

본 연구에서는 소비자의 돼지고기 소비 관련 라이프스타일 유형에 따른 집단을 구분하고, 각 군집의 특성을 분석하기 위해 군집 분석(cluster analysis)을 실시하였다[24]. 이를 위해 연구대상자 705명의 응답 데이터를 활용하였으며, 최종 군집 분석에는 돼지고기 소비 관련 라이프스타일 17개 문항 중 요인적재량이 낮은 2개 항목을 제외하고 15개 항목을 사용하였다. 군집 분석 방법으로는 계층적 군집 분석(hierarchical cluster analysis)을 통해 적절한 군집 수를 확인한 후, K-평균 군집 분석(K-means cluster analysis)을 실시하였다[25]. 계층적 군집 분석에서는 Ward's 방법과 제곱 유클리디안 거리(Euclidean distance)를 적용하였고, 덴드로그램(dendrogram)을 통해 3개 군집이 적절한 것으로 나타났다[26]. 각 군집 특성을 분석하기 위해 군집 중심값과 변수별 평균값을 비교하였으며, 이를 통해 군집 별 돼지고기 구매 및 소비 행태의 차이를 확인하였다.

4. 자료분석

본 연구는 IBM SPSS Statistics 27 (IBM Co.)을 활용하여 통계분석을 실시하였다. 그룹 간 비율 차이와 연속 변수 차이를 분석하기 위해 카이제곱 검정(Chi-square test)과 분산분석(analysis of variance, ANOVA)을 활용하였다. 명목형 변수에 대해 그룹 간 비율 차이를 분석하기 위해 카이제곱 검정을 수행하였

으며, 기대빈도가 5 미만인 셀이 포함된 경우에는 피셔의 정확 검정(Fisher's exact test)을 사용하였다. 분석 결과로 χ^2값(Chi-square statistic), *P*-value를 제시하여 비율 차이의 유의도를 평가하였다.

연속형 변수의 그룹 간 평균값 차이는 일원분산분석(one-way ANOVA)을 실시하여 검증하였다. ANOVA를 적용하기 전에 데이터의 정규성(normality)과 등분산성(homogeneity of variance) 가정을 검토하였으며, 정규성 검정에는 Shapiro-Wilk test, 등분산성 검정에는 Levene's test를 사용하였다. 만약 가정이 충족되지 않는 경우, Kruskal-Wallis test를 대안적으로 활용하였다. 분석 결과에서 유의미한 차이가 나타난 경우, 사후검정(post-hoc analysis) 방법인 Tukey's honestly significant difference 검정을 통해 그룹 간 평균 차이를 비교하였다.

본 연구에서는 군집분석과 importance-performance analysis (IPA)를 기반으로 한 Borich 요구도와 The Locus for Focus 모델을 활용하여 각 군집의 특성과 우선순위를 설정하고자 하였다[27-29]. 군집분석을 통해 응답자들을 국내산 선호형, 가격 민감형, 품질·경험 중시형 3개 그룹으로 분류하였다. 이후 각 군집 내에서 중요도와 만족도를 측정하고, Borich 요구도와 The Locus for Focus 모델을 이용하여 군집 별 우선순위를 설정하였다.

Borich 요구도 분석에서는 '(중요도 평균 – 수행도 평균) × 중요도 평균' 공식을 통해 각 항목의 요구도를 산출하고, 이를 기반으로 군집 별 관리 우선순위를 도출하였다. The Locus for Focus 모델은 가로축에 중요도, 세로축에 중요도와 만족도 간 차이를 배치하여 사분면을 나눈 후, 중요도가 높고 동시에 중요도와 만족도 간 차이가 큰 최우선 관리 영역을 중점적으로 분석하였다. 이를 통해 군집별로 중요도와 만족도 간 불일치가 높은 항목과 관리가 필요한 항목을 구체적으로 확인하였다.

RESULTS

1. 돼지고기 소비 관련 라이프스타일 요인 분석

요인분석을 통해 돼지고기 구매 및 소비 행동과 관련된 변수들에서 5개의 요인이 도출되었다. 각 요인은 관련 변수들의 적재량을 통해 구분되었으며, 주요 요인의 고유값, 설명력이 평가되었다. 요인 1은 고유값 2.752로 전체 변동성의 16.189%를 설명하며, 돼지고기 소비 시 품질과 맛을 중시하는 소비자 행동을 반영한다. 요인 2는 고유값 2.624로 전체 변동성의 15.436%를 설명하며, 돼지고기 소비에서 실용성과 요리 관련 행동을 중요시한다. 요인 3은 경제성을 중요시하며, 고유값은 1.967, 설명력은 11.569%로 나타났다. 요인 4는 돼지고기의 건강 및 영양적 가치를 고려하는 태도를 보이며, 요인 5는 가공 식품과 편리성을 중요하게 생각하는 소비자 태도를 반영한다.

요인 분석 결과는 돼지고기 소비 행동이 다차원적임을 확인하였으며, 각 요인은 소비자 세분화를 구분하기 중요한 기준으로 활용될 수 있다. 특히, 품질과 맛을 중시하는 행동(요인 1)과 실용성과 요리 관련 행동(요인 2)이 돼지고기 소비 결정에 주요한 요인으로 작용함을 확인하였다(Table 1).

2. 군집별 요인분석

군집별 요인 점수를 분석한 결과, 돼지고기 소비자 그룹 간 요인 점수에서 통계적으로 유의한 차이가 나타났다. 군집은 '국내산 선호형', '가격 민감형', '품질·경험 중시형'으로 구분되었다. 먼저, '품질 및 맛 중시형' 요인에서는 '품질·경험 중시형' 소비자 그룹이 가장 높은 평균 점수(4.21점)를 기록하여, 해당 군집이 돼지고기의 품질과 맛을 매우 중요시하는 특성을 보였다($P < 0.001$). 반면, '가격 민감형' 소비자 그룹은 이 요인에서 가장 낮은 평균 점수(2.88점)를 보여 품질보다는 가격을 우선시하는 경향을 확인할 수 있었다($P < 0.001$). '탐구적 미식형' 요인에서는 '품질·경험 중시형' 소비자 그룹이 가장 높은 점수(4.32점)를 기록하여, 이들이 새로운 요리와 맛에 대한 탐구적 성향이 강함을 보여주었다($P < 0.001$). 반면, '가격 민감형' 소비자 그룹은 비교적 낮은 점수(3.01점)를 나타내어 이러한 탐구적 미식적 행동이 유의적으로 적게 보이는 것을 알 수 있었다($P < 0.001$). '경제성 및 실용성 중시형' 요인에서는 '국내산 선호형' 소비자 그룹이 가장 낮은 점수(2.60점)를 보였으며, 반면에 '가격 민감형' 소비자 그룹은 2.90점, '품질·경험 중시형' 그룹이 3.09점으로 유의적으로 높은 점수를 보였다($P < 0.001$). '국내산 신뢰형' 요인에서는 '국내산 선호형' 소비자 그룹이 다른 그룹에 비해 현저히 높은 점수(4.11점)를 기록하여, 국내산 돼지고기에 대한 신뢰도가 높은 특성을 보여주었으나, '가격 민감형' 소비자 그룹은 유의적으로 가장 낮은 점수(3.01점)를 보였다($P < 0.001$). 마지막으로, '가공식품 및 밀키트 선호형' 요인에서는 '품질·경험 중시형' 소비자 그룹(2.60점)과 '가격 민감형' 소비자 그룹(2.53점)에서 높은 점수를 기록했으며, 반면에 이는 '국내산 선호형' 소비자 그룹(2.24점)에서는 유의적으로 낮은 점수를 보였다($P < 0.001$). 본 분석 결과는 소비자 그룹 간 돼지고기 소비 행동의 뚜렷한 차이를 확인하였으며, 각 그룹의 특성에 따라 차별화된 마케팅 접근이 필요함을 시사한다. 특히, 품질과 경험을 중시하는 그룹과 경제성을 중시하는 그룹 간의 명백한 차이는 소비자 세분화 전략의 유용성을 강조한다(Table 2).

3. 연구대상자의 일반사항

소비자 그룹 간 인구통계학적 특성 차이를 살펴보면, 연령은 세 소비자 그룹 간 유의한 차이를 보였으며($P = 0.027$), '국내산 선호형' 소비자 그룹의 평균 연령(44.01세)이 유의적으로 가장 높았다. 직업 분포 역시 유의한 차이가 나타났으며($P = 0.006$), 관리자, 전문가 및 관련 종사자 비율이 '국내산 선호형' 소비자 그룹에서 높은 반면, 단순 노무종사자 비율은 '가격 민감형' 소비

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Table 1. Factor analysis and reliability test results for pork consumption-related lifestyles (n = 705)

No.	Variable	Factor loadings[1)]					Eigenvalue (variance explained)	Cronbach's α
		Factor1	Factor2	Factor3	Factor4	Factor 5		
1	I look for and purchase high-quality pork.	0.839					2.752 (16.189%)	0.764
2	I actively seek out delicious pork to purchase.	0.828						
3	I have a good understanding of which type of pork tastes better, even within the same cut.	0.722						
4	I make an effort to purchase branded pork whenever possible.	0.517						
5	I enjoy eating pork when dining out.		0.808				2.624 (15.436%)	
6	I often decide on pork dishes for dinner impulsively.		0.771					
7	I enjoy trying new pork dishes.		0.722					
8	I am willing to invest significant time in cooking to create delicious pork dishes.		0.627					
9	Consuming pork is a multisensory experience and an engaging activity.		0.526					
10	I consume less domestically produced pork due to its high price.			0.824			1.967 (11.569%)	
11	Even if I have a preferred cut of pork, I often choose a different cut due to price considerations.			0.805				
12	I consume pork more for nutritional supplementation than for its taste.			0.575				
13	I place a high value on convenience when selecting pork dishes.			0.455				
14	I feel uneasy about consuming imported pork for some reason.				0.825		1.710 (10.056%)	
15	Domestically produced pork is definitely tastier than imported pork.				0.704			
16	When consuming pork at home, I prefer ready-to-cook meals or meal kits that can be prepared or heated quickly.					0.877	1.685 (9.913%)	
17	I tend to enjoy consuming processed pork products.					0.865		

Principal component analysis with varimax rotation.
[1)]Factor loading threshold: 0.4.

Table 2. Comparison of pork consumption factors across consumer groups

Factor[1), 2)]	Domestic preference consumer group (n = 275)	Price-sensitive consumer group (n = 175)	Quality- and experience-oriented consumer group (n = 255)	*P*-value
Quality and taste-oriented	3.76 ± 0.45[b]	2.88 ± 0.50[a]	4.21 ±0.54[c]	< 0.001
Explorative gourmet-oriented	3.39 ± 0.46[b]	3.01 ± 0.61[a]	4.32 ± 0.43[c]	< 0.001
Economy and practicality-oriented	2.60 ± 0.69[a]	2.90 ± 0.65[b]	3.09 ±0.87[c]	< 0.001
Trust in domestic pork	4.11 ± 0.75[c]	3.01 ± 0.90[a]	3.91 ±0.95[b]	< 0.001
Preference for processed foods and meal kits	2.24 ± 0.94[a]	2.53 ± 0.93[b]	2.60 ± 1.18[b]	< 0.001

Mean ± SD.
Tukey HSD test for post-hoc analysis.
[1)]Likert scale score from 1 (not important at all) to 5 (very important).
[2)]Superscripts (a, b, c) denote statistically significant differences between consumer groups.

자 그룹에서 8.6%로 다른 소비자 그룹에 비하여 높게 나타났다. 결혼 여부 또한 그룹 간 차이를 보였는데(P = 0.041), 기혼자 비율은 '국내산 민감형' 소비자 그룹에서 가장 높게 나타났다(81.1%). 월평균 가구 소득에서도 유의한 차이가 나타났으며(P = 0.017), '품질·경험 중시형' 소비자 그룹에서 고소득자(800만 원 이상)의 비율이 높았고(23.9%), '가격 민감형' 소비자 그룹은 399만 원 이하 비율(32.0%)이 상대적으로 높게 나타났다. 요약하면, 연령, 직업, 결혼 여부, 소득과 같은 사회경제적 요인은 소비자 그룹 간 특성을 구별하는 중요한 변수로 작용하였으며, 이는 특정 소비군 형성에 영향을 주었음을 확인하였다(Table 3).

Table 3. General characteristics of the participants

Variable[1)]	Domestic preference consumer group (n = 275)	Price-sensitive consumer group (n = 175)	Quality- and experience-oriented consumer group (n = 255)	χ^2/F-value (P-value)
Gender				5.393 (0.067)
Male	48 (17.5)	46 (26.3)	59 (23.1)	
Female	227 (82.5)	129 (73.7)	196 (76.9)	
Mean age (year)	44.01 ± 10.24[b]	41.95 ± 12.83[ab]	41.49 ± 11.45[a]	3.615 (0.027)
Occupation distribution				27.594 (0.006)
Manager/professional	75 (27.3)	34 (19.4)	65 (25.5)	
Office worker	79 (28.7)	56 (32.0)	64 (25.1)	
Service/sales worker	26 (9.5)	11 (6.3)	27 (10.6)	
Simple labor worker	9 (3.3)	15 (8.6)	7 (2.7)	
Housewife	63 (22.9)	31 (17.7)	63 (24.7)	
Student	2 (0.7)	5 (2.9)	9 (3.5)	
Unemployed/other	21 (7.6)	23 (13.1)	20 (7.8)	
Marital status				9.998 (0.041)
Married	223 (81.1)	127 (72.6)	179 (70.2)	
Single	51 (18.5)	48 (27.4)	75 (29.4)	
No response	1 (0.4)	0 (0.0)	1 (0.4)	
Housing type				11.985 (0.062)
Single-family house	18 (6.5)	12 (6.9)	27 (10.6)	
Apartment	223 (81.1)	131 (74.9)	185 (72.5)	
Multi-unit housing	31 (11.3)	30 (17.1)	34 (13.3)	
Other	3 (1.1)	2 (1.1)	9 (3.5)	
Household size	3.31 ± 1.07	3.06 ± 1.26	3.16 ± 1.24	3.918 (0.141)
Monthly household income (million KRW)[2)]				18.630 (0.017)
≤ 3.99	51 (18.5)	56 (32.0)	74 (29.0)	
4.00–5.99	89 (32.4)	50 (28.6)	61 (23.9)	
6.00–7.99	66 (24.0)	34 (19.4)	54 (21.2)	
≥ 8.00	59 (21.5)	28 (16.0)	61 (23.9)	
No response	10 (3.6)	7 (4.0)	5 (2.0)	
Residential area				2.314 (0.678)
Metropolitan area	140 (50.9)	99 (56.6)	137 (53.7)	
Medium/small cities	100 (36.4)	60 (34.3)	86 (33.7)	
Rural towns/villages	35 (12.7)	16 (9.1)	32 (12.5)	
Education level				5.719 (0.269)
High school or less	42 (15.3)	40 (22.9)	44 (17.3)	
College graduate	197 (71.6)	118 (67.4)	184 (72.2)	
Graduate degree or more	36 (13.1)	17 (9.7)	27 (10.6)	

Mean ± SD or n (%).
Chi-square (χ^2) test for categorical variables and F-test for continuous variables.
[1)]Superscripts (a, b, c) denote significantly differences between consumer groups (P < 0.05).
[2)]KRW: Korean won.

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4. 돼지고기 구매에 대한 IPA 분석

1) 국내산 선호형 소비자 그룹

Table 4의 IPA 분석 결과, '국내산 선호형' 소비자 그룹의 생산(production), 품질(quality), 유통 및 표시(distribution and labeling), 소비 및 조리(consumption and cooking) 4개 영역에서 중요도와 만족도 간의 차이가 분석되었다. 생산 영역에서는 무항생제(P2)가 가장 높은 중요도를 보였으며, 중요도와 만족도 간 차이도 양수(0.229점)로 나타나 관리가 필요한 항목으로 평가되었다. 반면, 품종(P4)은 낮은 중요도(3.34점)와 높은 만족도(3.57점)를 보여 비교적 우수한 관리항목으로 나타났다(t = −4.114, $P < 0.001$).

품질 영역에서는 잡냄새(Q7)가 가장 높은 Borich 요구도(2.59)를 기록하며, 소비자가 가장 중요시하는 항목임을 확인하였다. 또한, 잡냄새(Q7) 항목은 중요도와 만족도 간 차이가 가장 크게 나타났으며(t = 11.202, $P < 0.001$), 관리가 중요한 항목으로 분석되었다. 그 다음으로는 위생상태(Q1) 항목의 중요도와 만족도 간 차이가 크게 나타나 관리의 필요성을 확인했다(t = 8.606, $P < 0.001$).

유통 및 표시 영역에서는 유통기한(D2)과 품질인증마크(D5)가 중요도와 만족도 간의 가장 큰 차이를 보여 관리의 필요성이 강조되었다(D2: t = 7.442, $P < 0.001$; D5: t = 5.661, $P < 0.001$). 반면, 브랜드(D6)는 중요도와 만족도 간 차이가 음수

Table 4. Importance-performance analysis for the domestic preference consumer group (n = 275)

Domain		Content	Importance[1)]	Satisfaction[1)]	Gap[2)]	t	Borich needs assessment[3)]	Ranks for each content	Total rank
Production	P1	Additive-free/preservative-free	4.10 ± 0.85	3.97 ± 0.71	0.131	2.508*	0.54	2	12
	P2	Antibiotic-free	4.19 ± 0.81	3.96 ± 0.78	0.229	4.234***	0.96	1	6
	P3	Animal welfare certification	3.58 ± 0.96	3.47 ± 0.95	0.116	1.779	0.42	3	17
	P4	Breed (e.g., black pork, Iberico)	3.34 ± 0.88	3.57 ± 0.83	−0.233	−4.114***	−0.78	4	24
Quality	Q1	Hygiene	4.64 ± 0.57	4.25 ± 0.69	0.385	8.606***	1.79	2	2
	Q2	Tenderness	4.16 ± 0.76	4.03 ± 0.67	0.124	2.702**	0.52	6	13
	Q3	Pork cuts	4.20 ± 0.67	4.09 ± 0.68	0.113	2.719**	0.48	7	14
	Q4	Texture	4.12 ± 0.77	4.04 ± 0.70	0.076	1.574	0.31	10	19
	Q5	Meat color	4.23 ± 0.72	4.08 ± 0.71	0.149	3.473**	0.63	5	9
	Q6	Juiciness	4.25 ± 0.71	4.08 ±0.65	0.164	3.945***	0.70	4	7
	Q7	Off-flavors	4.78 ±0.49	4.24 ± 0.76	0.542	11.202***	2.59	1	1
	Q8	Fat thickness	4.21 ± 0.78	3.93 ± 0.79	0.280	5.212***	1.18	3	4
	Q9	Marbling	3.93 ± 0.87	3.82 ± 0.76	0.113	2.531*	0.44	8	16
	Q10	Grading system information	4.11 ± 0.80	4.01 ± 0.73	0.095	2.094*	0.39	9	18
Distribution and labeling	D1	Storage condition (refrigerated/frozen)	4.46 ± 0.68	4.31 ± 0.70	0.156	3.525***	0.70	3	8
	D2	Expiration date	4.65 ± 0.56	4.35 ± 0.65	0.302	7.442***	1.40	1	3
	D3	Product packaging	4.17 ± 0.85	4.03 ± 0.78	0.149	2.873**	0.62	4	10
	D4	Package size	4.01 ± 0.86	3.90 ± 0.77	0.113	2.191*	0.45	6	15
	D5	Quality certification mark	4.38 ± 0.71	4.12 ± 0.72	0.262	5.661***	1.15	2	5
	D6	Brand	3.67 ± 0.94	3.75 ± 0.82	−0.076	−1.484	−0.28	7	22
	D7	Grading system display	4.12 ±0.76	3.98 ± 0.78	0.138	3.049**	0.57	5	11
Consumption and cooking	C1	Purchase convenience	4.20 ± 0.70	4.13 ± 0.70	0.069	1.550	0.29	1	20
	C2	Cooking convenience	4.02 ± 0.76	3.98 ± 0.74	0.040	0.822	0.16	2	21
	C3	Cooking versatility	3.77 ± 0.83	3.86 ± 0.77	−0.091	−1.779	−0.34	3	23

Mean ± SD.
Paired t-tests for the significance of the gap (*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$).
[1)]Likert scale score from 1 (not important/satisfied at all) to 5 (very important/satisfied).
[2)]Gap representing the difference between importance and satisfaction scores.
[3)]Borich needs assessment calculated as 'mean gap × mean importance'.

로 보여 관리 우선순위에서 뒤로 밀리는 것으로 확인되었다(t = −1.484, $P > 0.05$).

마지막으로 소비 및 조리 영역에서는 조리의 편리성(C2)과 조리의 다양성(C3) 항목이 중요도와 만족도 간 차이가 가장 적었으며(C2: t = 0.822, $P > 0.05$; C3: t = −1.779, $P > 0.05$), 해당 영역에서 만족도가 비교적 높은 것으로 나타났다.

결론적으로, '국내산 선호' 소비자 그룹의 관리가 필요한 주요 항목은 잡냄새(Q7)와 위생 상태(Q1), 유통기한(D2)으로 나타났으며, 이를 통해 소비자 요구도를 충족시키기 위한 세부적인 관리 전략이 필요함을 확인하였다.

2) 가격 민감형 소비자 그룹

'가격 민감형' 소비자 그룹의 중요도와 만족도 간 차이를 분석한 결과(Table 5), 생산 영역에서는 첨가물 무첨가/보존료(P1)와 무항생제(P2)가 높은 중요도를 보였으나, Borich 요구도는 음수 값을 기록하며 관리 우선순위에서는 낮은 순위를 보였다. 특히, 품종(P4)은 중요도(3.07)가 가장 낮고 Borich 요구도 역시 낮아 해당 항목은 관리 우선순위에서 상대적으로 낮은 순위를 차지하였다.

품질 영역에서 잡냄새(Q7)와 지방의 두께(Q8)는 Borich 요구도가 각각 1.54와 1.46으로 분석되어 가장 높은 우선순위를 차지하였다. 이는 소비자들이 해당 항목을 매우 중요하게 인식하

Table 5. Importance-performance analysis for the price-sensitive consumer group (n = 175)

Domain		Content	Importance[1)]	Satisfaction[1)]	Gap[2)]	t	Borich needs assessment[3)]	Ranks for each content	Total rank
Production	P1	Additive-free/preservative-free	3.55 ± 1.02	3.63 ± 0.79	−0.074	0.971	−0.26	1	18
	P2	Antibiotic-free	3.53 ± 1.01	3.66 ± 0.81	−0.131	0.947	−0.46	3	21
	P3	Animal welfare certification	3.27 ± 1.03	3.41 ± 0.87	−0.131	0.935	−0.43	2	20
	P4	Breed (e.g., black pork, Iberico)	3.07 ± 1.03	3.47 ± 0.80	−0.406	0.971***	−1.25	4	24
Quality	Q1	Hygiene	4.24 ± 0.84	3.91 ± 0.80	0.331	0.847***	1.40	3	3
	Q2	Tenderness	3.80 ± 0.90	3.71 ± 0.80	0.086	0.857	0.33	5	10
	Q3	Pork cuts	3.79 ± 0.80	3.83 ± 0.74	−0.040	0.812	−0.15	9	16
	Q4	Texture	3.66 ± 0.86	3.79 ± 0.80	−0.137	0.893*	−0.50	10	22
	Q5	Meat color	3.86 ± 0.81	3.79 ± 0.77	0.074	0.802	0.29	6	11
	Q6	Juiciness	3.78 ± 0.86	3.75 ± 0.78	0.029	0.791	0.11	7	13
	Q7	Off-flavors	4.34 ± 0.87	3.99 ± 0.84	0.354	0.977***	1.54	1	1
	Q8	Fat thickness	4.06 ± 0.86	3.70 ± 0.83	0.360	0.923***	1.46	2	2
	Q9	Marbling	3.70 ± 0.93	3.59 ± 0.77	0.109	0.798	0.40	4	7
	Q10	Grading system information	3.64 ± 0.92	3.66 ± 0.81	−0.017	0.847	−0.06	8	15
Distribution and Labeling	D1	Storage condition (refrigerated/frozen)	4.05 ± 0.88	3.95 ± 0.80	0.097	0.807	0.39	5	9
	D2	Expiration date	4.31 ± 0.84	4.02 ± 0.78	0.291	0.728***	1.25	1	4
	D3	Product packaging	4.01 ± 0.93	3.85 ± 0.83	0.160	0.849*	0.64	3	6
	D4	Package size	3.88 ± 0.93	3.71 ± 0.86	0.166	0.872*	0.64	2	5
	D5	Quality certification mark	3.87 ± 0.98	3.77 ± 0.90	0.103	0.774	0.40	4	8
	D6	Brand	3.25 ± 1.02	3.51 ± 0.88	−0.257	0.828***	−0.84	7	23
	D7	Grading system display	3.59 ± 1.04	3.64 ± 0.85	−0.046	0.822	−0.17	6	17
Consumption and Cooking	C1	Purchase convenience	3.92 ± 0.86	3.85 ± 0.79	0.069	0.755	0.27	1	12
	C2	Cooking convenience	3.83 ± 0.85	3.82 ± 0.79	0.011	0.773	0.04	2	14
	C3	Cooking versatility	3.59 ± 0.92	3.67 ± 0.86	−0.074	0.802	−0.27	3	19

Mean ± SD.
Paired t-tests for the significance of the gap (*$P < 0.05$, ***$P < 0.001$).
[1)]Likert scale score from 1 (not important/satisfied at all) to 5 (very important/satisfied).
[2)]Gap representing the difference between importance and satisfaction scores.
[3)]Borich needs assessment calculated as 'mean gap × mean importance'.

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고 있음을 시사한다. 반면, 돼지고기 부위(Q3), 식감(Q4), 등급제 정보(Q10)는 중요도와 만족도 간 차이가 음수로 나타나 상대적으로 관리 필요성이 낮았다.

유통 및 표시 영역에서는 유통기한(D2)과 포장 단위(D4)가 Borich 요구도에서 모두 높은 순위를 차지하여 관리가 요구되는 항목으로 나타났다. 반면, 브랜드(D6)는 매우 낮은 중요도와 Borich 요구도를 기록하여 소비자 관심이 적은 항목으로 확인되었다.

구매 및 조리 영역에서는 구매의 편리성(C1)이 Borich 요구도에서 관리가 요구되는 가장 높은 순위를 차지하였다. 조리의 다양성(C3)은 중요도보다 만족도 점수가 높아 관리항목의 우선순위가 낮은 것으로 관찰되었다.

결론적으로, '가격 민감형' 소비자 그룹에서 관리 우선순위가 높은 항목은 잡냄새(Q7), 지방의 두께(Q8), 위생 상태(Q1)로 나타났으며, 이는 해당 소비자 그룹의 요구를 충족시키기 위해 관리가 필요한 주요 요소임을 확인하였다.

3) 품질·경험 중시형 소비자 그룹

'품질·경험 중시형' 소비자 그룹의 중요도와 만족도 간 차이를 분석한 결과(Table 6), 생산 영역에서는 첨가물 무첨가/보존료(P1)는 Borich 요구도(0.35)가 가장 높아 관리가 필요한 항목으로 분석되었다.

Table 6. Importance-performance analysis for the quality- and experience-oriented consumer group (n = 255)

Domain		Content	Importance[1)]	Satisfaction[1)]	Gap[2)]	t	Borich needs assessment[3)]	Ranks for each content	Total rank
Production	P1	Additive-free/preservative-free	4.21 ± 0.90	4.13 ± 0.84	0.082	1.492	0.35	1	15
	P2	Antibiotic-free	4.19 ± 0.92	4.15 ± 0.84	0.043	0.787	0.18	2	18
	P3	Animal welfare certification	3.83 ± 1.00	3.85 ± 0.94	−0.020	−0.284	−0.08	3	22
	P4	Breed (e.g., black pork, Iberico)	3.75 ± 0.91	3.86 ± 0.92	−0.106	−1.677	−0.40	4	24
Quality	Q1	Hygiene	4.73 ± 0.53	4.40 ± 0.74	0.329	7.128***	1.56	2	2
	Q2	Tenderness	4.39 ± 0.72	4.31 ± 0.70	0.082	1.661	0.36	8	14
	Q3	Pork cuts	4.41 ± 0.65	4.42 ± 0.69	−0.004	−0.083	−0.02	10	21
	Q4	Texture	4.36 ± 0.72	4.27 ± 0.68	0.090	1.821	0.39	7	11
	Q5	Meat color	4.47 ± 0.67	4.24 ± 0.73	0.231	4.694***	1.03	4	4
	Q6	Juiciness	4.46 ± 0.66	4.26 ± 0.75	0.196	4.072***	0.87	5	6
	Q7	Off-flavors	4.77 ± 0.51	4.31 ± 0.81	0.463	9.102***	2.21	1	1
	Q8	Fat thickness	4.37 ± 0.77	4.09 ± 0.89	0.278	4.680***	1.22	3	3
	Q9	Marbling	4.19 ± 0.86	4.06 ± 0.84	0.129	2.423*	0.54	6	8
	Q10	Grading system information	4.30 ± 0.79	4.24 ± 0.81	0.059	1.169	0.25	9	16
Distribution and Labeling	D1	Storage condition (refrigerated/frozen)	4.57 ± 0.65	4.45 ± 0.68	0.114	2.431*	0.52	3	9
	D2	Expiration date	4.67 ± 0.56	4.47 ± 0.66	0.196	4.442***	0.92	1	5
	D3	Product packaging	4.38 ± 0.83	4.24 ± 0.76	0.137	2.398*	0.60	2	7
	D4	Package size	4.17 ± 0.95	4.11 ± 0.79	0.055	0.900	0.23	5	17
	D5	Quality certification mark	4.44 ± 0.80	4.34 ± 0.75	0.102	2.247*	0.45	4	10
	D6	Brand	3.97 ± 0.95	4.00 ± 0.87	−0.027	−0.514	−0.11	7	23
	D7	Grading system display	4.24 ± 0.85	4.20 ± 0.78	0.039	0.811	0.17	6	19
Consumption and Cooking	C1	Purchase convenience	4.34 ± 0.71	4.25 ± 0.77	0.086	1.746	0.37	2	13
	C2	Cooking convenience	4.22 ± 0.84	4.13 ± 0.80	0.090	1.653	0.38	1	12
	C3	Cooking versatility	4.14 ± 0.86	4.12 ± 0.79	0.016	0.278	0.07	3	20

Mean ± SD.
Paired t-tests for the significance of the gap (*P < 0.05, ***P < 0.001).
[1)]Likert scale score from 1 (not important/satisfied at all) to 5 (very important/satisfied).
[2)]Gap representing the difference between importance and satisfaction scores.
[3)]Borich needs assessment calculated as 'mean gap × mean importance'.

품질 영역에서는 잡냄새(Q7)는 Borich 요구도(2.21)와 중요도가 가장 높은 항목으로 확인되었으며, 관리가 가장 중요한 부분으로 평가되었다. 두번째로, 위생 상태(Q1)가 Borich 요구도(1.56)와 t값(7.128, $P < 0.001$) 모두에서 높은 값을 기록하며, 소비자가 중요하게 여기는 항목임을 나타냈다. 또한, 지방의 두께(Q8)도 높은 중요도와 성과 차이를 보였으며($t = 4.680$, $P < 0.001$), 소비자가 중요시하는 요소로 관찰되었다.

유통 및 표시 영역에서는 유통기한(D2)와 상품포장(D3)가 Borich 요구도와 성과 차이에서 높은 순위를 차지했으며, 관리의 필요성이 제기되었다(D2: $t = 4.442$, $P < 0.001$; D3: $t = 2.398$, $P < 0.05$). 반면, 브랜드(D7)는 낮은 Borich 요구도와 중요도와 만족도 간 차이를 보여 소비자의 우선 순위가 가장 낮은 것으로 해석되었다.

구매 및 조리 영역에서는 조리의 편리성(C2)이 Borich 요구도 가장 높은 항목으로 나타났다. 반면에 조리의 다양성은 중요도와 만족도 간 가장 낮은 차이를 보였다.

결론적으로, '품질·경험 중시형' 소비자 그룹에서 관리 우선순위가 높은 항목은 잡냄새(Q7), 위생 상태(Q1), 지방의 두께(Q8)로 나타났으며, 이는 소비자의 요구도를 충족시키기 위해 집중적이고 지속적인 관리가 필요함을 시사한다.

4) 소비자 집단 별 돼지고기 속성 요인 평가 비교

돼지고기 속성 요인의 중요도 및 중요도와 만족도 간 불일치를 평가하기 위해 Locus for Focus 모델을 활용하여 중요도가 높고 중요도와 만족도 간 차이가 큰 우상단면을 중심으로 분석하였다(Fig. 1). 모든 소비자 그룹에서 잡냄새(Q7)와 위생(Q1)이 공통적으로 관리가 필요한 주요 속성으로 관찰되었다. 특히 잡냄새는 가장 높은 불일치를 보이며, 돼지고기 소비 만족도를 높이기 위해 필수적으로 관리해야 할 요소임을 시사한다. '국내산 선호' 소비자 그룹은 위생(Q1)과 잡냄새(Q7)와 더불어 유통기한(D2)에서도 불일치가 확인되었다. '가격 민감형' 소비자 그룹은 상품 지방의 두께(Q8)에서 높은 중요도와 더불어 중요도와 만족도 간 큰 차이를 보였다. 반면, 품질·경험 중시형 소비자 그룹은 육즙(Q6), 육색(Q5) 등 감각적 요인을 중시하며, 잡냄새(Q7)의 중요도와 만족도 간 불일치가 가장 크게 나타나 감각적 품질 관리가 필요함을 확인하였다. 이러한 결과는 소비자 그룹별 맞춤형 전략과 함께 공통적으로 감각적 품질과 위생 관리가 돼지고기 소비 만족도 향상에 중요한 역할을 할 수 있음을 시사한다.

DISCUSSION

본 연구는 돼지고기 소비와 관련된 소비자 라이프스타일과 소비 속성의 중요도와 만족도 간의 관계를 분석하여, 소비자 요구를 충족시키기 위한 방안을 제시하였다. 본 연구의 결과를 요약하면, 모든 소비자 그룹에서 잡냄새(Q7)와 위생(Q1)이 공통적으로 관리가 필요한 속성으로 나타났으며, 이는 돼지고기 소비 경험의 품질 향상을 위한 핵심 관리 요소임을 확인하였다. 특히, 잡냄새는 모든 그룹에서 가장 높은 불일치를 기록하며 소비자 만족도를 저해하는 주요 요인으로 나타났다. 이러한 연구결과는 선행연구들의 결과와 일치하며, 감각적 품질 요인이 소비자의 돼지고기 구매 결정 과정에서 중요한 역할을 한다는 점을 더욱 명확히 보여준다 [11, 14, 19]. 한돈미래연구소(2024) [30]의 보고서에서도, 소비자와 영양사는 돼지고기 품질을 평가할 때 육색, 위생 상태, 잡냄새를 가장 중요한 기준으로 고려하는 것으로 나타났다. 이는 본 연구에서 확인된 결과와도 일치하며, 소비자가 직관적으로 판단할 수 있는 시각적 요소와 후각적 요소가 구매 결정에서 중요한 역할을 한다는 점을 뒷받침한다 [30]. 돼지고기의 감각적 요소에 대한 관리는 소비자 만족도 향상과 재구매 의도 강화를 위한 핵심적인 전략으로 확인되었다.

특히, 2019 한국인의 돼지고기 소비 트렌드 연구에 따르면, 한국 소비자들은 돼지고기 구매 시 신선도와 맛을 가장 중요하게 고려하는 것으로 나타났으며, 돼지고기 소비 촉진을 위한 품질 개발 방향으로 육질이 더 부드러운 고기, 기능성 성분이 함유된 고기, 잡내가 없는 돼지고기 개발의 필요성이 높은 것으로 조사되었다. 이는 본 연구에서 확인된 감각적 요소(잡냄새, 육즙, 육색 등)의 중요성과도 일맥상통하며, 소비자 만족도를 높이기 위해 감각적 품질 향상 전략이 필수적임을 시사한다[31].

본 연구는 소비자 그룹별로 세분화된 분석을 통해 돼지고기 소비 특성의 차별성을 확인할 수 있었다. '국내산 선호형' 소비자 그룹은 위생(Q1)과 잡냄새(Q7) 외에도 유통기한(D2)에 대해 높은 중요도 및 중요도와 만족도 간 불일치를 보여, 국내산 돼지고기에 대한 신뢰도를 강화하기 위한 유통 관리가 중요함을 확인하였다. 선행연구에서도 생산 및 유통 과정의 투명성이 소비자 신뢰 형성에 긍정적인 영향을 미친다는 결과를 보였다[17, 32]. '가격 민감형' 소비자 그룹의 주요 관심사는 지방의 두께(Q8)로 나타났으며, 이는 선행연구에서 가격 대비 제품의 가치가 소비자 구매 행동에 중요한 영향을 미친다는 점과 유사하다 [10, 33]. 품질·경험 중시형 소비자 그룹은 육즙(Q6), 육색(Q5) 등 감각적 요인을 중시하며, 잡냄새(Q7)의 중요도와 만족도 간 불일치가 가장 크게 나타나 감각적 만족을 충족시키는 관리가 필요함을 확인하였다. 본 연구결과는 기능적 품질과 감각적 요소의 균형이 소비자 만족도에 중요한 영향을 미친다는 선행연구 결과와 일치한다[12, 14]. 기능적 품질(functional quality)은 소비자가 기대하는 기본적인 제품의 특성으로, 돼지고기의 위생 상태, 유통기한, 영양적 가치, 생산 및 유통 과정의 안전성 등을 포함한다. 기능적 품질은 제품의 객관적 특성과 직결되며, 소비자가 신뢰할 수 있는 정보를 제공함으로써 구매 결정을 지원하는 중요한 요소이다. 반면, 감각적 요소(sensory attributes)는 돼지고기의 육즙, 육색, 풍미, 식감, 잡냄새 등의 감각적 경

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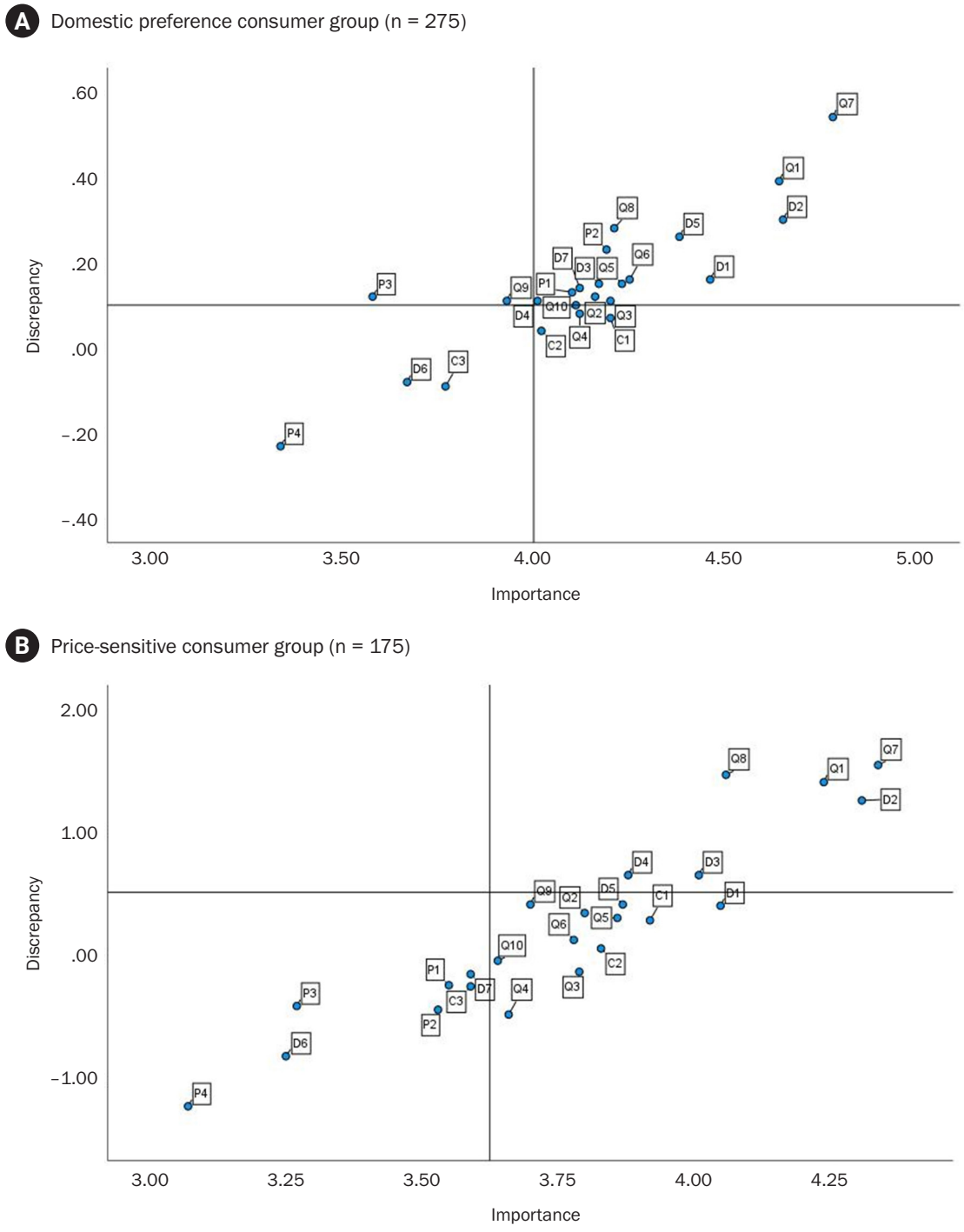

Fig. 1. The Locus for Focus model prioritizing pork-related attributes by the consumer groups. Quadrants represent the prioritization of attributes: high importance-high discrepancy (top-right), low importance-high discrepancy (top-left), high importance-low discrepancy (bottom-right), low importance-low discrepancy (bottom-left).
P1, additive-free/preservative-free; P2, antibiotic-free; P3, animal welfare certification; P4, breed; Q1, hygiene; Q2, tenderness; Q3, pork cuts; Q4, texture; Q5, meat color; Q6, juiciness; Q7, off-flavors; Q8, fat thickness; Q9, marbling; Q10, grading system information; D1, storage condition (refrigerated/frozen); D2, expiration date; D3, product packaging; D4, package size; D5, quality certification mark; D6, brand; D7, grading system display, consumption and cooking attributes; C1, purchase convenience; C2, cooking convenience; C3, cooking versatility.

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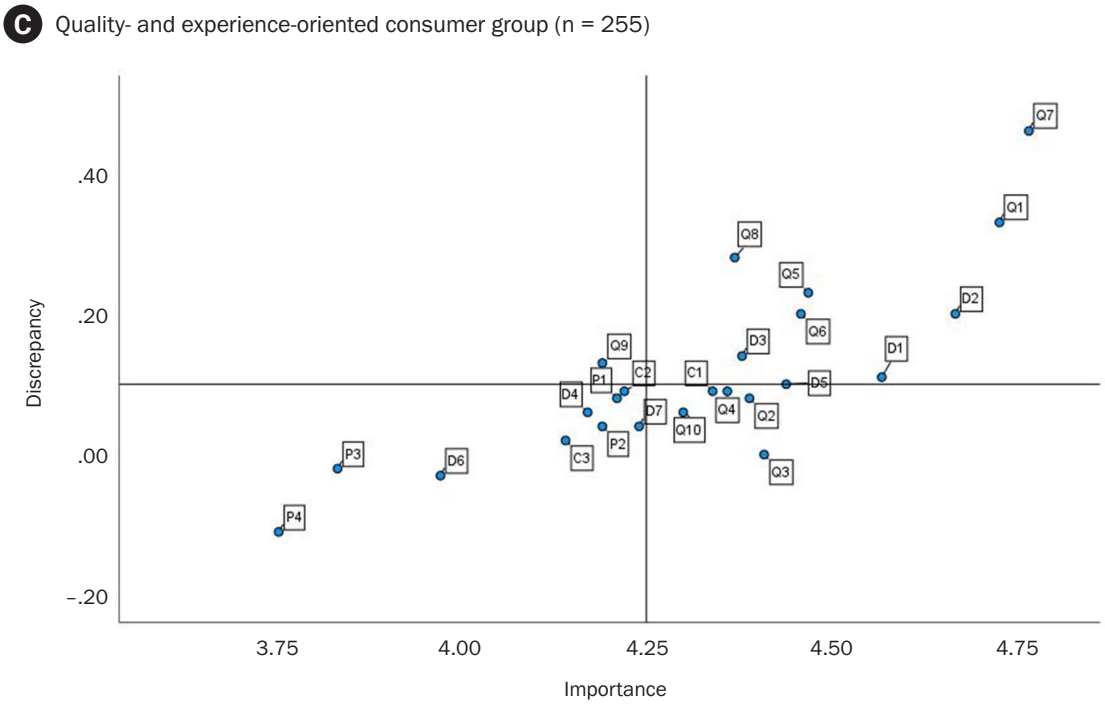

Fig. 1. Continued

험과 관련된 특성으로, 소비자가 직접 섭취하면서 느끼는 주관적인 품질 요인을 의미한다. 감각적 요소는 소비자의 미각적 만족도를 결정하는 핵심 요인으로 작용하며, 특히 프리미엄 돼지고기 시장에서 제품 차별화의 중요한 기준이 될 수 있다.

감각적 요소에 대한 관리는 단순히 소비자 만족도를 높이는 데 그치지 않고, 소비자의 건강과 안전에 대한 신뢰를 강화하는 데 중요한 역할을 한다. 선행연구에서도 식품의 감각적 만족이 소비자의 건강 지향적 태도와 연계되어 식품에 대한 긍정적인 평가를 유도할 수 있음을 보고하였다[34, 35]. 본 연구에서도 위생(Q1)과 감각적 속성이 소비자 만족의 중요한 요인으로 확인되었으며, 이는 돼지고기 산업이 품질 관리와 위생 기준을 강화하고 지속적으로 관리할 필요가 있음을 강조한다[17, 20]. 특히, 품질·경험 중시형 소비자 그룹에서 잡냄새(Q7)와 육즙(Q6)이 중요한 속성으로 나타난 것은 고급화된 시장 수요를 충족시키기 위한 관리가 필요한 영역임을 보여준다. 돼지고기의 잡냄새 발생에는 사육단계와 가공, 저장단계의 다양한 요인이 관여한다. 따라서, 소비자가 원하는 잡냄새가 없는 돼지고기를 생산, 제공하기 위해서는 소비자가 느끼는 잡냄새에 대한 원인을 요인별로 파악하여야 한다. 이를 위해 생산단계부터 유통 및 가공단계에 걸친 원인을 체계적으로 분석하고, 이를 바탕으로 추후에 바람직한 풍미로 관리할 수 있는 구체적인 조사연구가 이루어져야 한다.

또한, 본 연구는 소비자를 특성에 따라 분류하고 소비자 그룹의 세분화된 요구를 반영하여 주요한 관리 과제를 도출한 점에서 기존 연구와 차별화된다. 기존 연구들이 전체 대상자의 일반적인 식품 소비 행동이나 건강 중심적 태도에 초점을 맞춘 반면, 본 연구는 돼지고기라는 특정 식품에 초점을 맞추어 구체적인 속성과 소비자 라이프스타일 간의 관계를 설명하였다[36, 37]. 이는 Verbeke & Ward (2006) [17] 가 제시한 특정 식품군별 소비자 분석의 중요성을 뒷받침하며, 돼지고기 산업에서 소비자 맞춤형 마케팅 전략을 수립하는데 구체적인 정보를 제공할 수 있다. 특히, 품질과 경험을 중시하는 소비자 그룹은 감각적 속성 향상을 통해 고급화된 시장 수요도를 충족시킬 수 있으며, '가격 민감형' 소비자 그룹은 경제적 효율성을 강조한 제품 개발과 프로모션 전략이 효과적일 것이다.

Limitations

본 연구는 다음과 같은 제한점을 가진다. 첫째, 본 연구는 온라인 설문조사를 통해 데이터를 수집하였으므로, 인터넷 사용이 제한되거나 익숙하지 않은 소비자 집단의 의견이 충분히 반영되지 않을 수 있다[38, 39]. 이로 인해 특정 소비자 집단이나 지역의 의견이 과소 또는 과대하게 수집되었을 가능성이 존재한다. 이를 보완하기 위해, 향후 연구에서는 오프라인 설문조사나 심층 인터뷰를 병행하여, 디지털 접근성이 낮은 소비자의 의견을 보다 균형 있게 반영할 필요가 있다. 또한, 전국적으로 대표성을 확보할 수 있는 확률표집(probability sampling) 방법을 활

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용하여 소비자군을 보다 포괄적으로 포함할 것을 제안한다.

둘째, 설문조사에서 자기보고식 응답 방식은 사회적 바람직성 편향(social desirability bias)으로 인해 응답자의 실제 행동과 답변 간 차이가 있을 수 있다[38, 39]. 이는 소비자 행동을 객관적이고 정확하게 평가하는 데 제한점이 될 수 있다. 이를 해결하기 위해, 향후 연구에서는 실제 구매 데이터 또는 돼지고기 소비와 관련된 실험연구를 병행하여 소비자의 실제 행동을 보다 객관적으로 분석할 필요가 있다.

셋째, 본 연구는 돼지고기 소비와 관련된 주요 속성을 다차원적으로 분석하였지만, 문화적 요인, 사회적 인식 등의 외부 요인은 포함하지 않았다. 이러한 요인들은 소비자 행동에 중요한 영향을 미칠 수 있음에도 불구하고, 본 연구의 분석 범위에서 제외되었다. 이를 보완하기 위해, 향후 연구에서는 문화적 배경이 소비자의 돼지고기 소비 행동에 미치는 영향을 분석하기 위해, 다양한 문화권에서 동일한 설문을 진행하거나, 문화적 차이를 반영한 비교 연구를 수행할 필요가 있다. 또한, 사회적 인식(예: 환경 지속 가능성, 동물복지 등)이 소비자 태도 및 구매 행동에 미치는 영향을 분석하기 위해 질적 연구를 추가적으로 수행할 것을 제안한다.

마지막으로, 본 연구는 한국 내 소비자에 국한된 연구로, 결과를 다른 국가나 문화적 배경에 일반화하기 어려운 제한점이 따른다. 이를 해결하기 위해, 향후 연구에서는 다양한 국가 및 문화적 배경을 가진 소비자를 대상으로 한 다국적 비교 연구(cross-cultural study)를 수행하여, 국가별 소비 패턴 차이를 규명할 필요가 있다. 특히, 아시아권 및 서구권 소비자의 돼지고기 소비 태도를 비교함으로써, 글로벌 마케팅 전략 수립에 기여할 수 있을 것이다. 따라서, 향후 연구에서는 다양한 소비자 그룹을 포함하고, 외부 요인을 통합 분석하여 보다 포괄적이고 일반화된 결과를 도출할 필요가 있다.

Conclusion

본 연구는 소비자 라이프스타일에 따른 돼지고기 소비 행태의 차이를 분석하고, 소비자 요구를 충족시키기 위한 맞춤형 전략을 제안하기 위하여 수행되었다. 모든 소비자 그룹에서 잡냄새와 위생 상태가 소비 만족도의 핵심 요인으로 확인되었다. '국내산 선호형' 소비자는 위생과 유통기한을 중시하며, 신뢰도 강화를 위한 철저한 위생 및 유통 관리가 필요하다. '가격 민감형' 소비자는 가격 대비 품질을 고려하므로, 가성비 높은 제품 개발과 가격 경쟁력 강화 전략이 효과적이다. '품질·경험 중시형' 소비자는 육즙, 육색, 풍미 등의 감각적 요소를 중시하며, 프리미엄 제품 개발과 감각적 품질 개선이 필수적이다. 본 연구는 소비자 특성에 맞춘 마케팅 및 품질 개선 전략 수립에 기여할 수 있는 기초자료를 제공한다.

CONFLICT OF INTEREST

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

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DATA AVAILABILITY

Research data is available upon request to the corresponding author.

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Research Article

당섭취와 암유병 간의 관계분석: 제8기 국민건강영양조사를 활용한 단면조사연구

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Analysis of the relationship between sugar intake and cancer prevalence: a cross-sectional study using the 8th Korea National Health and Nutrition Examination Survey

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Objectives: This study aimed to analyze the association between sugar intake and cancer risk among Korean adults aged 19 years and older.
Methods: A total of 13,016 adults aged 19 years and older who participated in the 8th Korea National Health and Nutrition Examination Survey from 2019 to 2021 were included. Sugar intake was assessed in terms of both absolute intake and sugar energy rate. Sugar intake was divided into quartiles, while sugar energy rate was categorized into three groups (< 10%, 10%–20%, > 20%) based on the 2020 Dietary Reference Intakes for Koreans and into two groups (< 10%, ≥ 10%) based on WHO recommendations. Cancer prevalence was determined using cancer-related survey questions. The association between sugar intake and cancer prevalence was analyzed by sex and cancer type using logistic regression. All statistical analyses were performed using IBM SPSS statistics 29.0 (IBM Co.).
Results: From 2019 to 2021, sugar intake significantly declined with age in both men and women (P for trend < 0.001), with the highest intake observed in the 19–29 age group (61.38 g). Men consumed significantly more sugar than women across all age groups except for the 50–64 and 65–74 groups ($P < 0.05$). However, the sugar energy rate was significantly higher in women than in men ($P < 0.05$). While the association between sugar intake and cancer prevalence varied across regression models and cancer types, cervical cancer consistently showed a significant association with sugar intake ($P < 0.05$).
Conclusion: The association between sugar energy rate and the prevalence of premenopausal cervical cancer was consistent and significant. Given that women had a higher sugar energy rate than men, the relationship between sugar intake and cancer prevalence in women warrants further investigation. Longitudinal studies with more detailed sugar intake assessments are needed.

Keywords: dietary sugars; neoplasms; Korean

INTRODUCTION

한국인의 1일 총당류 섭취 기준은 2015년 제정부터 현재까지 영양소 섭취기준 제정 시 총 에너지 섭취량의 10%–20% (2,000 kcal 기준 50–100 g)로 설정되었다. 총당류란 식품 내에 존재하는 천연당과 식품을 조리하거나 가공할 때 첨가하는 당인 첨가당을 합한 개념이다[1]. 특히 첨가당 섭취량은 총 에너지 섭취량의 10% 이내로 섭취하도록 제한하였다[2]. 세계보건기구(World Health Organizaion, WHO)는 유리당을 총 에너지 섭취량의 10% 미만으로 줄일 것을 권고 하고 있으나, 최근 이를 5%까지 줄이는 것을 추가적으로 제안하고 있다[1]. 1세 이상 한국인의 하루 칼로리 섭취 대비 1인 1일 평균 총 당류 섭취량은 지난 10년(2010–2022년)동안 2010년 70.0 g에서 2015년 76.9 g으로 증가한 후, 2020년 57.2 g으로 감소한 것으로 나타났다[3]. 이는 전체 에너지 섭취의 12%–14% 정도로 한국인 영양소 섭취기준에서 제시한 총 당류 섭취 기준 범위에 해당되므로 적정수준이다. 그러나 우유를 제외한 가공식품을 통한 당류 섭취는 2010년 8.28%, 2013년 8.91%, 2016년 9.92%로 꾸준히 증가하였으며, 1일 첨가당 섭취량을 총 섭취 열량의 10% 미만으로 섭취하라는 WHO의 기준에 근접하고 있다[4]. 즉, 일일 총 당류 섭취량은 권고 기준보다 낮은 수준으로 유지되고 있으나 가공식품을 통한 당류의 섭취가 꾸준히 증가하고 있는 것을 보았을 때, 한국인의 당류 섭취 실태를 주목하고 모니터링 할 필요가 있다.

과도한 당류 섭취는 일부 만성질환과 관계가 있다고 알려져 있고, 그 관계성을 분석한 국내 연구들이 다수 있다. 2007–2011년 국민건강영양조사 자료를 통해 30세 이상 성인 총 13,972명의 탄산음료 섭취빈도와 대사증후군 간의 관련성을 조사한 연구에 따르면, 여성에서 탄산음료의 섭취비율이 높아질수록 모든 대사증후군과 유의한 상관관계가 나타났으며, 주당 4회 이상 탄산음료를 소비한 여성은 그렇지 않은 여성에 비해 대사증후군 위험이 74% 더 높았다[5]. 국민건강영양조사(2012–2016)에 참가한 한국 성인(35–65세)을 대상으로 가당음료 섭취와 비만 및 대사증후군 발병 위험의 연관성을 조사하였을 때, 가당음료의 섭취가 높은 그룹은 그렇지 않은 그룹에 비해 유의미한 유병률 증가를 보였다[6]. 또한 한국 중년 남녀(40–69세 7,005명)의 총 설탕 섭취량과 대사증후군 간의 연관성을 안산-안성 한국인유전체역학조사사업(Korean Genome and Epidemiology Study; KoGES) 자료를 활용하여 알아본 종적연구에 따르면 남성에서 총 설탕 섭취량과 대사증후군 간의 유의미한 연관이 있었다[7]. 한국 중년 성인 5,775명을 대상으로 한 KoGES 안산-안성 코호트 연구는 가당음료의 섭취가 높은 그룹일수록 그렇지 않은 그룹에 비해 고혈압 발생위험이 유의미하게 더 높아짐을 보고하였다[8]. 이와 같이 당류의 섭취가 높은 사람들에게 있어 대사증후군, 고혈압, 비만과 같은 만성질환이 유의미한 관계가 있음을 알 수 있다.

그러나 한국인의 당류 섭취와 암과의 관련성에 대한 연구가 아직은 부족한 실정이다. 그에 반해 해외에서는 당류 섭취와 암에 대한 연구들이 많이 보고되고 있다. 가당음료 섭취빈도의 증가와 총 사망률과 유방암 사망률 간의 유의미한 비례관계가 보고되었다[9]. 또한 심혈관계질환 위험이 높은 7,056명의 노인(55–80세)을 대상으로 하여 단순당의 섭취와 암 발병률, 암 사망률 간의 관련성을 조사한 연구에서는 액체 형태의 단순당 섭취가 암 발생, 사망률 증가와 유의미한 연관성이 있음을 나타냈다[10]. 간호사 건강연구(Nurses' Health Study II)라는 전향적 코호트 연구의 참가자 33,106명을 대상으로 청소년기의 단순당 및 가당음료의 섭취와 대장암 전구체 위험 사이의 연관성을 연구한 결과, 단순당과 가당음료의 과도한 섭취와 대장암 전구체 위험 증가 간의 유의미한 관련이 있음을 밝혔다[11]. 프랑스의 전향적 코호트 연구에서 18세 이상의 참가자 101,279명을 대상으로 총 당섭취량과 암 위험 간의 연관성을 연구한 결과, 총 당섭취와 전반적인 암 위험 증가 간 유의미한 연관성이 있음을 밝혔다[12]. 이처럼 여러 해외 연구를 통해서 당류의 섭취와 암 위험 증가 사이에 유의미한 관련성이 있음을 알 수 있으므로, 한국인의 당류 섭취와 암 위험 증가 여부에 대한 연구가 필요하다.

암으로 인한 한국의 사망률은 오랜 기간 전체 사망률의 1위를 차지하고 있다. 2022년 남자와 여자 모두에서 암으로 인한 사망 순위가 가장 높았으며, 남자 암 사망률(10만 명당 200.6명)이 여자 암 사망률(10만 명당 125.0명)보다 1.6배 높았다[13]. 암유병률이란 암환자와 암 완치 후 생존하고 있는 사람을 하나로 종합하여 나타내는 수치이며 2021년의 연령군별 남녀전체 암유병 현황을 보면 0–14세 0.1%, 15–34세 0.5%, 35–64세 4.8%, 65세 이상 13.9%로 연령이 증가할 수록 유병자수가 증가함을 알 수 있다[13]. 남녀 전체에서 2021년 암의 종류별 유병률 현황을 보면 갑상선암이 21.5%로 1위였으며 위암(14.5%), 대장암(12.9%), 유방암(12.3%), 전립선암(5.3%), 폐암(4.9%) 순으로 높았다. 같은 해의 암 사망분률을 보면 폐암(22.3%), 간암(12.2%), 대장암(11.0%), 췌장암(8.8%), 위암(8.6%) 순으로 높았다[14]. 이처럼 한국인에게 암은 위험한 만성질환으로 관련 요인에 대한 탐색과 연구가 필요하다.

이 연구는 제8기 국민건강영양조사(2019–2021) 자료를 활용하여 한국인의 당섭취정도를 알아보고 당섭취와 암 유병 위험 간의 관계를 분석하였다. 이 연구는 많이 보고 되지 않은 한국인에 있어 당섭취와 암 위험에 대한 연구결과를 제공할 것이다. 이는 2020 한국인 영양소 섭취기준 '당류 섭취 기준 설정을 위한 분석틀'의 당류 섭취와 이와 관련된 건강상태를 종합 검토한 항목 중 암이 없었는데[2] 향후 개정 시 분석틀을 보완하는데 참고할 수 있을 것으로 보인다.

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METHODS

Ethics statement

This study was exempted by the Inha University Institutional Review Board (IRB NO. 240521-1A).

1. Study design

본 연구는 2019년부터 2021년까지 제8기 국민건강영양조사 원시자료를 분석한 단면연구로 Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) 보고 지침을 참고하여 기술하였다(https://www.strobe-statement.org/).

2. 연구자료 및 대상

제8기 국민건강영양조사는 총 30,490명을 대상으로 조사했으나, 조사에 참여한 참여자 수는 22,559명으로 참여율은 74.0%였다. 이 연구는 Fig. 1과 같이 19세 이상 성인 18,691명 중 위암, 간암, 대장암, 유방암, 자궁경부암, 폐암, 갑상선암, 기타암 1 의사진단여부 항목에 무응답이 있거나 당섭취량에 결측치가 있는 경우, 하루 에너지 섭취량이 500 kcal 미만 또는 5,000 kcal 이상인 경우, 폐경 여부 항목에 무응답인 경우, 경구피임약 복용여부 항목에 무응답인 경우와 신장, 체질량 지수, 교육 수준, 흡연 여부, 신체활동 여부, 음주 여부, 에너지 섭취량, 포화지방산 섭취량, 나트륨 섭취량, 식이섬유 섭취량, 탄수화물 섭취량에 결측치가 있는 경우를 제외한 총 13,016명(남성 5,752명, 여성 7,264명)을 대상자로 선정하였다.

3. 연구내용

1) 당섭취

당섭취는 선행연구[7, 12, 15]에서 당섭취량과 당섭취율 두 가지 방법으로 연구되었기에 본 연구에서는 당섭취량, 당섭취율 두가지 모두 사용하여 분석하였다. 조사대상자들의 1일 당섭취량은 개인별 24시간 회상법을 통해 작성된 식품섭취조사표의 가공 자료를 바탕으로 산출된 자료를 활용하였다.

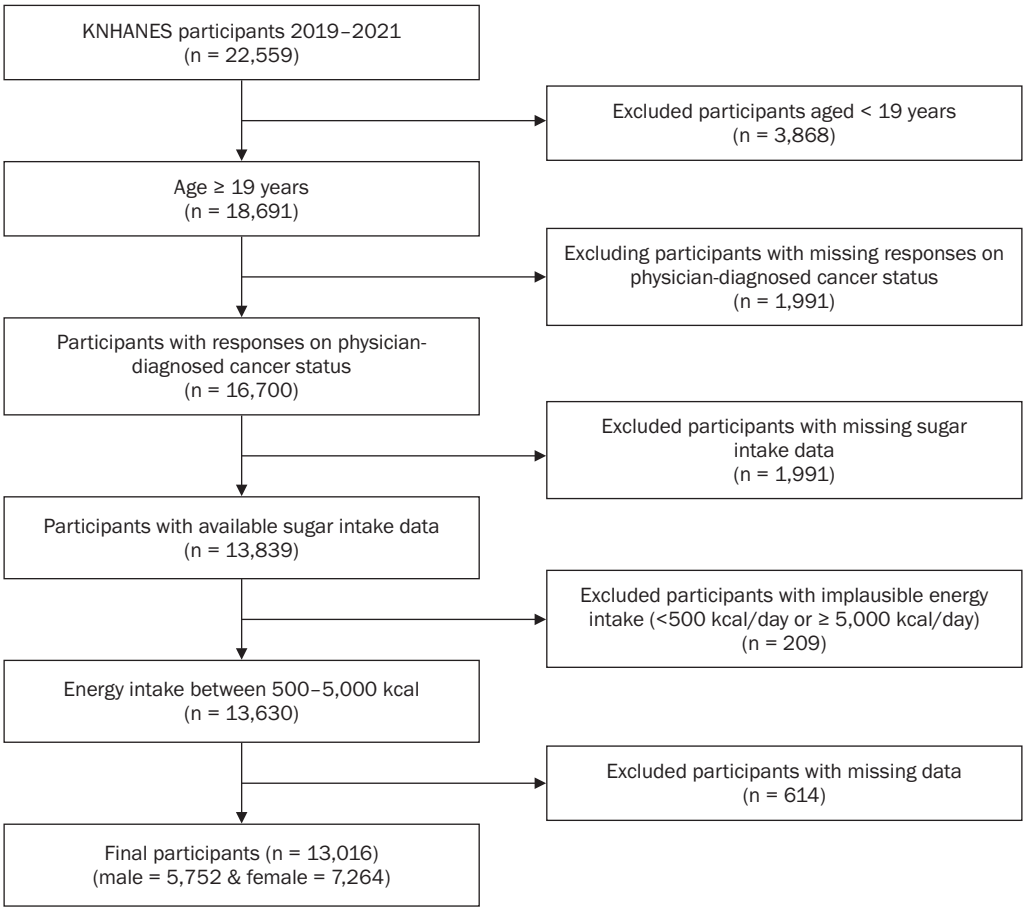

Fig. 1. Flowchart of inclusion and exclusion of study participants.
KNHANES, Korea National Health and Nutrition Examination Survey.

당섭취량은 사분위수로 나누어 분석에 사용되었다. 사분위수 범위는 Fig. 2와 같이 남성의 경우 Q1 ≤ 31.5 g, 31.5 g < Q2 ≤ 51.8g, 51.8 g < Q3 ≤ 80.2 g, 80.2 g < Q4로 구분되었으며, 여성의 경우 Q1 ≤ 29.0 g, 29.0 g < Q2 ≤ 47.0 g, 47.0 g < Q3 ≤ 72.0 g, 72.0 g < Q4로 구분되었다.

당섭취율은 1일 당섭취량(g)에 4를 곱하고, 1일 에너지 섭취량(kcal)으로 나눈 후 100을 곱하여 산출하였다. 당섭취율 그룹은 Fig. 2와 같이 두가지 방법으로 나누어 분석하였다. 한국영양학회의 2020 한국인 영양소 섭취기준[2]에서 한국인의 1일 총 당류 섭취 기준을 1일 총 에너지 섭취량의 10%–20%로 제한하고 있는 것에 근거하여 당섭취율 10% 미만, 10%–20%, 20% 초과로 구분하였다. 또한 WHO의 권고에 근거하여 당섭취율 10% 미만, 10% 이상으로 기준을 나누었다.

2) 암 관련 변수

여러 종류 암 유병자는 국민건강조사의 설문 항목 중 '위암 의사진단 여부', '간암 의사진단 여부', '대장암 의사진단 여부', '유방암 의사진단 여부', '자궁경부암 의사진단 여부', '폐암 의사진단 여부', '갑상선암 의사진단 여부', '기타암1 의사진단 여부'에 각각 '있음'이라고 답한 자를 의미하며 전체암 유병자는 위의 설문 항목에 '있음'이라고 답한 자를 모두 합친 것을 의미한다. 이중 유방암과 자궁경부암은 여성 대상자에서 폐경 전과 폐경 후로 세분화하여 분석에 사용하였다. 다만, 진단 당시의 폐경 여부에 대한 정보를 확인할 수 없어 설문 당시의 폐경 여부로 구분하였다.

3) 공변량

일반적 사항으로 연령, 성별, 교육 수준, 폐경 여부, 경구피임약 복용 여부, 신장, 체질량 지수 등의 변수를 사용하였다. 이는 원자료 그대로 사용하거나 다시 분류하여 일반적 사항의 분석에 사용하였다. 연령은 19–29세, 30–39세, 40–49세, 50–64세, 65–74세, 75세 이상으로 구분하였다. 교육 수준은 초등학교 졸업 이하, 중학교 졸업, 고등학교 졸업, 대학교 졸업 이상으로 구분하였다.

건강행태는 흡연 여부, 음주 여부, 신체활동 여부 변수를 사용하였다. 흡연의 경우 평생 담배 5갑(100개비) 이상을 피웠으며 현재 담배를 피우는 사람의 수를 나타내는 현재 흡연율, 음주는 최근 1년 동안 한 달에 1회 이상 술을 마신 적이 있다고 답한 사람 수를 나타내는 월간 음주율 변수를 사용하였다. 신체활동은 일주일에 중강도 신체활동을 2시간 30분 이상 또는 고강도 신체활동을 1시간 15분 이상 또는 중간도와 고강도 신체활동을 섞어서(고강도 1분 = 중강도 2분) 각 활동에 상당하는 시간을 실천한 사람 수인 유산소 신체활동 실천율 변수를 사용하였다.

영양소 섭취량은 개인별 24시간 회상법을 통해 작성된 식품섭취조사표의 제공된 가공 자료를 이용하여 분석하였다. 대상

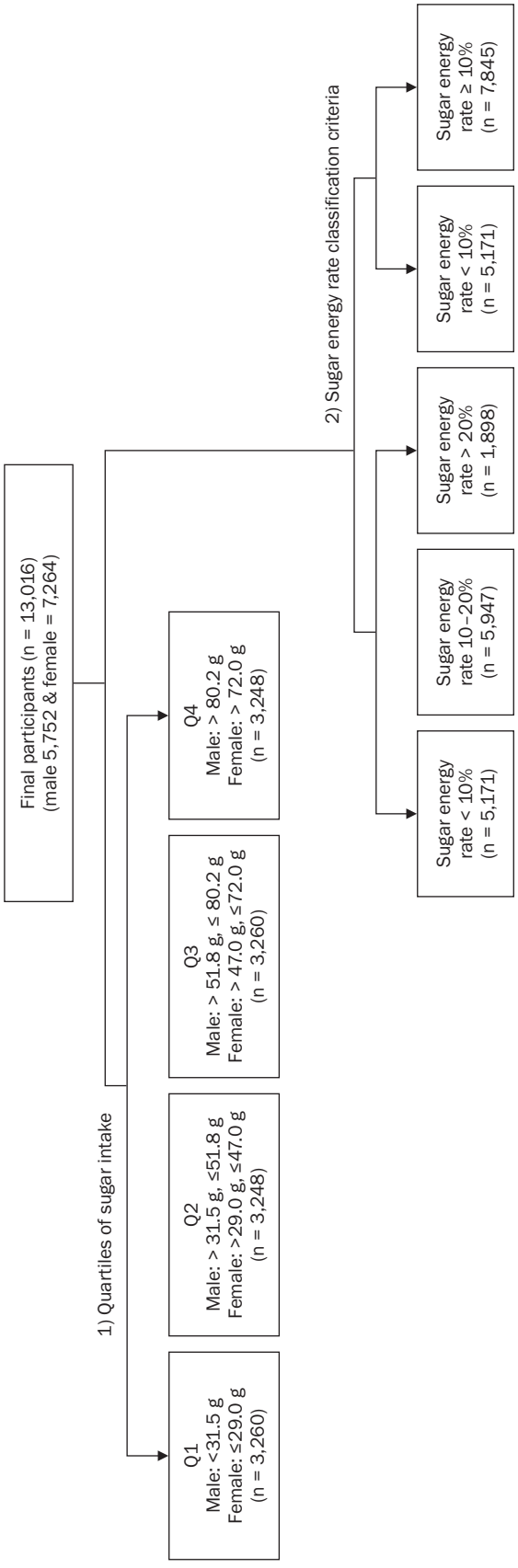

Fig. 2. Flowchart based on quartiles of sugar intake and sugar energy rate classification criteria.

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자의 당섭취량 사분위수에 따라 에너지, 포화지방산, 나트륨, 식이섬유, 탄수화물, 당에 대한 1일 섭취량을 분석하였다.

4. 통계분석

본 연구의 모든 자료의 처리 및 통계분석은 IBM SPSS statistics 29.0 (IBM Co.)을 활용하였다. 제8기 국민건강영양조사(2019–2021)의 3개 연도 자료를 기수 내 자료 통합을 통해 결합한 후 층화, 집락, 통합가중치 등의 요소를 고려해 복합 표본 통계 분석을 시행하였다.

일반적 사항은 당섭취량 사분위수와 당섭취율 10% 미만, 10%–20%, 20% 초과군 그룹, 당섭취율 10% 미만, 10% 이상군 그룹에 따라 독립표본 일반선형모형과 복합표본 교차분석을 실시하였다. 연속형 자료인 연령, 신체 계측치, 영양소 섭취량의 차이는 당섭취량 사분위수와 당섭취율 그룹에 따라 복합표본 일반선형모델을 이용하여 통계분석 하였다. 당섭취량 사분위수와 당섭취율 그룹에 따른 성별, 교육 수준, 흡연 여부, 음주 여부, 신체활동 여부, 폐경 여부, 경구피임약 복용 여부 등 범주형 자료의 관련성에 대한 차이는 복합표본 교차분석을 이용하여 통계분석 하였다. 조사 연도별 성별과 연령대에 따른 당섭취량과 당섭취율의 차이는 복합표본 일반선형모델을 이용하여 통계분석 하였고, 성별과 연령대에 따른 암 종류별 유병 현황의 연관성 분석은 복합표본 교차분석을 이용해 통계분석 하였다. 암 종류별 유병 현황에 따라 남녀의 당섭취량과 당섭취율의 차이는 복합표본 일반선형모델을 이용하여 통계분석 하였다.

당섭취와 암 종류별 유병여부의 연관성 분석은 보정변수에 따라 5가지 모델로 구분하여 복합표본 다중 로지스틱 회귀분석을 실시하여 교차비(odds ratio, OR)와 95% 신뢰구간(95% confidence interval, CI)을 계산하였다. 보정변수가 5가지 모델에서 당섭취량 사분위수와 당섭취율에 따라 각각 다르게 설정되었다. Model 1은 아무런 보정을 하지 않았으며, Model 2는 연령과 성별을 보정하였다. 이때 남성과 여성으로 분류하여 분석을 한 경우 성별은 따로 보정하지 않았다. Model 3은 Model 2에 키와 체질량지수를 추가로 보정한 것이며, Model 4는 Model 3에 교육수준, 흡연여부, 음주여부, 신체활동여부를 추가로 보정한 것이다. Model 5는 Model 4에 에너지 섭취량, 포화지방산 섭취량, 나트륨 섭취량, 식이섬유 섭취량, 탄수화물 섭취량을 보정한 것이다. 이때 당섭취율에 대한 분석을 할 경우 에너지 섭취량은 제외하고 보정하였다. 모든 통계적 유의 수준은 $P < 0.05$로 설정하였다.

RESULTS

1. 대상자의 일반적 특성

조사대상자의 일반적 특성을 총 당섭취량 사분위군과 당섭취율 군으로 나누어 Table 1에 제시하였다. 총 대상자 수는 13,016명(남성 50.9%, 여성 49.1%)이 연구에 포함되었으며, 전체 대상자의 평균연령은 47.5세이다.

당섭취량은 폐경 여부와 피임약 복용여부를 제외한 모든 일반적 특성변수와 유의미한 관계를 보였다. 당섭취량이 높은 사람들의 경우 평균연령이 낮고(P-trend < 0.001), 평균신장이 큰 경향을 보이며(P-trend < 0.001), 체질량지수가 낮은 경향을 보였다(P-trend = 0.003). 당섭취량이 증가함에 따라 1일 에너지 섭취량, 포화지방산 섭취량, 나트륨 섭취량, 식이섬유 섭취량, 탄수화물 섭취량, 총 당섭취량이 많은 경향을 보였다(P-trend < 0.001). 당섭취량 사분위에 따른 교육수준은 차이가 있으며(P < 0.001) 당섭취량이 가장 많은 군이 당섭취량이 가장 적은 군에 비해 교육수준이 더욱 높았다. 당섭취량이 가장 많은 군이 당섭취량이 가장 적은 군에 비해 흡연을 하지 않는 비율(Q4 = 81.1%, Q1 = 79.6%)이 유의하게 높았고(P < 0.001), 음주를 하지 않는 비율(Q4 = 48.2%, Q1 = 41.3%)이 유의하게 높았으며(P < 0.001), 신체활동을 실천하는 비율(Q4 = 48.4%, Q1 = 43.0%)도 유의하게 높았다(P = 0.002).

당섭취율 10% 미만, 10%–20%, 20% 초과군으로 분석한 결과 신체활동 실천율과 피임약복용여부를 제외한 모든 일반적 특성변수와 유의미한 관계를 보였다. 당섭취율이 높은 경우 평균신장이 낮은 경향을 보였고(P-trend < 0.001), 체질량지수가 낮은 경향을 보였다(P-trend < 0.001). 영양소 섭취량에서 당섭취율이 높아질수록 1일 에너지 섭취량(P-trend < 0.001), 포화지방산 섭취량(P-trend = 0.037), 나트륨 섭취량(P-trend < 0.001)은 적은 경향을 보였고, 반면 식이섬유 섭취량과 탄수화물 섭취량, 당섭취량은 많은 경향을 보였다(P-trend < 0.001). 당섭취율 20% 초과군이 당섭취율 10% 미만군에 비해 교육수준이 높은 대상자의 비율(44.6%)이 더 높았고, 흡연을 하지 않는 비율(85.8%)과 음주를 하지 않는 비율(55.3%)이 더 높았다. 당섭취율 10% 미만, 10%–20%, 20% 초과에 따른 폐경 여부(P < 0.001)는 차이가 있으며, 이는 당섭취율 20% 초과군에서 더 높은 비율(48.15%)을 나타냈다.

당섭취율 10% 미만, 10% 이상군으로 분석한 결과 신체활동 실천율, 피임약 복용여부, 포화지방산 섭취를 제외한 모든 일반적 특성과 유의미한 관계를 보였다. 당섭취율이 높은 경우 평균신장이 낮은 경향을 보였고(P-trend < 0.001), 체질량지수가 낮은 경향을 보였다(P-trend < 0.001). 영양소 섭취량에서 당섭취율이 높아질수록 1일 에너지 섭취량과 나트륨 섭취량은 적은 경향을 보였고(P-trend < 0.001), 반면 식이섬유 섭취량과 탄수화물 섭취량, 당섭취량은 많은 경향을 보였다(P-trend < 0.001). 당섭취율 10% 이상군이 당섭취율 10% 미만군에 비해 교육수준이 높은 대상자의 비율(46.3%)이 더 높았고, 흡연을 하지 않는 비율(84.5%)과 음주를 하지 않는 비율(49.9%)이 더 높았다. 당섭취율 10% 미만, 10% 이상에 따른 폐경 여부(P < 0.001)는 차이가 있으며, 이는 당섭취율 10% 이상군에서 더 높은 비율

Table 1. General characteristics of the study population

Category	All participants	Sex-specific quartiles of sugar intake[1]				*P*-value[2]	*P*-trend[2]	Sugar energy rate[3]			*P*-value[2]	*P*-trend[2]	Sugar energy rate[3]		*P*-value[2]	*P*-trend[2]
		Q1	Q2	Q3	Q4			< 10%	10%–20%	> 20%			< 10%	≥ 10%		
No. of participants	13,016	3,260	3,248	3,260	3,248	-	-	5,171	5,947	1,898	-	-	5,171	7,845	-	-
Age (year)	47.51 ± 0.27	48.84 ± 0.45	48.35 ± 0.41	47.16 ± 0.36	45.79 ± 0.37	< 0.001	< 0.001	46.97 ± 0.36	48.01 ± 0.32	47.50 ± 0.46	0.021	0.064	46.97 ± 0.36	47.88 ± 0.29	0.010	0.010
Sex, female	7,264 (49.1)	1,821 (48.6)	1,808 (48.8)	1,823 (49.8)	1,812 (49.1)	-	-	2,400 (39.3)	3,556 (53.8)	1,308 (62.5)	-	-	2,400 (39.3)	4,864 (55.9)	-	-
Height (cm)	165.48 ± 0.12	164.70 ± 0.22	165.29 ± 0.21	165.70 ± 0.20	166.20 ± 0.20	< 0.001	< 0.001	166.71 ± 0.18	164.95 ± 0.15	163.65 ± 0.25	< 0.001	< 0.001	166.71 ± 0.18	164.63 ± 0.14	< 0.001	< 0.001
BMI (kg/m^2)	24.05 ± 0.05	24.24 ± 0.08	24.07 ± 0.09	23.98 ± 0.08	23.92 ± 0.08	0.022	0.003	24.34 ± 0.06	23.83 ± 0.06	23.92 ± 0.11	< 0.001	< 0.001	24.34 ± 0.06	23.85 ± 0.06	< 0.001	< 0.001
Education						< 0.001	-				< 0.001	-			< 0.001	-
≤ Elementary school	2,368 (11.6)	920 (18.1)	684 (13.7)	477 (9.3)	287 (5.7)			1,119 (13.4)	994 (10.8)	255 (8.9)			1,119 (13.4)	1,249 (10.3)		
Middle school	1,253 (7.5)	329 (8.1)	339 (8.4)	300 (6.9)	285 (6.6)			492 (7.6)	577 (7.3)	184 (7.7)			492 (7.6)	761 (7.4)		
High school	4,340 (36.3)	1,009 (35.8)	1,044 (35.6)	1,113 (36.0)	1,174 (37.8)			1,697 (36.7)	1,941 (35.2)	702 (38.8)			1,697 (36.7)	2,643 (36.0)		
≥ College	5,055 (44.7)	1,002 (38.0)	1,181 (42.4)	1,370 (47.9)	1,502 (50.0)			1,863 (42.3)	2,435 (46.8)	757 (44.6)			1,863 (42.3)	3,192 (46.3)		
Smoking status[4]						< 0.001	-				< 0.001	-			< 0.001	-
Yes	2,071 (18.7)	555 (20.4)	544 (19.7)	452 (16.0)	520 (18.9)			1,043 (23.3)	804 (16.0)	224 (14.2)			1,043 (23.3)	1,028 (15.5)		
No	10,945 (81.3)	2,705 (79.6)	2,704 (80.3)	2,808 (84.0)	2,728 (81.1)			4,128 (76.7)	5,143 (84.0)	1,674 (85.8)			4,128 (76.7)	6,817 (84.5)		
Drinking status[5]						< 0.001	-				< 0.001	-			< 0.001	-
Yes	6,602 (55.5)	1,719 (58.7)	1,697 (57.3)	1,644 (54.5)	1,542 (51.8)			3,015 (63.3)	2,823 (51.8)	764 (44.7)			3,015 (63.3)	3,587 (50.1)		
No	6,414 (44.5)	1,541 (41.3)	1,551 (42.7)	1,616 (45.5)	1,706 (48.2)			2,156 (36.7)	3,124 (48.2)	1,134 (55.3)			2,156 (36.7)	4,258 (49.9)		
Physical activities[6]						0.002	-				0.417	-			0.950	-
Yes	5,517 (45.4)	1,254 (43.0)	1,334 (44.3)	1,408 (45.8)	1,521 (48.4)			2,142 (45.5)	2,526 (44.9)	849 (46.9)			2,142 (45.5)	3,375 (45.4)		
No	7,499 (54.6)	2,006 (57.0)	1,914 (55.7)	1,852 (54.2)	1,727 (51.6)			3,029 (54.5)	3,421 (55.1)	1,049 (53.1)			3,029 (54.5)	4,470 (54.6)		
Menopausal status, yes[7]	3,858 (42.6)	1,029 (43.7)	992 (44.0)	919 (40.2)	918 (42.7)	0.212	-	1,242 (39.5)	1,878 (42.7)	738 (48.1)	< 0.001	-	1,242 (39.5)	2,616 (44.2)	< 0.001	-
Oral contraception	1,206 (15.5)	313 (15.8)	326 (16.9)	287 (14.7)	280 (14.6)	0.311	-	402 (15.7)	588 (15.5)	216 (15.1)	0.896	-	402 (15.7)	804 (15.4)	0.731	-
Energy intake (kcal/d)	1,899.57 ± 9.88	1,450.80 ± 14.05	1,764.18 ± 14.74	1,962.72 ± 13.55	2,390.52 ± 17.46	< 0.001	< 0.001	1,949.31 ± 15.54	1,900.60 ± 13.18	1,753.53 ± 20.95	< 0.001	< 0.001	1,949.31 ± 15.54	1,864.93 ± 11.46	< 0.001	< 0.001
SFA intake (g/d)	15.71 ± 0.16	10.78 ± 0.24	14.15 ± 0.24	16.46 ± 0.24	21.12 ± 0.30	< 0.001	< 0.001	15.73 ± 0.27	16.14 ± 0.20	14.31 ± 0.31	< 0.001	0.037	15.73 ± 0.27	15.69 ± 0.17	0.895	0.895
Sodium intake (mg/d)	3,300.57 ± 23.04	2,610.15 ± 31.86	3,197.38 ± 36.70	3,463.46 ± 37.07	3,893.61 ± 47.25	< 0.001	< 0.001	3,466.90 ± 34.53	3,359.85 ± 32.26	2,637.71 ± 51.45	< 0.001	< 0.001	3,466.90 ± 34.53	3,184.71 ± 28.02	< 0.001	< 0.001
Dietary fiber intake (g/d)	25.60 ± 0.16	17.55 ± 0.17	22.83 ± 0.23	27.13 ± 0.24	34.34 ± 0.33	< 0.001	< 0.001	22.81 ± 0.20	27.00 ± 0.22	29.25 ± 0.47	< 0.001	< 0.001	22.81 ± 0.20	27.55 ± 0.22	< 0.001	< 0.001
Carbohydrate intake (g/d)	270.41 ± 1.30	198.23 ± 1.63	244.09 ± 1.76	280.65 ± 1.76	353.58 ± 2.35	< 0.001	< 0.001	255.04 ± 1.81	278.91 ± 1.75	288.03 ± 3.40	< 0.001	< 0.001	255.04 ± 1.81	281.12 ± 1.64	< 0.001	< 0.001
Total sugar intake (g/d)	58.90 ± 0.52	19.29 ± 0.15	39.89 ± 0.12	61.88 ± 0.17	111.38 ± 0.80	< 0.001	< 0.001	31.55 ± 0.32	67.36 ± 0.51	111.04 ± 1.49	< 0.001	< 0.001	31.55 ± 0.32	77.95 ± 0.64	< 0.001	< 0.001

Mean ± SE or n (%).

Physical activity level: Engages in at least 150 minutes of moderate-intensity physical activity per week or 75 minutes of vigorous-intensity physical activity per week (where 1 minute of vigorous activity = 2 minutes of moderate activity).

BMI, body mass index; SFA, saturated fatty acids.

[1]Sex-specific quartiles of sugar intake: The quartile cutoffs were 31.5, 51.8, and 80.2 g/day for men and 29.0, 47.0, and 72.0 g/day for women.

[2]Statistical analysis: Values were obtained using the general linear model for continuous variables and the χ^2 test for categorical variables in complex sample survey data analysis.

[3]Sugar energy rate formula: (Total sugar intake (g) × 4) / Energy intake (g) × 100.

[4]Smoking status: Current smoker.

[5]Alcohol consumption: Consumes alcohol at least once a month.

[6]Do 150 minutes of moderate physical activity/week or 75 minutes of moderate and hard physical activity/week (1 minute of hard = 2 minutes of moderate).

[7]Menopausal status at the time of survey (not at the time of diagnosis).

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(44.2%)을 나타냈다.

따라서 당섭취량이 많으면 더 어리고, 신장이 크고, 체질량지수가 낮고, 1일 에너지 섭취량, 포화지방산 섭취량, 나트륨 섭취량, 식이섬유 섭취량, 탄수화물 섭취량이 많았다. 이에 비해 당섭취율이 높은 경우 신장이 작고 1일 에너지 섭취량과 나트륨 섭취량은 적고, 식이섬유 섭취량과 탄수화물 섭취량은 많았음을 알 수 있다. 또한 당섭취량이 많고 당섭취율이 높을 경우 교육 수준이 높고, 흡연과 음주를 하지 않는 비율이 높았다.

2. 연도별, 성별, 연령대에 따른 당섭취 수준

조사 연도별 성별과 연령대에 따른 당섭취량과 당섭취율을 Table 2에 나타내었다. 당섭취량은 2019년 58.37 g, 2020년 56.14 g, 2021년 56.15 g으로 2019년 대비 2020년에 약간 감소하였으나, 2020년 대비 2021년에는 큰 변화가 없었음을 알 수 있다. 2019–2021년 평균 당섭취량은 여성보다 남성에서 많았고, 이는 50–64세, 65–74세를 제외한 전연령대에서 통계적으로 유의하였다($P < 0.05$).

당섭취율은 2019년 12.66%, 2020년 12.41%, 2021년 12.51%로 연도에 따른 큰 변화가 없었다. 2019–2021년 평균 당섭취율은 당섭취량과 다르게 남성보다 여성에서 높았고, 이는 전연령대에서 통계적으로 유의하였다($P < 0.05$). 2021년 여성의 당섭취율(P-trend = 0.022)과 2019–2021년 여성의 평균 당섭취율(P-trend = 0.048)에서만 연령대에 따른 당섭취율 추이가 유의미함을 알 수 있다.

전체기간(2019–2021년)동안 남녀 전체 연령대별 당섭취 수준을 보았을 때, 당섭취량은 19–29세가 61.38 g으로 가장 많았으며, 당섭취율은 50–64세가 13.21%로 가장 높았다. 연도에 따른 당섭취량의 추이를 보면 19–29세 여성과 30–39세 남성에서 당섭취량의 추이가 유의미함을 알 수 있다(P-trend = 0.026, P-trend < 0.001). 여성에서 연도에 따른 전체 당섭취량 추이가 경계선 상에서 유의함을 알 수 있다(P-trend = 0.043). 또한 연도에 따른 당섭취율의 추이는 30–39세 남성에서만 유의미한 추이를 나타내었다(P-trend = 0.017).

3. 연령대에 따른 암 종류별 유병 현황

연령대에 따른 암 종류별 유병 현황을 성별에 따라 Table 3에 나타내었다. 조사대상자 남녀 전체에서 연령대와 암 유병 현황이 모든 종류 암에서 유의미한 연관성을 나타내었다($P < 0.05$). 남성에서는 연령대와 암 유병 현황이 모든 종류 암에서 유의미한 연관성을 보였으나($P < 0.05$), 여성에서는 폐경 후 유방암, 폐경 전 자궁경부암, 폐경 후 자궁경부암과 폐암을 제외한 암에서 연관성을 보였다($P < 0.05$). 또 여성에서 갑상선암과 자궁경부암은 다른 암과 달리 10대에서도 유병자가 있었다. 남녀 전체에서 기타암을 제외하면 갑상선암, 위암, 유방암, 대장암, 폐암, 간암 순으로 유병자가 많았다. 남자의 경우 위암, 대장암, 갑상선암, 폐암, 간암 순으로 유병자가 많았으며, 여자의 경우 갑상선암, 유방암, 자궁경부암, 위암, 대장암, 폐암, 간암 순으로 유병자가 많았다.

4. 암 종류별 유병 여부에 따른 남녀 당섭취 수준

암 종류별 유병 여부에 따라 남녀의 당섭취량과 당섭취율을 Table 4에 나타내었다. 남녀 전체 조사대상자 중 암 유병 여부에 따라 평균 당섭취량이 유의미한 차이를 나타내는 암 종류는 없었으나, 암 유병 여부에 따라 평균 당섭취율이 유의미한 차이가 나타난 암 종류는 전체암($P = 0.007$)과 유방암($P = 0.002$)이고, 유병자인 경우 비유병자보다 당섭취율이 높았다. 남성에서 암 유병 여부에 따라 당섭취량과 당섭취율의 평균 차이가 유의함을 나타내는 암 종류는 없었다. 반면 여성의 경우 폐경 전 자궁경부암 유병자가 비유병자에 비해 당섭취량이 많았으며($P = 0.015$), 간암 유병자가 비유병자에 비해 당섭취량과 당섭취율 모두 적었다($P = 0.006$, $P < 0.001$).

5. 당섭취와 암 종류별 유병여부의 연관성

당섭취와 암종류별 유병여부를 성별에 따라 나누어 분석하였고, 유방암, 자궁경부암의 경우는 여성 대상자에서만 분석을 진행하였다. 당섭취 수준은 범주형과 연속형을 통해 분석하였다. 범주형으로 분석한 결과 당섭취율보다 당섭취량에서 더 다양한 종류의 암에서 연관성을 보였으며, 총 에너지 섭취량 중 당이 섭취하는 비율이 높은 경우에 더 유의미한 결과를 나타내었다(Supplementary Table 1). 그러나 Model 1–5에서 일관성 있게 유의미한 관계성을 보이는 경우는 드물었는데, 당섭취율이 10% 미만군에 비해 10% 이상군인 경우 폐경 전 자궁경부암에서만 일관된 양의 연관성을 나타내었다(OR: 5.39; 95% CI: 1.04–27.96) (Fig. 3). 연속형으로 분석한 결과 당섭취량과 자궁경부암, 폐경 전 자궁경부암, 폐경 후 자궁경부암에서 유의미한 결과를 나타내었으며, 이중 자궁경부암에서만 Model 1–5에서 일관된 양의 연관성을 나타내었다(OR: 1.02; 95% CI: 1.02–1.03) (Fig. 4).

DISCUSSION

본 연구는 제 8기 국민건강영양조사(2019–2021년) 자료를 활용하여 연도별, 성별, 연령대별로 계층화하여 당섭취 수준을 알아보고, 암 유병과의 연관성에 대해 조사하였다. 전기간(2019–2021년) 평균 당섭취량은 여성보다(53.9 g) 남성에서(59.8 g) 더 많았고, 평균 당섭취율은 남성(11.4%)보다 여성(13.6%)에서 더 높았다. 여성에서 폐경 전 자궁경부암 유병 여부에 따라 당섭취량의 평균 차이가 유의하였고, 당섭취율이 10% 이상인 군이 10% 미만인 군에 비해 폐경 전 자궁경부암 유병 위험이 5.39배 높았다.

Table 2. Sugar intake, sugar intake rate by sex and age group according to survey year

Category	Age range (year)	2019			*P*-value[1)]	2020			*P*-value[1)]	2021			*P*-value[1)]	2019-2021			*P*-value[1)]	*P*-trend[1)]		
		Male	Female	Total		Male	Female	Total		Male	Female	Total		Male	Female	Total		Male	Female	Total
Sugar intake (g)																				
	19–29	67.04 ± 3.32	64.22 ± 2.40	65.68 ± 2.21	0.458	63.97 ± 2.60	53.12 ± 2.30	58.71 ± 1.72	0.003	63.49 ± 3.62	55.96 ± 2.76	59.84 ± 2.34	0.096	64.83 ± 1.87	57.71 ± 1.47	61.38 ± 1.23	0.002	0.469	0.026	0.071
	30–39	70.73 ± 2.73	55.38 ± 2.09	63.31 ± 1.76	< 0.001	65.86 ± 3.00	56.39 ± 2.43	61.38 ± 2.02	0.013	57.76 ± 2.60	52.55 ± 2.56	55.34 ± 1.88	0.140	64.78 ± 1.68	54.80 ± 1.36	60.05 ± 1.13	< 0.001	< 0.001	0.397	0.002
	40–49	65.78 ± 2.34	57.54 ± 2.34	61.70 ± 1.77	0.008	61.16 ± 2.21	57.06 ± 2.08	59.14 ± 1.67	0.123	66.59 ± 4.30	52.37 ± 1.90	59.80 ± 2.49	0.003	64.53 ± 1.82	55.70 ± 1.23	60.21 ± 1.17	< 0.001	0.860	0.090	0.533
	50–64	62.19 ± 1.61	63.73 ± 1.80	62.95 ± 1.35	0.464	57.68 ± 1.77	60.83 ± 2.11	59.24 ± 1.47	0.220	62.72 ± 2.04	60.45 ± 2.04	61.59 ± 1.56	0.390	60.85 ± 1.07	61.66 ± 1.14	61.25 ± 0.85	0.564	0.849	0.227	0.520
	65–74	57.30 ± 2.74	49.49 ± 1.80	53.11 ± 1.54	0.020	54.77 ± 2.37	52.59 ± 2.17	53.64 ± 1.83	0.422	54.71 ± 2.62	53.99 ± 2.24	54.34 ± 1.85	0.820	55.55 ± 1.48	52.05 ± 1.22	53.73 ± 1.01	0.052	0.503	0.118	0.607
	≥ 75	45.19 ± 1.99	41.77 ± 2.24	43.45 ± 1.63	0.211	50.30 ± 2.94	38.87 ± 2.70	44.73 ± 2.33	< 0.001	48.90 ± 2.42	42.89 ± 2.33	45.96 ± 1.82	0.049	48.04 ± 1.42	41.35 ± 1.40	44.73 ± 1.11	< 0.001	0.258	0.734	0.322
	Total	61.37 ± 1.07	55.35 ± 0.98	58.37 ± 0.82	-	58.96 ± 1.01	53.14 ± 0.99	56.14 ± 0.77	-	59.03 ± 1.40	53.04 ± 1.02	56.15 ± 0.92	-	59.76 ± 0.70	53.88 ± 0.56	56.89 ± 0.50	-	-	-	-
	P-trend[1)]	< 0.001	< 0.001	< 0.001		< 0.001	0.335	< 0.001		0.017	0.388	0.014		< 0.001	< 0.001	< 0.001		0.126	0.043	0.027
Sugar energy rate (%)																				
	19–29	11.92 ± 0.51	14.51 ± 0.41	13.17 ± 0.33	< 0.001	11.29 ± 0.42	12.92 ± 0.50	12.08 ± 0.33	0.014	11.67 ± 0.55	13.21 ± 0.51	12.42 ± 0.37	0.045	11.63 ± 0.29	13.54 ± 0.28	12.55 ± 0.20	< 0.001	0.742	0.053	0.136
	30–39	11.78 ± 0.35	13.39 ± 0.39	12.56 ± 0.27	0.001	11.53 ± 0.53	13.18 ± 0.57	12.31 ± 0.42	0.019	10.46 ± 0.43	12.89 ± 0.47	11.59 ± 0.33	< 0.001	11.26 ± 0.26	13.16 ± 0.27	12.16 ± 0.20	< 0.001	0.017	0.396	0.021
	40–49	11.44 ± 0.37	13.28 ± 0.37	12.35 ± 0.27	< 0.001	11.14 ± 0.39	14.10 ± 0.37	12.61 ± 0.30	< 0.001	12.17 ± 0.55	13.43 ± 0.41	12.77 ± 0.35	0.063	11.59 ± 0.26	13.61 ± 0.22	12.58 ± 0.18	< 0.001	0.268	0.770	0.338
	50–64	11.71 ± 0.31	15.50 ± 0.36	13.58 ± 0.26	< 0.001	10.64 ± 0.30	14.69 ± 0.33	12.64 ± 0.23	< 0.001	11.68 ± 0.35	15.17 ± 0.44	13.41 ± 0.30	< 0.001	11.34 ± 0.19	15.12 ± 0.22	13.21 ± 0.16	< 0.001	0.944	0.555	0.675
	65–74	11.87 ± 0.48	13.69 ± 0.42	12.85 ± 0.33	0.005	11.70 ± 0.41	14.07 ± 0.47	12.93 ± 0.34	< 0.001	11.25 ± 0.40	14.55 ± 0.43	12.94 ± 0.34	< 0.001	11.58 ± 0.24	14.12 ± 0.26	12.91 ± 0.20	< 0.001	0.297	0.153	0.852
	≥ 75	10.57 ± 0.39	12.34 ± 0.52	11.47 ± 0.34	0.005	11.92 ± 0.52	11.85 ± 0.59	11.88 ± 0.43	0.920	11.30 ± 0.46	12.61 ± 0.50	11.94 ± 0.37	0.037	11.23 ± 0.27	12.30 ± 0.31	11.76 ± 0.22	0.006	0.254	0.718	0.377
	Total	11.55 ± 0.17	13.79 ± 0.19	12.66 ± 0.14	-	11.37 ± 0.18	13.47 ± 0.21	12.41 ± 0.15	-	11.42 ± 0.20	13.64 ± 0.19	12.51 ± 0.15	-	11.44 ± 0.11	13.64 ± 0.11	12.53 ± 0.08	-	-	-	-
	P-trend[1)]	0.296	0.619	0.392		0.930	0.135	0.245		0.782	0.022	0.055		0.621	0.048	0.178		0.538	0.408	0.294

Mean ± SE.

[1)]Values were obtained using the general linear model for continuous variables in complex sample survey data analysis.

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Table 3. Prevalence status by cancer types by sex and age group

Sex	Cancer site	Age range (year)							*P*-value[1]
		19–29	30–39	40–49	50–64	65–74	≥ 75	Total	
Total									
	All cancer	8 (1.6)	35 (6.9)	89 (14.9)	250 (34.9)	218 (24.3)	169 (17.5)	769 (100)	< 0.001
	Thyroid cancer	2 (2.5)	21 (16.2)	38 (28.9)	73 (40.6)	24 (8.5)	10 (3.3)	168 (100)	< 0.001
	Gastric cancer	0 (0.0)	1 (2.7)	5 (5.0)	30 (31.9)	32 (26.9)	44 (33.6)	112 (100)	< 0.001
	Breast cancer	0 (0.0)	2 (0.5)	16 (19.1)	51 (48.5)	24 (19.8)	15 (12.0)	108 (100)	< 0.001
	Colon cancer	0 (0.0)	0 (0.0)	11 (14.1)	30 (32.5)	34 (30.4)	31 (23.0)	106 (100)	< 0.001
	Lung cancer	0 (0.0)	0 (0.0)	1 (2.8)	9 (24.8)	18 (53.6)	7 (18.8)	35 (100)	< 0.001
	Liver cancer	0 (0.0)	0 (0.0)	0 (0.0)	4 (22.9)	9 (56.1)	3 (21.0)	16 (100)	0.003
	Other cancers	5 (3.4)	7 (7.0)	13 (7.4)	55 (29.5)	76 (30.4)	55 (22.3)	211 (100)	< 0.001
Male									
	All cancer	3 (1.4)	4 (2.9)	17 (8.8)	87 (29.8)	122 (32.3)	94 (24.9)	327 (100)	< 0.001
	Gastric cancer	0 (0.0)	0 (0.0)	2 (3.6)	22 (33.3)	22 (31.3)	27 (31.7)	73 (100)	< 0.001
	Colon cancer	0 (0.0)	0 (0.0)	3 (6.1)	17 (28.4)	27 (38.9)	21 (26.6)	68 (100)	< 0.001
	Thyroid cancer	0 (0.0)	2 (9.4)	7 (43.1)	10 (36.8)	4 (7.5)	1 (3.2)	24 (100)	0.035
	Lung cancer	0 (0.0)	0 (0.0)	0 (0.0)	2 (7.5)	15 (69.4)	5 (23.1)	22 (100)	< 0.001
	Liver cancer	0 (0.0)	0 (0.0)	0 (0.0)	4 (28.2)	6 (46.0)	3 (25.8)	13 (100)	0.010
	Breast cancer	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	-
	Other cancers	3 (3.2)	2 (4.3)	5 (5.1)	34 (28.9)	57 (31.7)	42 (26.8)	143 (100)	< 0.001
Female									
	All cancer	5 (1.8)	31 (9.9)	72 (19.6)	163 (38.7)	96 (18.2)	75 (11.8)	442 (100)	< 0.001
	Thyroid cancer	2 (3.0)	19 (17.8)	31 (25.6)	63 (41.5)	20 (8.8)	9 (3.3)	144 (100)	< 0.001
	Breast cancer	0 (0.0)	2 (0.5)	16 (19.1)	51 (48.5)	24 (19.8)	15 (12.0)	108 (100)	< 0.001
	Premenopausal breast cancer[2]	0 (0.0)	1 (0.9)	11 (84.2)	3 (14.9)	0 (0.00)	0 (0.00)	15 (100)	< 0.001
	Postmenopausal breast cancer[2]	0 (0.0)	1 (0.4)	5 (5.8)	48 (55.5)	24 (23.9)	15 (14.5)	93 (100)	0.235
	Cervical cancer	1 (1.9)	4 (10.1)	6 (10.4)	6 (21.0)	15 (34.0)	13 (22.6)	45 (100)	< 0.001
	Premenopausal cervical cancer[2]	1 (9.1)	4 (49.2)	5 (41.7)	0 (0.0)	0 (0.0)	0 (0.0)	10 (100)	0.325
	Postmenopausal cervical cancer[2]	0 (0.0)	0 (0.0)	1 (2.2)	6 (26.5)	15 (42.8)	13 (28.5)	35 (100)	0.126
	Gastric cancer	0 (0.0)	1 (8.3)	3 (7.7)	8 (28.8)	10 (17.8)	17 (37.4)	39 (100)	< 0.001
	Colon cancer	0 (0.0)	0 (0.0)	8 (28.0)	13 (39.6)	7 (15.7)	10 (16.7)	38 (100)	0.018
	Lung cancer	0 (0.0)	0 (0.0)	1 (7.7)	7 (55.7)	3 (25.4)	2 (11.2)	13 (100)	0.210
	Liver cancer	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (100)	0 (0.0)	3 (100)	0.038
	Other cancers	2 (3.8)	5 (13.5)	8 (12.9)	21 (31.0)	19 (27.3)	13 (11.5)	68 (100)	0.004

n (%).
[1]Values were obtained using the χ^2 test for categorical variables in complex sample survey data analysis.
[2]Menopausal status: Assessed at the time of the survey, not at the time of diagnosis.

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Table 4. Sugar intake and sugar intake rate by cancer types and sex

Sex	Cancer site	Sugar intake(g)		*P*-value[1]	Sugar intake rate (%)		*P*-value[1]
		Cancer	Non-cancer		Cancer	Non-cancer	
Total							
	All cancer	60.02 ± 2.02	58.85 ± 0.52	0.556	13.42 ± 0.30	12.62 ± 0.08	0.007
	Gastric cancer	59.46 ± 4.97	58.90 ± 0.51	0.909	13.26 ± 0.72	12.65 ± 0.08	0.392
	Liver cancer	56.44 ± 8.06	58.90 ± 0.52	0.759	11.73 ± 1.17	12.65 ± 0.08	0.428
	Colon cancer	55.82 ± 3.60	58.92 ± 0.52	0.389	11.57 ± 0.59	12.66 ± 0.08	0.065
	Breast cancer[2]	58.29 ± 4.27	58.90 ± 0.52	0.885	15.39 ± 0.89	12.64 ± 0.08	0.002
	Lung cancer	51.84 ± 4.50	58.91 ± 0.52	0.118	12.73 ± 1.00	12.65 ± 0.08	0.942
	Thyroid cancer	58.57 ± 3.64	58.90 ± 0.52	0.926	13.11 ± 0.56	12.65 ± 0.08	0.408
	Other cancers	59.57 ± 2.93	58.89 ± 0.52	0.818	12.98 ± 0.55	12.65 ± 0.08	0.542
Male							
	All cancer	60.25 ± 2.49	61.64 ± 0.73	0.579	11.89 ± 0.38	11.43 ± 0.11	0.228
	Gastric cancer	62.48 ± 6.50	61.58 ± 0.72	0.889	12.41 ± 0.79	11.44 ± 0.11	0.224
	Liver cancer	60.66 ± 8.73	61.59 ± 0.72	0.915	12.21 ± 1.30	11.45 ± 0.11	0.556
	Colon cancer	53.69 ± 4.81	61.65 ± 0.73	0.102	10.21 ± 0.74	11.46 ± 0.11	0.094
	Breast cancer	0.00 ± 0.00	61.59 ± 0.72	-	0.00 ± 0.00	11.45 ± 0.11	-
	Lung cancer	51.09 ± 5.91	61.61 ± 0.72	0.078	11.42 ± 0.97	11.45 ± 0.11	0.975
	Thyroid cancer	74.57 ± 10.03	61.53 ± 0.72	0.194	12.37 ± 1.21	11.44 ± 0.11	0.445
	Other cancers	58.08 ± 3.58	61.65 ± 0.73	0.326	12.07 ± 0.65	11.44 ± 0.11	0.336
Female							
	All cancer	59.85 ± 2.72	55.90 ± 0.60	0.153	14.59 ± 0.41	13.87 ± 0.11	0.092
	Gastric cancer	53.25 ± 7.01	56.13 ± 0.60	0.683	15.02 ± 1.30	13.90 ± 0.11	0.390
	Liver cancer	38.05 ± 6.49	56.12 ± 0.60	0.006	9.68 ± 0.93	13.91 ± 0.11	< 0.001
	Colon cancer	59.48 ± 5.31	56.10 ± 0.60	0.526	13.90 ± 0.93	13.90 ± 0.11	0.997
	Breast cancer	58.29 ± 4.27	56.09 ± 0.60	0.608	15.39 ± 0.89	13.88 ± 0.11	0.095
	Premenopausal breast cancer[3]	61.13 ± 12.17	56.52 ± 0.80	0.704	14.69 ± 2.36	13.55 ± 0.15	0.627
	Postmenopausal breast cancer[3]	57.71 ± 4.53	55.49 ± 0.89	0.623	15.54 ± 0.96	14.35 ± 0.17	0.224
	Cervical cancer	81.83 ± 19.50	55.98 ± 0.60	0.186	16.58 ± 2.11	13.89 ± 0.11	0.203
	Premenopausal cervical cancer[3]	84.53 ± 11.50	56.48 ± 0.80	0.015	15.47 ± 1.32	13.55 ± 0.15	0.148
	Postmenopausal cervical cancer[3]	81.13 ± 24.41	55.28 ± 0.86	0.291	16.87 ± 2.62	14.35 ± 0.17	0.340
	Lung cancer	53.16 ± 6.55	56.12 ± 0.60	0.654	15.06 ± 1.98	13.90 ± 0.11	0.559
	Thyroid cancer	54.89 ± 3.45	56.14 ± 0.60	0.719	13.28 ± 0.60	13.92 ± 0.11	0.291
	Other cancers	63.14 ± 4.70	56.06 ± 0.60	0.129	15.19 ± 0.92	13.89 ± 0.11	0.159

Mean ± SE.
[1]Values were obtained using general linear model for continuous variables in complex sample survey data analysis.
[2]Values corresponding to female participants.
[3]Menopausal status: Assessed at the time of the survey, not at the time of diagnosis.

본 연구에서 연도별 당섭취 수준을 분석한 결과, 19세 이상 성인의 평균 당섭취량은 2019년 58.4 g, 2020년 56.1 g, 2021년 56.2 g으로 2019년에서 2020년까지 감소하다가 2021년 소폭 증가하는 경향을 보였다. 또한, 연도별 당섭취율은 2019년 12.7%, 2020년 12.4%, 2021년 12.5%로 큰 변동 없이 유지되었다. 이러한 결과는 기존 연구에서 보고된 당섭취량과 당섭취율의 연도별 변화와 유사하였다[3, 4, 16]. 성별에 따른 당섭취 수준을 분석한 결과, 2019–2021년 평균 당섭취량은 남성에서 59.8 g, 여성에서 53.9 g으로 남성이 여성보다 더 높았으며, 당섭취율은 남성 11.4%, 여성 13.6%로 여성에서 더 높게 나타났다. 이는 기존 연구에서 보고된 결과와 유사하였으며[3, 4, 17], 남성이 여성보다 식품 섭취량이 많아 절대적인 당섭취량은 높으나, 에너지섭취량을 보정한 당섭취율은 여성에서 더 높은 경향을 보이는 것이 확인되었다. 연령대별 당섭취 수준을 분석한 결과, 2019–2021년 당섭취량은 19–29세(61.4 g)에서 가장 많았으며, 당섭취율은 50–64세(13.2%)에서 가장 높게 나타났다. 이러한

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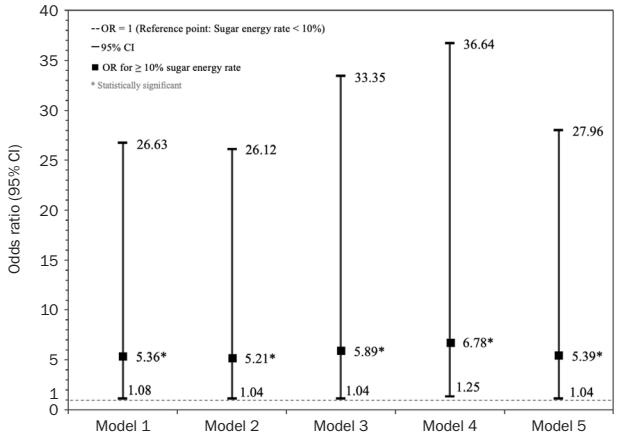

Fig. 3. OR for sugar energy rate ≥ 10% on premenopausal cervical cancer.
OR, odds ratio; 95% CI, 95% confidence interval.

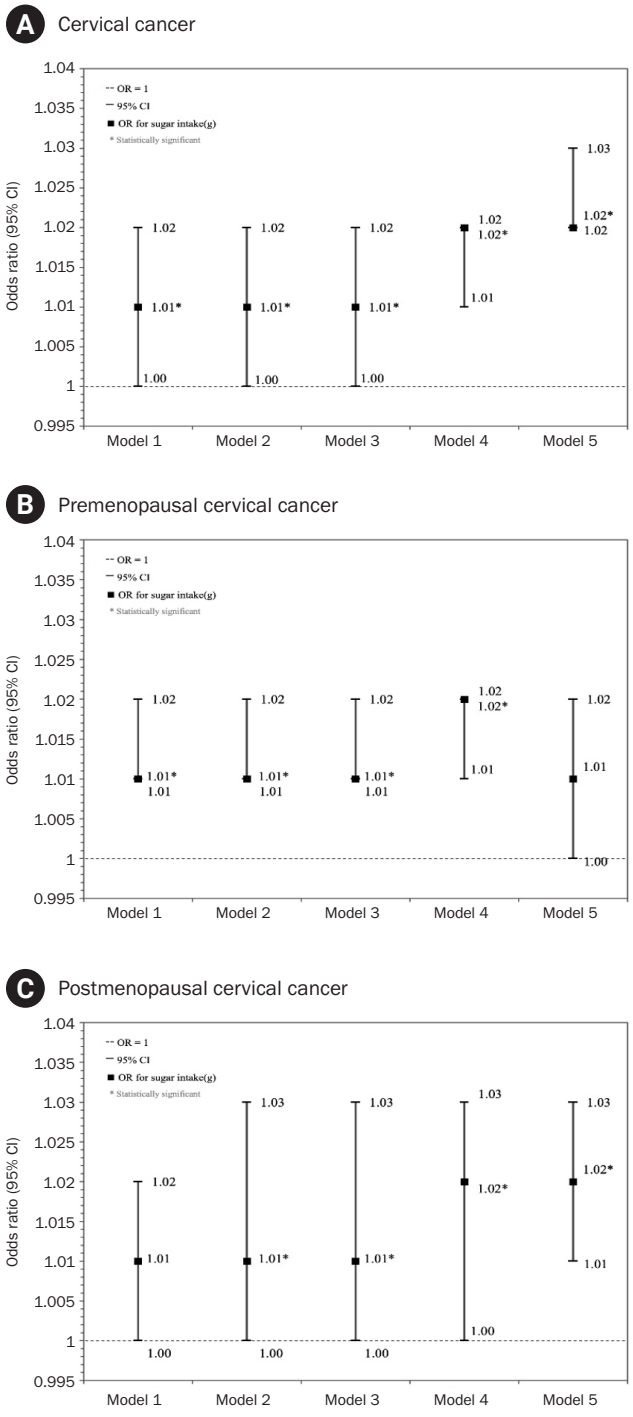

Fig. 4. OR for sugar intake on cervical cancer, premenopausal cervical cancer and postmenopausal cervical cancer.
OR, odds ratio; 95% CI, 95% confidence interval.

결과는 기존 연구에서 보고된 바와 유사하였으며[4], 20대의 과도한 당류 섭취는 주로 가공식품과 가당음료의 섭취 횟수가 많아 첨가당의 섭취량이 높은 것으로 생각되며[18], 50–64세에서 당섭취율이 높은 것은 나이가 들면서 총 에너지 섭취량은 감소하는 반면, 당이 포함된 식품 소비는 크게 줄지 않아 상대적으로 당섭취 비율이 증가한 것으로 추정된다. 따라서 전반적으로 본 연구의 결과는 선행 연구와 유사한 경향을 보였으며, 이를 통해 독립변수가 적절하게 설정되었음을 확인할 수 있었다.

한국 성인의 2019–2021년 평균 당섭취량은 58.9 g이었으며, 당섭취율은 12.5%였다. 스페인 55–80세를 대상으로 진행된 연구에서 총 설탕 섭취량의 평균은 67.0 g이었으며[10], 19세 이상 프랑스 성인을 대상으로 진행된 연구에서 평균 당섭취량은 92.8 g [12], 미국 20세 이상 성인의 1일 평균 당섭취량은 106 g이었다[19]. 한국 성인의 평균 당섭취량은 다른 나라의 당섭취량과 비교 했을 때 과도한 섭취를 우려할 수준은 아니나, 어린이·청소년·청년에 해당하는 연령대의 가공식품을 통한 당류 섭취가 첨가당 섭취 기준을 넘겼다는 보고가 있다[20]. 2020 한국인 영양소 섭취기준에서 첨가당을 총 에너지섭취량의 10% 이내로 권고하고 있는 점과 WHO에서 첨가당의 섭취를 5% 미만으로 권고하고 있는 점을 고려하였을 때 첨가당을 정확하게 구분하여 분석하는 연구가 필요하다.

이 연구에서 당섭취와 가장 일관성 있는 관계성을 보인 암은 자궁경부암이다. 여성에서 당섭취량 사분위수를 기준으로 분석하였을 때 폐경 전 자궁경부암에서 유의성을 나타내었으나 Model 4까지만 유의성을 나타내었고, 당섭취율을 기준으로 분석하였을 때는 Model 5까지 일관된 유의성을 나타냈다. 당섭취율을 2그룹으로 나누었을 때 10% 미만군에 비해 10% 이상군인 경우 폐경 전 자궁경부암 유병 오즈비가 5.39배였다(OR: 5.39; 95% CI: 1.04–27.96). 이러한 결과는 아이오와 여성 건강 연구(Iowa Women's Health Study)에 참여한 23,039명 폐경 후 여성을 대상으로 한 연구에서 가당음료와 설탕의 섭취가 높

을수록 체중상태와 상관 없이 I형 자궁내막암 위험이 커지는 결과와[21], 캐나다 식생활 및 건강연구(Canadian Study of Diet Lifestyle and Health)에 참여한 3,185명 여성들을 대상으로 한 연구에서 과일주스를 포함한 가당음료의 섭취가 높을수록 전반적인 자궁경부암과 I형 자궁내막암의 위험이 커지는 결과와 유사하였다[22]. 또한 자궁내막암의 발생과 관련된 호르몬, 식이, 유전자와 같은 다양한 요인들을 연구하는 사례 대조 연구에 따르면, 자궁내막암과 관련된 여러 위험 요인들을 보정한 후에도 첨가당의 섭취량이 가장 높은 사분위수에 속하는 경우 자궁내막암 위험이 증가하였다[23]. 그러나 미국 국가 건강 및 영양 검진 조사(National Health and Nutrition Examination Survey, NHANES)를 활용한 단면연구에 따르면 자궁경부암과 총당섭취량 간에 유의미한 연관성이 없었다[24].

본 연구에서 당섭취와 전체암, 위암, 폐암에서 일관되진 않으나 일부 연관성을 나타내고 있다. 당섭취율이 높아질수록 전체암 유병 위험이 증가하는 결과를 보였으나(> 20% = OR: 1.31; 95% CI: 1.02–1.68, ≥ 10% = OR: 1.22; 95% CI: 1.02–1.47) 이는 Model 4 이후로 연관성을 보이지 않았다. 당섭취량이 높아질수록 전체암 유병 위험 간의 연관성을 보였으나 이는 Model 2, 3, 4에서만 연관성을 보였다. 그러나 당섭취와 전반적인 암 위험 간의 연관성을 조사한 코호트 연구에 따르면 당섭취와 전체암 간의 연관성은 유의하였으며, 총 당섭취량이 증가할수록 전체암 유병 위험 오즈비가 1.17배였다[12]. 또한 가당음료의 섭취와 암 위험간의 연관성을 조사한 코호트 연구에 따르면 가당음료의 소비와 전체암 위험 간에 양의 상관관계가 있으며, 이의 오즈비는 1.18배였다[25]. 그러나 암 예방 연구-II (Cancer Prevention Study-II) 전향적 코호트 연구에 따르면 가당음료의 섭취 빈도 증가와 전체암 사망률 증가와 연관성을 나타내지 않았다[26].

당섭취량 사분위수를 기준으로 분석하였을 때 2사분위에서만 폐암 유병 오즈비가 3.98배로 나타났으며(OR: 3.98; 95% CI: 1.46–10.87), 이와 같은 결과는 남성에서 기인하였다(male = OR: 4.55; 95% CI: 1.58–13.15). 첨가당의 섭취와 당지수 간 양의 상관관계를 나타내고[27], 당지수와 폐암 위험 간의 연관성을 분석하기 위해 코호트 및 사례 대조 연구를 메타분석하였을 때, 연구 설계, 성별, 지리적 영역 및 에너지 섭취에 따라 계층화한 경우에도 둘 사이엔 양의 상관관계가 있었다[28]. 그러나 Q2에서만 유의성을 나타낸 것으로 보아, 추후 연구에서 당섭취 외에도 직업적인 노출, 공기 질 등 폐암의 주요 원인들이 관여하지 않았는지 조사할 필요가 있다.

당섭취율과 위암 유병은 Model 2, 3에서만 연관성을 보였으며, 변수를 추가로 보정할수록 둘 간의 유의성을 상실하였다. 식도/위 분문 선암(esophageal [EA]/gastric cardia adenocarcinoma)과 당섭취 간의 연관성을 본 미국의 사례 대조 연구에 따르면 EA 발병 위험은 자당과 설탕이 포함된 디저트, 음료와 관련하여 51%–58% 증가했음을 알 수 있다[29]. 당의 과도한 섭취와 고혈당, 인슐린 저항성 간에 연관성이 있다고 알려져 있으며, 조기 위암(early gastric cancer)과 이들 간의 연관성을 조사한 연구에서 양의 상관관계가 있다는 결과를 발표하였다[30]. 그러나 설탕이 함유된 음료 소비와 위암 간의 연관성을 조사하기 위한 일본의 코호트 연구에 따르면 둘 사이에 유의한 연관성이 없었다[31].

Limitations

본 연구의 강점과 제한점은 다음과 같다. 당섭취에 대한 기준을 당섭취량과 당섭취율로 나누고, 당섭취율을 다시 두가지 기준을 통해 나누었기에 더욱 자세한 결과를 얻을 수 있었다. 한국인을 대상으로 한 당섭취와 암 유병 간의 연관성을 분석한 연구가 많이 보고되지 않았기에 본 연구 결과가 이와 관련된 중요한 자료를 제공한다는 것에 큰 의미가 있다고 생각된다. 그러나 국민건강영양조사를 활용한 단면연구로 인과관계성립에 제한점이 있으며 하루동안 진행된 24시간 회상법을 통하여 수집된 자료이기 때문에 조사대상자의 평소의 일상적인 당섭취 조사가 어려우며, 회상의 부정확성으로 인한 실제 섭취량과의 오차가 있을 수 있다. 이 연구에서는 첨가당을 구분하지 않았고, 당을 종류별로 구분하지 못해 다양한 당 종류에 따른 연관성을 나타낼 수 없다는 한계점이 존재한다.

Conclusion

연구결과 당섭취와 암유병의 관계가 일관된 유의성을 보이지 않았으나 자궁경부암 유병과는 비교적 일관된 유의성을 보였다. 이 연구에서 단면적으로 자궁경부암과의 연관성을 나타낸 것을 확인하였으므로 지속적인 분석이 필요하다. 당섭취와 암 위험 관계에 대해서는 유의미한 연관성과 그렇지 않은 경우가 섞여 보고되고 있으나 전향적 코호트 연구에서 유의미한 연관성이 보고되고 있는 바 한국인에서 당섭취가 암위험에 미치는 영향에 보다 주의를 기울여야 할 것이다. 특히 여성이 상대적으로 높은 당섭취율을 보이고, 자궁경부암이라는 여성암이 유의한 관계를 보였기에 전향적 코호트 연구를 통해 이 부분에 대한 추가 연구가 필요하다 여겨진다.

CONFLICT OF INTEREST

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

FUNDING

None.

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DATA AVAILABILITY

The data that support the findings of this study are openly available in KNHANES at https://knhanes.kdca.go.kr/knhanes/main.do.

SUPPLEMENTARY MATERIALS

Supplementary Table 1. Association between sugar intake and cancer types.
Supplementary Table 2. Association between sugar intake and cancer types in men.
Supplementary Table 3. Association between sugar intake and cancer types in women.
Supplementary Table 4. Association between sugar energy rate and cancer types.
Supplementary Table 5. Association between sugar energy rate and cancer types in men.
Supplementary Table 6. Association between sugar energy rate and cancer types in women.

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Instructions for authors

KJCN
Korean Journal of Community Nutrition

Revised in October 15, 2024

1. GENERAL INFORMATION

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.

2. AUTHORS' QUALIFICATIONS

It is essential that at least one author of the manuscript is a member of the Korean Society of Community Nutrition. Exceptions will be made when the Editorial Committee invites authors and when researchers affiliated with institutions outside Korea submits.

3. TYPES OF MANUSCRIPTS

1) **Research articles:** Research articles are reports of original research in the area of community nutrition.
2) **Reviews:** Reviews provide concise and precise updates on the latest progress made within the scope of the journal. Systematic reviews should follow the PRISMA guidelines.
3) **Research notes:** Research notes discuss new ideas, research methods, or policy issues relevant to community nutrition.
4) **Educational materials:** Educational materials describe contents of nutrition education program, its application or new approaches to nutrition education.

4. RESEARCH AND PUBLICATION ETHICS

1) **Duplicate publication:** The manuscript must be original and not published or submitted for publication in other scientific journals.
2) **Authorship:** All authors listed in a manuscript must have contributed substantially to the research design, collection and analysis of data, or preparation of the manuscript. And they should agree to be responsible for investigating and solving research-related problems.
3) **Protection of human subjects:** Research carried out on human subjects must be in compliance with the Helsinki Declaration, and authors should specify that it was reviewed and approved by an Institutional Review Board (IRB).
4) **Conflicts of interest:** Authors must disclose any financial or personal relationships with the company or organization sponsoring the research.
5) **Adherence to the ethics guidelines:** Authors should adhere to the research ethics regulations and guidelines of Korean Society of Community Nutrition. For the policies on the research and publication ethics not stated in these instructions, international standards of publication ethics for editors and authors (http://publicationethics.org/international-standards-editorsand-authors) can be applied.
6) **Copyright:** Copyright of the published article belongs to the Korean Society of Community Nutrition. A copyright transfer form should be signed by all author(s) and sent when the manuscript is submitted.
7) **Preprints:** The journal does not accept research articles that have been shared as preprints.

5. CONSIDERATION OF SEX/GENDER

In all studies, sex (a biological variable) or gender (a socio, cultural, and psychological trait) should be factored into research designs and analyses and reported in a manuscript as follows.

- Sex and gender should be described separately and correctly.
- 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

study, the reason the other sex/gender is not reported or included should be explained based on reasonable and scientific basis.

6. SUBMISSION

A manuscript file without authors' information must be submitted through our online submission system (https://submit-kjcn.or.kr) by the corresponding author. In addition, authors should remember to upload the author's information separately. This includes the title page, copyright transfer agreement signed by all authors, IRB approval, and author checklist. You can upload these documents to the "Attachment" section on the submission site.

7. PEER REVIEW

A submitted manuscript without authors' information is sent to two independent reviewers selected by an editor-in-chief or an editor. Reviewers review the manuscript in detail according to the KJCN review guidelines. The editor-in-chief then makes an initial decision based on the reviewers' comments and notifies the corresponding author of the decision within six weeks of receipt of a manuscript. One additional reviewer can be appointed when the two reviewers' comments are not in agreement.

8. MANUSCRIPT PREPARATION

1) **General:** Text must be written in Korean or English using MS Word program. The designated font style for English is Times New Roman in 11-point and the text should be 200%-spaced or double-spaced. Each page must be numbered beginning with the abstract page. Manuscripts are to have line numbers in the left margin.
2) **Title page:** The title page should include the following:
   - The type of manuscript (research articles, reviews, research notes, and educational materials)
   - The running head summarizing in Englisgh (50 characters or less including spaces)
   - Titles should be written in sentence case (only the first word of the text and proper nouns are capitalized). For observational studies (cross-sectional, case-control, or prospective cohort), clinical trials, systematic reviews, or meta-analyses, the subtitle should include the study design.
   - The names and affiliations, positions of all authors

A corresponding author should be marked with "†" at the end of the name. If some of the authors have different affiliations, superscript 1), 2), 3) should be placed at the end of each author's name in this order and the same number should be placed in front of the affiliation. 1), 2), 3) are attached in the same order, even if they belong to the same organization but have different positions.

The position of the researcher (professor, lecturer, student, researcher, etc.) should be listed in front of the affiliation. If there is no position and title, only the name is given. For minors who are not currently affiliated, submit the final affiliation, position, and school year separately.

<Example>
Youngok Kim[1)], Jin-Sook Yoon[2)†], Kil-dong Hong[3)], Na-ra Kim[4)]
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[2)]Professor, Department of Food and Nutrition, Keimyung University, Daegu, Korea
[3)]Student, Graduate School of Education, Keimyung University, Daegu, Korea
[4)]Student, OO High School, Daegu, Korea

- The name, address, telephone number, fax number, and email address of the corresponding author in English. Country code is also indicated for telephone and fax numbers.

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- ORCID (https//orcid.org/)
  All authors should register their affiliation and position at ORCID. When author identification is required, this information can be used. ORCID numbers of all authors should be indicated without blinding.

<Example>
Kil-Dong Hong https://orcid.org/****-****-****-****

• Funding
When there is no funding associated with the manuscript, “None” should be stated.

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

3) Arrangement of research articles: Each manuscript should be divided into the following sections in the order: Title page, Abstract, Introduction, Methods, Results, Discussion, Conflict of Interest, Acknowledgments, References, followed by Tables and Figures. These section headings and subheadings should be written in English. In case of educational materials, the contents of the results and discussion can be composed of contents, evaluation, and implications. In the case of a review, unlike the structure of a research articles, it can be described as an introduction, body, and conclusion. However, a scoping review or a systematic review should follow the structure of the research articles.

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.

• Study Design
Authors should present the study design (e.g., descriptive analysis, randomized controlled trial, cohort study, or meta-analysis) and any reporting guidelines referenced in the "Methods" section.

<Example>
This was a cross-sectional study. It was described according to the STROBE statement (https://www.strobe-statement.org/).

• Discussion
Authors should interpret the results and provide the Limitations and Conclusion in the latter part of the “Discussion” section.

• 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 Conclusion. 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

9) 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.

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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

Revised in October 15, 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	
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투고규정

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(2024년 10월 15일 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

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1) **이중게재:** 원고는 다른 학회지에 발표되거나 투고되지 않은것이어야 한다.
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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 올바르게 기술한다.
- 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

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

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

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〈예〉

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

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〈예〉

Kil-Dong Hong https://orcid.org/****-****-****-****

- 연구지원내역(Funding)

  해당하는 내용이 없더라도 'None.' 으로 기재한다.

〈예〉

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

3) 원고의 구성: 원고의 부제목은 모두 영문으로 작성하고, 구성은 다음과 같다. Title page, Abstract, Introduction, Methods, Results, Discussion, Conflict of Interest, 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.

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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.

• 연구설계(Study design)
저자는 "방법(Methods)" 연구설계에 연구설계(기술분석, 무작위 대조연구, 코호트 연구 또는 메타 분석 등) 및 참고한 보고지침을 제시한다.

〈예〉 This was a cross-sectional study. It was described according to the STROBE statement (https://www.strobe-statement.org/).

• 고찰(Discussion)
저자는 결과를 해석하고 "고찰(Discussion)"의 후반부에 Limitations 및 Conclusion을 제시한다.

• 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.

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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(Conclusion)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〉 Kim [3]은, Park & Lee [5]는, Brown 등[7]은

• 본문 중에 참고문헌의 저자를 기재하는 경우 영문 last name을 표기한다. 저자가 2명일 경우에는 두 저자 사이에 &를 삽입하고, 3인 이상일 때는 제1저자만 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

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〈예〉

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9) 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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대한지역사회영양학회지 연구윤리규정

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 편집위원장으로 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

(2024년 10월 15일 개정)

[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-Conclusion 의 순서	
	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, Conflict of Interest, Acknowledgments, Data Availability, References, Tables, Figures 순서로 작성 - Method의 Study design, Results의 소제목, Discussion의 Limitations, Conclusion 반드시 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 Corp.) 예) SAS 9.4 (SAS Institute)	
	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 – 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