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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 title) 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 2951-3146). 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'.

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ABSTRACTING AND INDEXING

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Review

The transition of nutritional status in infants, young children, and school-aged children in Korea and future-oriented nutritional strategies: a narrative review

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Objectives: This study examined the secular trends in anthropometric changes and the nutritional transition among Korean infants and school-aged children, while evaluating the efficacy and constraints of existing state-led nutritional policies. Ultimately, it proposes a “systems-centered” nutrition strategy, aligned with the United Nations Children’s Fund (UNICEF) Nutrition Strategy 2020–2030, to ensure health equity for future generations.
Methods: We reexamined comprehensive national health statistics, including school health examination data (1965–2024) and the Korea National Health and Nutrition Examination Survey (1998–2023). Additionally, Dietary Screening Test results from 126,768 young children (2021–2024) were reviewed. These quantitative findings were synthesized through a narrative review of South Korean pediatric nutrition policies and UNICEF’s global strategic frameworks.
Results: While Korean children have historically experienced rapid secular growth, this has decelerated in the 2000s. Conversely, the prevalence of obesity has surged along with stagnant underweight rates. Dietary problems such as insufficient vegetable intake and frequent consumption of sweet snacks were also found, accelerating the “triple burden” of malnutrition. Policies such as school lunches, NutriPlus program, and Center for Children’s Foodservice Management have demonstrated great success in reducing nutritional risks and improving dietary habits. However, existing fragmented programs face limitations in comprehensively addressing regional disparities or blind spots and in providing tailored nutritional management.
Conclusion: A paradigm shift is imperative to fundamentally resolve these multidimensional nutritional crises. Moving beyond fragmented programs, we need to adopt a “systems-centered” approach integrating health, education, and welfare ecosystems. Key policy recommendations include establishing a continuous life-cycle health database, introducing artificial intelligence and FoodTech-driven precision nutrition coaching, and fostering a healthy food environment through public-private partnerships within a community integrated care network.

Keywords: infant; children; nutritional status; dietary intake; nutrition policy

INTRODUCTION

Infancy, early childhood, and school-age represent critical windows of rapid physical and cognitive development, during which nutritional status constitutes

a pivotal determinant of lifelong health and quality of life. Historically, the Republic of Korea emerged from a post-war emergency relief phase and, in tandem with remarkable economic growth, has achieved substantial improvements in children's physical development. However, the nation is now confronted with a new and complex juncture—quantitative dietary abundance coexisting with nutritional imbalance—amid the structural demographic crisis of severely low birth rates and population aging. While the primary public health objectives of the past centered on alleviating poverty and preventing skipped meals, contemporary society faces the "triple burden" of malnutrition, wherein stunting, micronutrient deficiencies, and overweight/obesity coexist simultaneously [1]. Addressing this multifaceted nutritional challenge necessitates a departure from the fragmented, piecemeal policies of the past toward a sophisticated, life cycle-tailored nutrition strategy that encompasses the entire national system. The present study reviews the secular trends in physical growth and nutritional status among Korean infants and school-aged children from the past to the present, examines the achievements and limitations of major nutrition policies implemented to date, and, building upon the paradigm shift articulated in United Nations Children's Fund's (UNICEF's) "Nutrition Strategy 2020–2030," proposes directions for the advancement of a Korea-specific nutrition strategy [2].

METHODS

Ethics statement

As this study is a narrative review, it did not require institutional review board approval or individual consent.

Study design

This study was a non-systematic, narrative review designed to comprehensively examine secular changes in physical growth, nutritional status, dietary behavior, and related nutritional policies among Korean infants and school-aged children. Drawing on long-term accumulated national statistics, policy documents, and academic literature, its purpose was to discuss the achievements and limitations of domestic child nutrition policy and explore future directions.

A literature search was conducted using PubMed, DBpia, KISS, and Google Scholar. Official statistics and policy documents were retrieved from the websites of the Ministry of Education, School Health Information Center, Korea Disease Control and Prevention Agency, Korea National Health and Nutrition Examination Survey (KNHANES), National Health Insurance Service, Ministry of Health and Welfare, Ministry of Food and Drug Safety, and UNICEF. Search terms included combinations of "Korea," "infants," "preschool children," "school-aged children," "obesity," "underweight," "growth," "school meals," "NutriPlus," "Center for Children's Foodservice Management (CCFSM)," and "nutrition policy," along with their Korean-language equivalents. The search period extended from the inception of relevant programs to the present to capture long-term trends; however, literature pertaining to policy outcomes and recent dietary changes was primarily drawn from publications issued after 2000. The inclusion criteria were as follows: (1) official reports, nationally representative statistics, and academic papers addressing the nutritional status and dietary behavior of Korean infants and children; (2) official reports, policy documents, and academic papers concerning child-targeted nutrition policies; and (3) strategic documents from international organizations, such as UNICEF. Selected literature was synthesized according to the target age group, policy type, key outcomes, limitations, and policy implications.

SECULAR TRENDS IN PHYSICAL GROWTH AND NUTRITIONAL STATUS AMONG KOREAN INFANTS AND SCHOOL-AGED CHILDREN

The height and weight of Korean children and adolescents have undergone pronounced generational changes over the past several decades. According to anthropometric data from the Korean Pediatric Society, between 1965 and 2005, the mean height of 7-year-old children increased by 12.4 cm in boys and 11.7 cm in girls, while mean weight increased by 7.7 kg in boys and 6.4 kg in girls—representing a period of remarkable physical growth. Generational changes were even more pronounced during puberty, a period of accelerated growth. Among 13-year-old boys, height increased by

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18.6 cm over the same interval, while among girls, the greatest increase of 15.5 cm was observed at age 12 years, suggesting a progressive advancement in the age of pubertal onset [3-9] (Fig. 1). However, since the 2000s, the rate of increase in mean height and weight has visibly decelerated, whereas the prevalence of overweight and obesity has increased sharply [5-9]. Based on a sample analysis of national school health examination data using the body mass index (BMI) percentile criteria, the combined prevalence of overweight and obesity among elementary school students increased from 14.6% in 2007 to 33.3% in 2024, whereas the obesity rate alone rose markedly from 5.2% to 18.0%. Notably, the obesity rate among boys has increased steeply, widening the sex gap in obesity prevalence [5-9]. In contrast, the underweight rate among elementary school students during the same period fluctuated within a range of approximately 4%–6%, with no clear directional trend [5-9] (Fig. 2). The definition of obesity as BMI ≥ 95th percentile and overweight as BMI 85th to 95th percentile has been maintained since 2007, preserving basic year-to-year comparability. Nevertheless, it should be noted that the national pediatric growth charts were revised in 2017, at which time the 95th percentile BMI-for-age threshold was adjusted downward and the criterion of BMI ≥ 25 kg/m^2 was removed from the definition of obesity; therefore, caution is warranted in interpretation [10]. Despite this caveat, the upward trend in elementary school obesity rates observed within the same national statistical framework is difficult to attribute solely to changes in measurement criteria and is therefore interpreted as reflecting a genuine increase.

Studies analyzing data from the National Health Screening Program for Infants and Children have reported somewhat divergent patterns in the younger age group. Between 2007 and 2017, the prevalence of overweight and obesity among children aged 50–60 months remained stable or declined, while the proportion classified as suspected underweight among those aged 30–36 months trended upward, vividly illustrating the

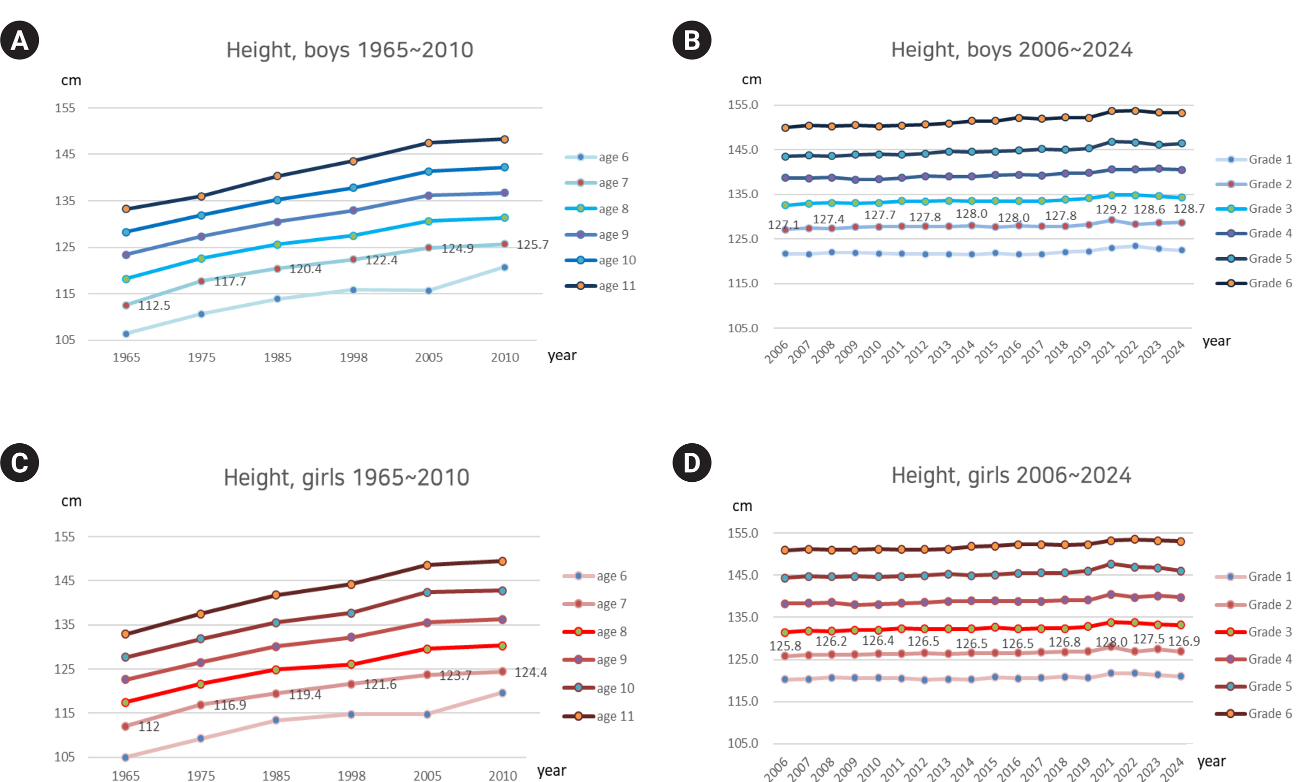

Fig. 1. Secular trends in the height of Korean children. (A), (C) Anthropometric survey data by the Korean Pediatric Society and the Ministry of Health and Welfare [3-4]. (B), (D) National school health examination data by the Ministry of Education [5-9].

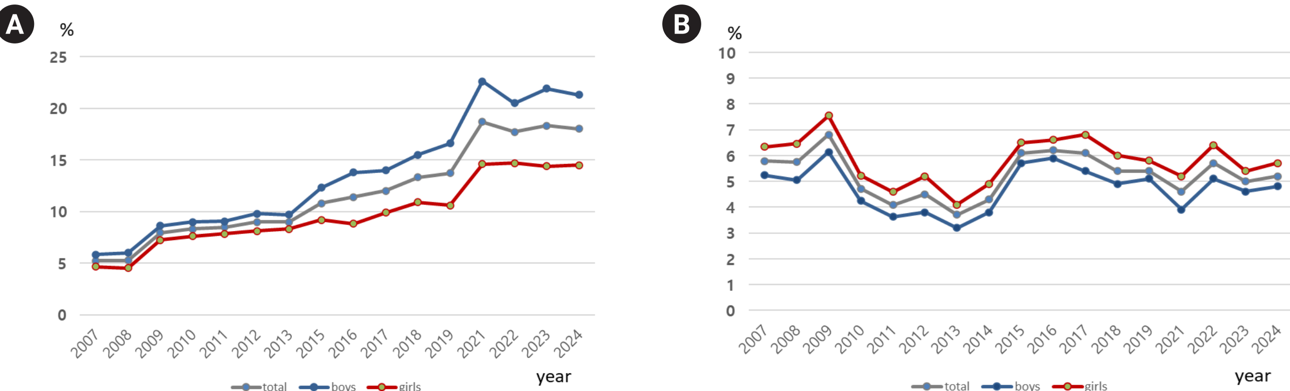

Fig. 2. Long-term trends in the prevalence of obesity and underweight among Korean elementary school children. (A) Prevalence of obesity (BMI ≥ 95th percentile) (data by the Ministry of Education) [5-9]. (B) Prevalence of underweight (BMI < 5th percentile) (data by the Ministry of Education) [5-9]. BMI, body mass index.

coexistence of obesity and underweight [11].

Structural differences in the care environment and food context may underlie the divergent obesity trends between infancy and school age. During infancy and early childhood, meals are relatively more controlled by caregivers in home, day care, and preschool settings; moreover, caregivers' dietary competency and social support reportedly exert a significant influence on the nutritional status of preschool-aged children [12]. More recently, institutional feeding at childcare facilities under the guidance of registered dietitians or the CCFSM has been reported to partially compensate for poor dietary quality. Indeed, analysis of KNHANES data from 2016 to 2019 found that children aged 3–5 years utilizing daycare center meals had higher intakes of protein, thiamine, niacin, potassium, and iron at lunch and lower intakes of sugars and fat than that of non-users [13]. In contrast, from the school-age period onward, children are increasingly exposed to food environments of their own choosing—including convenience stores and snack bars near schools, food delivery services, processed snacks, demanding after-school academy schedules, and rising use of smart devices—all of which may be associated with higher consumption of high-calorie snacks and convenience foods, as well as reduced physical activity [14]. This suggests that in infancy and early childhood, caregiver dietary competency and childcare facility meal management have relatively greater explanatory power for nutritional status, whereas in the school-age period, school and community food environments become comparatively more influential.

Nevertheless, the coexistence of obesity/overweight and underweight was evident in both age groups, and the underlying cause of this nutritional imbalance can be traced to dietary behavior. According to national health statistics, the proportion of young children classified as having inadequate nutrient intake—defined as energy intake below 75% of the estimated energy requirement combined with intake of calcium, iron, vitamin A, and riboflavin below the estimated average requirement—has generally trended downward; however, among elementary school students, this proportion has shown a tendency to increase in recent years, while vegetable intake among elementary school students has declined [15] (Fig. 3). Furthermore, analysis of Dietary Screening Test data collected through the CCFSM from 126,768 children, aged 1–5 years, between 2021 and 2024 revealed that 44% consumed vegetables once daily or less and 33.2% consumed dairy products four times per week or less. Conversely, 40% consumed sweet snacks five or more times per week, reflecting widespread dietary problems [16]. Particularly noteworthy is the evidence of regional disparities in health and dietary problems as well as a direct association between lifestyle factors, including late bedtime, meal frequency, smartphone use during meals, and dietary intake patterns [16]. Children who went to bed late consumed ramen noodles, fast food, and sweet snacks significantly more frequently; moreover, those eating two or fewer meals per day were also more likely to consume ramen,

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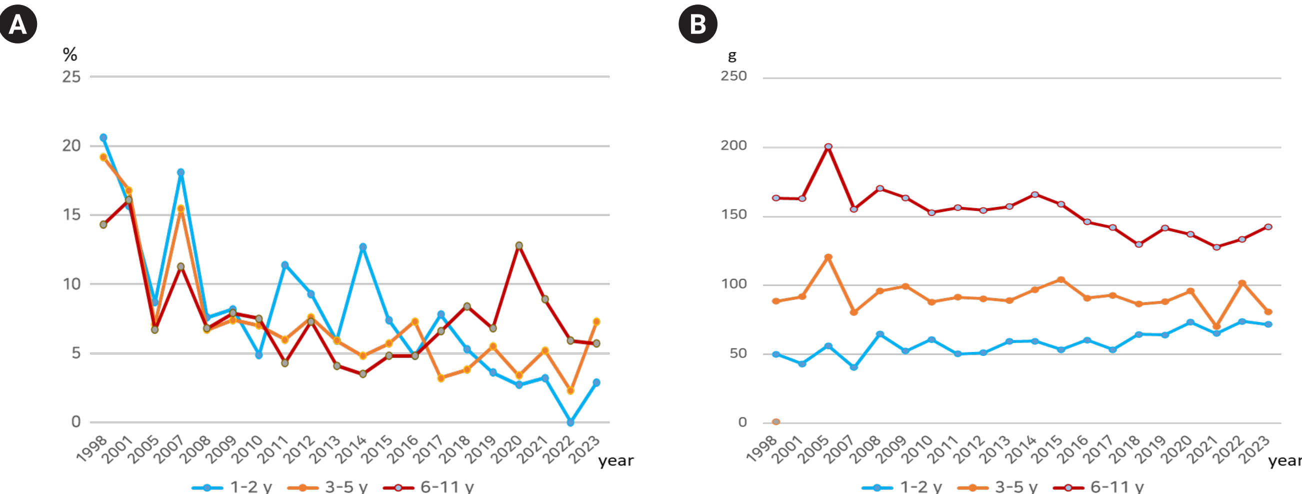

Fig. 3. Long-term trends in the prevalence of inadequate nutrient and vegetable intake in Korean children. (A) Prevalence of inadequate nutrient intake: the proportion of the population whose energy intake is less than 75% of the estimated energy requirement and whose intake of calcium, iron, vitamin A, and riboflavin is less than the estimated average requirement, as reported in Korea Health Statistics 2023 [15]. (B) Vegetable intake as reported in Korea Health Statistics 2023 [15].

noodle dishes, and sweet snacks at higher frequencies [16]. This underscores the urgent need for multidimensional management that moves beyond fragmented approaches to comprehensively consider the environment and individual characteristics of each child.

ACHIEVEMENTS AND CHALLENGES OF MAJOR DOMESTIC NUTRITION POLICIES

Nutrition policy for Korean children has evolved gradually in response to the demands of each era. For school-aged children, the post-war period of the 1950s–1960s involved relief feeding supported by foreign aid; beginning in 1972, an experimental phase of school self-reliant meals was initiated through on-site school cooking. Following the enactment of the School Meals Act in 1981, school meals became institutionalized and fully expanded between the 1990s and 2002 [17, 18]. This development of the school meal system is credited with contributing substantially to the prevention of meal skipping and the improvement of children's physical development. From 2003 onward, a modernization phase restructured the school meal management framework: hygiene standards were strengthened, nutrition teachers were deployed, school health promotion programs were expanded beyond mere meal management, and nutrition and dietary education was reinforced [17, 18].

In addition to school-related legislation, the Special Act on Safety Management of Children's Dietary Lifestyle and Support for Diet Education Act were enacted to implement policies aimed at creating a healthy food environment. Since 2010, free school meals have been expanded incrementally; efforts to achieve detailed improvements in school meal management, such as comprehensive school meal safety measures, have been pursued in parallel with policies targeting sodium and sugar reduction, contributing to broader health management goals [17, 18]. These efforts have resulted in improvements in the food environment within and around schools: implementation of the sodium reduction policy from 2010 onward, resulted in a measurable decrease in sodium intake among school-aged children [15].

In this manner, the school meal program has been developed both quantitatively and qualitatively, and has become established as a universal system operating in most elementary, middle, high, and special schools nationwide. Reportedly, students attending schools with meal programs demonstrate higher nutritional knowledge, consume a greater variety of side dishes at lunch, and exhibit better dietary balance [19]. Furthermore, consuming school meals at lunch is associated

with higher nutrient intake and dietary quality [20, 21]. However, recent studies have documented dietary problems including meal skipping and declining vegetable intake, indicating that school meals alone have limited capacity to change overall dietary behavior; moreover, the proportion of schools meeting all nutritional standards remains low, and that actual meal consumption rates require improvement [22-25]. Accordingly, it has been argued that continuous improvement is needed—not only in providing high-quality meals, but also in monitoring actual student intake, reducing food waste, improving the dining environment, considering menu choice options, and strengthening nutrition education [19, 23-27].

For infants and young children, UNICEF child relief programs providing powdered milk and nutritional supplementation were implemented in the 1950s, maternal and child health services were stipulated in the Public Health Center Act, and regional maternal and child health centers were established in the 1980s [28, 29]. However, the role of maternal and child health programs primarily focused on normal delivery assistance, general health management, and registration management of pregnant women and infants, making it difficult to characterize this period as systematic infant nutritional management [29]. Breastfeeding promotion programs, including the designation of baby-friendly hospitals, were implemented in the 1990s [29]. A pivotal national policy shift toward the systematic nutritional management of infants and young children occurred after 2000, when sophisticated institutional mechanisms were established to address nutritional inequities among vulnerable populations and ensure dietary safety.

Most notably, the NutriPlus program—targeting pregnant women, infants, and young children whose nutritional status is compromised by physiological and environmental factors—was piloted over 3 years from 2005 to 2007 before being expanded nationwide [30]. This program, which provides nutritional education and tailored supplementary foods, has been consistently evaluated as a successful initiative, with annual performance assessments documenting substantive effects, including reductions in anemia prevalence and a decrease in the proportion of infants classified as nutritionally at-risk based on anthropometric measures, such as underweight and stunting. In the 2024 performance analysis, a 66.9% reduction in anemia prevalence was reported among participants following program enrollment, and the proportion of infants with total nutritional risk based on anthropometric assessment decreased by 48.5%. Marked improvements in dietary adequacy, nutritional knowledge, and attitudes were also observed [30]. The effectiveness of the NutriPlus program has been corroborated not only in program reports, but also in select external academic studies based on regional public health center evaluations [31-35]. However, some studies have reported a tendency for anemia prevalence and rates of inadequate nutrient intake to increase over time following program completion, suggesting that post-program follow-up and long-term tracking are essential to sustain program effects. In recent years, the program has adapted to contemporary changes by including overweight and obesity as new nutritional risk factors for participant eligibility and introducing online education modules [30]. Nevertheless, the most significant limitation identified for this national program is that only a small fraction of eligible participants actually enroll owing to insufficient budgetary and human resources. Outstanding challenges include enhancing the supplementary food delivery system, establishing a framework for strengthening individualized nutritional management, improving the professional competency of program staff, and identifying strategies to ensure the continuity of program effects.

In 2008, the Special Act on Safety Management of Children's Dietary Lifestyle was enacted, and the CCFSM was established at the local government level and progressively expanded. With the mandatory registration of facilities without on-site dietitians taking effect in 2020, the nationwide establishment was completed in 2022, with centers now operating in every local government [36]. The centers systematically support hygiene and nutritional management at small-scale childcare facilities, such as daycare centers and preschools that lack registered dietitians; conduct regular on-site visits; and conduct educational programs tailored to children, food service staff, facility directors, and teachers. The establishment of these centers is of considerable significance in that it has created a bidirectional nutritional

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management network the NutriPlus program provides support and management at the household and individual levels, while the CCFSM provides management at the institutional level [36]. Satisfaction with center support has been reported to be above 90%, and outcomes, including improvements in hygiene scores and children's dietary habits, such as handwashing, have been documented [16, 37]. Previous studies have also reported improvements in the degree to which institutional menus meet recommended nutrient intakes, dietary diversity, and nutrient intake following center support [16, 38, 39]. The fact that systematic dietary education targeting young children has been implemented in earnest through these centers is also of considerable significance. However, there is need to develop a comprehensive outcome evaluation framework [13].

As described above, each program implemented to improve the nutritional status and dietary behavior of infants and children has been successfully operated, with substantive outcomes reported. Nevertheless, concerns have been raised regarding the need to secure employment stability and improve working conditions for program staff. In addition, these programs face the imperative of advancing from the concept of fragmented program operations and universal support to a more sophisticated, person-centered, customized service that reflects the multidimensional characteristics of the target population (Table 1).

GLOBAL PARADIGM SHIFT IN NUTRITION STRATEGY AND FUTURE DIRECTIONS FOR INFANT AND SCHOOL-AGE NUTRITION POLICY IN KOREA

Against the backdrop of the current crisis, in which more than one-third of children worldwide face the double or triple burden of malnutrition—encompassing stunting, micronutrient deficiencies, and overweight/obesity—the global nutrition paradigm is undergoing a fundamental transformation. Through its Nutrition Strategy 2020–2030, UNICEF has expanded its vision toward a world in which all children, adolescents, and women fully realize their right to nutrition, transitioning from a past emphasis on a single "program-centered approach" to a multi-sectoral "systems-centered approach," and extending its goal from mere "survival" achieved through the treatment of deficiency to ensuring that children can "thrive" with healthy diets [2]. The Republic of Korea, where the importance of the health of each child of the next generation is growing in the context of severely low birth rates and population

Table 1. Historical overview of nutrition policies for school-aged children and infants/young children in Korea

Period	Nutrition policies for school-aged children	Nutrition policies for infants and young children
1950–1970	-Foreign aid-supported school feeding programs	-UNICEF milk powder and nutritional supplementation programs -Maternal and child health services stipulated in the Public Health Center Act
1970–1980	-Transition to school-operated meal services and on-site meal preparation	
1980–1990	-Enactment of the School Meals Act	-Establishment of regional maternal and child health centers
1990–2000	-Nationwide expansion of school meal services	-Breastfeeding promotion programs, including the designation of baby-friendly hospitals
2000–2010	-Deployment of school nutrition teachers -Introduction of the school health promotion concept -Enactment of the Special Act on Safety Management of Children's Dietary Lifestyle -Enactment of the Support for Diet Education Act	-Introduction and nationwide expansion of the NutriPlus program -Enactment of the Special Act on Safety Management of Children's Dietary Lifestyle
Since 2010	-Expansion of free school meals -Comprehensive school meal safety measures -Sodium reduction initiative -Sugar reduction initiative	-Establishment and gradual expansion of the Center for Children's Foodservice Management

UNICEF, United Nations Children's Fund.

aging, is also at a juncture where existing fragmented and siloed public health policies must be reorganized. Drawing on the core transition strategies proposed by UNICEF and considering Korea's specific context, we propose the following strategies for constructing a person-centered system.

First, a system-based approach is required, rather than one centered on individual programs. UNICEF emphasizes that the five core systems—food, healthcare, education, water and sanitation, and social protection—must work in an interconnected manner to achieve nutritional improvement [2]. Mapping Korea's major policies for infants and school-aged children onto UNICEF's five-system framework, the school meal program and the CCFSM correspond to the food, education, and sanitation systems; the NutriPlus program, infant and child health checkups, and other health promotion programs at public health centers correspond to the food, health care, and social protection systems; and nutritional support and food access programs targeting vulnerable populations correspond to the social protection system. However, these systems currently tend to operate in fragmentation as separate program units, and a framework for continuously managing a child's nutritional risk across the life course and living space has not been sufficiently established. Therefore, future policies must move beyond the expansion of individual programs toward a transformation in which food, health, education, sanitation, and social protection systems share information and coordinate roles with a single child at the center. Just as has been done for older adults, children too should be served within a local government–centered "community integrated care" ecosystem, in which health care, welfare, and educational services are organically linked with nutritional services, so as to build the infrastructure necessary for the integrated delivery of services needed by each individual.

Second, continuous monitoring and management across the life course is required rather than management segmented by individual developmental periods. UNICEF's nutrition strategy emphasizes a "whole-of-life-cycle approach" extending beyond the previous focus on the first 1,000 days of infancy to encompass the school-age and adolescent periods [2]. In Korea, information management for participants in individual programs, health screening, and statistical data for each age group are currently disconnected and unlinked, thereby making it difficult to provide person-centered customized services in such a context and limiting the early identification of children facing nutritional risks during life-course transitions. Therefore, it is necessary to explore mechanisms for establishing a "life transition-linked nutrition database", connecting data from maternal and lactation period checkups, infant and toddler checkups, school-age and adolescent checkups, and adult health and nutrition surveys. The National Bio-Big Data Integration Project currently underway in Korea should be leveraged by reorganizing dietary and health-related surveys conducted on children and examining the feasibility of linkages with the bio-big data platform. It is essential that diet-related information, a critical element of bio-big data, be accumulated in a thorough and systematic manner. Realizing this requires careful consideration of the concurrent legal and institutional constraints. The current National Integrated Bio-Big Data initiative operates under the joint directive of four government ministries and is designed to link data based on participant consent [40, 41]. However, linking child nutritional data entails numerous practical challenges, including differences in consent scope across datasets, inter-ministerial governance issues, and procedures for pseudonymized data linkage and release [40-43]. Future policy must, therefore, be developed as a phased implementation strategy that goes beyond simple data linkage to address the reorganization of the consent framework, establishment of standardized data structures, development of pseudonymized data linkage procedures, and clarification of interministerial responsibilities and collaborative mechanisms.

Third, a context-specific rather than a uniform approach must be adopted. As discussed above, the analysis of dietary behavior among Korean infants and school-aged children revealed differences in nutritional status and dietary problems according to region and local government type (based on population size and fiscal self-reliance), and the characteristics of dietary problems varied according to factors such as lifestyle patterns and temperament [16]. For instance, even when a child exhibits a pattern of high sweet snack consumption and nutritionally imbalanced meals, the

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underlying causes and appropriate approaches differ among individuals. Therefore, it is necessary to move beyond universal education and standardized services toward nutritional support that analyzes the characteristics and root causes specific to each region and individual, enabling truly tailored interventions.

Fourth, public-private partnerships must be established to ensure that nutritional management is both sustainable and effective. This is not only an essential element for the quantitative and qualitative expansion of services, but may also be a critical factor in shaping public awareness and creating environments that support healthy dietary behavior. Government efforts alone are insufficient to control the vast food environment to which children are exposed daily, including the pervasive influence of the media. In line with UNICEF's trend toward expanded private sector collaboration, Korea must strengthen its partnerships with the food industry, educational technology companies, and other private sector actors.

Fifth, investment in and research on the realization of "hyper-personalized precision nutrition" utilizing cutting-edge technological innovation and artificial intelligence (AI) are necessary. Advanced healthcare technologies must be integrated to address the increasingly diverse characteristics and nutritional challenges faced by children. Technologies for measuring dietary intake and food exposure—including AI-based monitoring of food waste and vegetable and fruit consumption in children's meal settings—are currently being piloted [44-46]. AI technologies are expected to contribute to personalized services in multiple ways. Given that individual lifestyle characteristics such as eating speed, sleep duration, and smartphone use during meals exert a profound influence on dietary behavior [16], the development of technologies capable of acquiring granular real-time behavioral data for the early identification of nutritional risk is imperative. AI-based hyperpersonalized nutrition coaching holds considerable potential in its capacity to precisely characterize children's dietary behavior and lifestyle patterns; however, the use of children's data requires a higher level of ethical protection than that applicable to adults. Korea's Personal Information Protection Act requires the consent of a legal representative and notification in an easily comprehensible format for the processing of personal information of children under 14 years of age [47], whereas the National AI Ethics Standards identify privacy protection, minimization of bias and discrimination, data governance, accountability, safety, and transparency as the core requirements [48]. Similarly, the World Health Organization emphasizes human oversight, risk management, and transparency in the application of AI in health care [49], and the Convention on the Rights of the Child enshrines the "best interests of the child" as the paramount principle in policies and services affecting children [50]. Accordingly, AI-based nutritional services targeting children must be designed to incorporate the principles of data minimization, restriction of use beyond the original purpose, algorithmic bias auditing, interpretable feedback, and human oversight systems that allow expert intervention. Through research on the resolution of current technological limitations, potential personal information, and ethical concerns, it is imperative to advance toward an intelligent management system capable of providing children and their caregivers with hyperpersonalized, tailored assessment, and coaching.

CONCLUSIONS

Nutrition during infancy and the school-age period constitutes a core driver that determines not only individual health outcomes but also the future potential of the nation as a whole. The Republic of Korea has achieved remarkable generational improvements in physical growth since the 1960s and developed successful state-led programs, including school meals and NutriPlus program. However, in the face of the complex triple burden of malnutrition characterizing contemporary society, a structural leap that transcends the mere expansion of fragmented programs is required. The values of a "systems-centered framework" and the "guarantee of life-cycle continuity" articulated in UNICEF's 2020–2030 Strategy align precisely with the future direction of Korea's child nutrition policy. Moving forward, it is imperative to build an environment in which children can readily make healthy choices—through the construction of an integrated big-data health platform that connects fragmented information; the delivery of

hyperpersonalized and tailored services incorporating innovative technologies such as AI; organic multi-ministerial collaboration; and active partnerships with the private sector, including the food industry. Building on the accumulated achievements of public health and nutrition policy, the time has come to achieve a second and third leap forward through the construction of a precise, person-centered system. This study drew on UNICEF's global strategy as a reference; however, it did not incorporate a cross-national comparative analysis or systematic literature review. As a narrative review aimed at proposing future nutrition policy directions based on past achievements, the policy recommendations presented may have limitations with respect to generalizability.

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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

The data that support the findings of this study are openly available in "School Health Information Center" at https://www.schoolhealth.kr/web/srs/selectPublicDataList.do and in "KNHANES" at https://knhanes.kdca.go.kr/knhanes/archive/wsiStatsClct.do.

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Review

Life-course personalized nutrition strategy for adolescents and young adults in Korea based on a behavioral science approach and community-based model: a narrative review

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Objectives: This review examines the nutritional challenges among Korean adolescents and young adults from life-course and behavioral science perspectives and proposes an integrated, community-based nutrition strategy for this critical transitional period.
Methods: A narrative review was conducted following the Scale for the Quality Assessment of Narrative Review Articles guidelines. Literature published between January 2015 and June 2025 was retrieved from PubMed, Google Scholar, and Research Information Sharing Service using keywords related to adolescent and young adult nutrition, life course approaches, behavioral nutrition, and personalized nutrition. Policy documents from the World Health Organization, Food and Agriculture Organization of the United Nations, United Nations Nutrition, and Korean government agencies were also included. A total of 40 references (32 peer-reviewed articles and 8 policy reports) were analyzed.
Results: Korean adolescents and young adults exhibited high rates of skipping breakfast (> 38.3%), obesity, and excessive sodium and sugar intakes, with disparities driven by socioecological determinants. The Developmental Origins of Health and Disease framework highlights adolescence as the "second window of plasticity" for reshaping long-term health trajectories. Two behavioral frameworks were synthesized: the Formation–Maintenance Model, distinguishing adolescent (Learn–Practice) and young adult (Sustain) stages, and the socioecological nutrition model, addressing multi-level influences on dietary behavior. A structural discontinuity in public nutrition support, termed the "School-to-Society Nutrition Gap," was identified. Community-based, participatory, and digitally integrated interventions showed strong potential for sustaining behavioral change.
Conclusion: A personalized life-course nutrition strategy based on a Learn-Practice-Sustain framework was proposed. A Community-Linked Circular Nutrition Model was presented to bridge the gap between school-based and community-level nutrition systems, emphasizing nutrition equity and digital engagement as key drivers of sustainable health outcomes.

Keywords: adolescents; young adults; life-course nutrition; behavioral nutrition; community-based personalized nutrition

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INTRODUCTION

The United Nations (UN)-Nutrition Strategy 2022–2030 establishes a coordinated framework for UN agencies to address all forms of malnutrition, with the vision

of "a world free from all forms of malnutrition where all people achieve their full potential in health and well-being" [1]. The strategy outlines two overarching goals: ensuring consistent joint action and implementation of nutrition policy across the UN system, and promoting coherent policies and approaches to nutrition challenges at national, regional, and global levels [1]. Accountability mechanisms are embedded within the framework through biennial workplans, a midterm review, and an end-term evaluation, providing a structured cycle of planning, implementation, and assessment [1]. This approach aligns with the World Health Organization (WHO)'s Global Action Plan for the Prevention and Control of Noncommunicable Diseases (NCDs) 2013–2020, which identifies unhealthy diet as a primary modifiable risk factor for NCDs including cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes, and provides governments with a policy roadmap to reduce the global burden of these conditions [2], thereby reinforcing nutrition as a foundational dimension of sustainable public health.

Food choice is increasingly understood as a behavioral construct shaped by interactions among individual, social, and environmental determinants [3]. In particular, the dietary behaviors of adolescents are influenced by intrapersonal, socio-physical, and macro-level environmental factors [4], and nutritional status during this period constitutes a critical determinant of health and cognitive development across their lifespan [5].

Although adolescence (10–19 years) and young adulthood (20–29 years) represent pivotal transitional periods during which health behaviors are formed and consolidated, these life stages have historically been underrepresented in existing nutritional policy frameworks [6]. Nutritional status during this period exerts long-term effects not only on the risk of chronic disease in adulthood, but also on cognitive function, academic and occupational attainment, and socioeconomic productivity [6, 7]. In this context, Hargreaves *et al.* [7] emphasized that nutrition interventions targeting adolescents and young adults extend beyond health protection to directly influence the national developmental potential, calling for a fundamental reordering of policy priorities. Azzopardi *et al.* [8] showed that investing in adolescent health, particularly in low- and middle-income countries, is cost-effective and can reduce intergenerational health inequities.

The life-course perspective and Developmental Origins of Health and Disease (DOHaD) theory posit that early developmental environments are primary determinants of subsequent health trajectories [9, 10]. More recent scholarship has reframed adolescence and young adulthood as a "window of opportunity" during which existing health trajectories may be actively modified and reshaped [9, 10]. Notably, the nutritional environment during this period may influence gene expression through epigenetic mechanisms [11], and these effects may extend beyond the individual and affect the health of subsequent generations. To our knowledge, few reviews have attempted to integrate life-course theory, behavioral science, and community-based nutrition systems within a unified conceptual framework tailored to adolescents and young adults. This review responds to that gap by proposing an integrative framework linking these domains.

In light of these considerations, the present study applied a narrative review methodology [12] with three principal aims: (1) to examine the nutritional status and key nutritional challenges of Korean adolescents and young adults from integrated life-course and behavioral science perspectives; (2) to analyze the structural determinants of the nutritional management gap arising during the school-to-society transition; and (3) to develop a conceptual community-based, life-course personalized nutrition strategy model to address this gap. Ultimately, this review seeks to inform evidence-based strategies for extending healthy life expectancy and strengthening sustainable population health systems.

METHODS

Ethics statement

This study was conducted as a narrative review based exclusively on previously published literature. It did not involve the collection, use, or analysis of human participants, biological specimens, or identifiable personal data. Accordingly, institutional review board (IRB) approval was not required for this study.

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Study design

This study employed a narrative review methodology to comprehensively synthesize evidence on life-course nutrition, behavioral science, and community-based nutrition strategies [12, 13]. To ensure methodological rigor and transparency of reporting, the Scale for the Quality Assessment of Narrative Review Articles (SANRA) guidelines [12] and the narrative review procedures proposed by Sukhera [13] were adopted as reference frameworks. The six evaluative criteria of SANRA were operationalized as follows. The importance of the topic and the aims of the review were explicitly stated in the Introduction. The literature search strategy was described in detail, including databases, search terms, and screening procedures. References were selected to balance peer-reviewed evidence and policy reports. Scientific reasoning was derived through integrated life-course, behavioral, and community-based perspectives. Evidence synthesis was presented in tabular form (Table 1) [14] and as a conceptual framework (Fig. 1).

A literature search was conducted using PubMed, Google Scholar, and Research Information Sharing Service for studies published between January 2015 and June 2025; seminal references on the DOHaD framework [9, 10] and life-course nutrition [15] were additionally included regardless of publication date because of their conceptual relevance. The English-language search terms were as follows: (“adolescent nutrition” OR “young adult nutrition”) AND (“life-course nutrition” OR “community nutrition strategy”) AND (“behavioral nutrition” OR “personalized nutrition” OR “DOHaD”). The Korean-language search terms included “adolescent nutrition”, “young adult nutrition strategy”, “life-course nutrition”, “community nutrition”, and “dietary behavior”. The inclusion criteria were as follows: (1) studies focusing on adolescents (10–19 years), young adults (20–29 years), or life-course studies encompassing these age groups; and (2) peer-reviewed articles and policy reports from authoritative institutions addressing nutritional status, dietary behavior, nutrition strategies, or community-based interventions. Case reports, irrelevant studies, and duplicate sources were excluded. Literature selection was conducted using a two-stage screening process comprising a title/abstract review and full-text evaluation. The final corpus comprised 40 references (32 peer-reviewed articles and eight policy reports), which were classified and synthesized under four thematic domains: (1) life-course nutrition theory, (2) behavioral science-based dietary behavior models, (3) DOHaD and the strategic positioning of adolescence and young adulthood, and (4) case studies of community-based nutrition strategies. Narrative synthesis was performed through thematic organization and critical interpretation [12, 13].

STRATEGIC IMPORTANCE OF ADOLESCENCE AND YOUNG ADULTHOOD: THEORETICAL RATIONALE

Adolescence and young adulthood as strategic life-course periods

Adolescence and the transition to adulthood, broadly spanning from age 10 through the mid-to-late twenties, represent critical developmental stages during which health behaviors and lifestyle patterns are formed and internalized [16, 17]. Dietary behaviors established during this period shape dietary trajectories that persist into adulthood, thereby exerting enduring effects on health across the lifespan [18]. The concept of “emerging adulthood” (18–25 years) proposed by Arnett [17] characterizes this stage as a distinct developmental phase

Table 1. Major nutrition risk indicators among Korean adolescents and young adults

Indicator	Adolescents (10–19 years)	Young adults (20–29 years)	Interpretation
Breakfast skipping	38.3% (2023)	40.3% (2023)	Irregular eating patterns and increased risk of nutritional imbalance
Obesity prevalence	16.2% (middle/high school, 2023)	29.6% (2023)	Continuous increase over the past decade; higher prevalence in males
Sodium intake	2,950 mg (exceeding WHO limit of 2,000 mg/day)	3,204 mg (exceeding WHO limit of 2,000 mg/day)	Associated with processed foods and food delivery consumption

Based on Korea Disease Control and Prevention Agency [14].
WHO, World Health Organization.

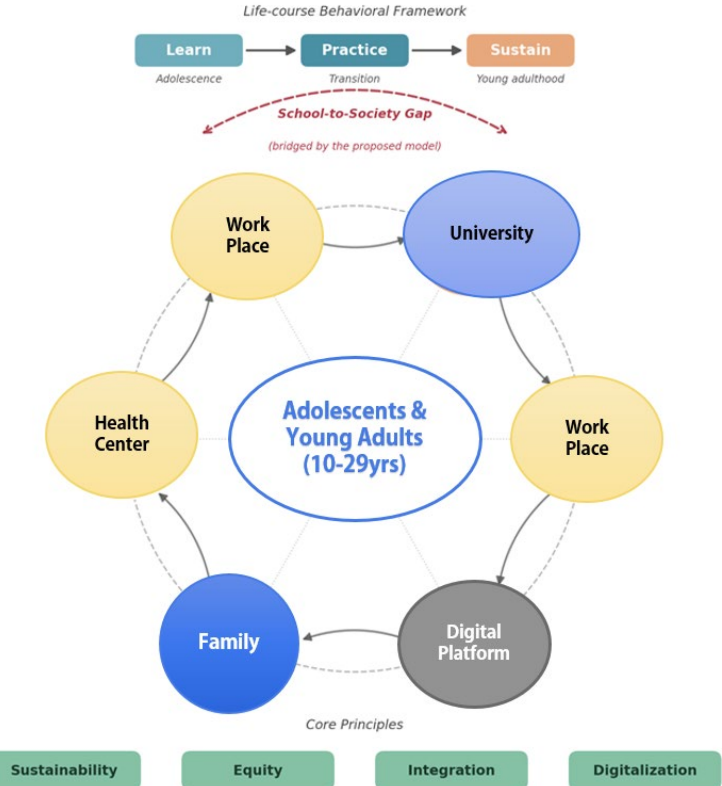

Fig. 1. Community-linked circular nutrition model for adolescents and young adults, illustrating the integration of life-course stages, community-linked ecosystems, and core implementation principles.

situated between adolescence and full adulthood—a period in which dietary behaviors and health habits are autonomously shaped yet have not been fully consolidated. Given that repetitive dietary behaviors become internalized as habits and routines [19], nutritional interventions during this period have important implication across the life course.

Adolescence and young adulthood constitute a complex transitional period marked by concurrent neurodevelopment, hormonal changes, and expansion of social roles. Nutritional imbalances during this period may exert sustained adverse effects on major physiological systems, including the endocrine system, brain development, gut microbiome, and immune function [20, 21]. Dietary behaviors during this stage are further shaped by the interaction of individual factors (nutritional knowledge, food preferences, and autonomy), interpersonal factors (family influence and peer pressure), and environmental factors (school meal programs, food service environment, and food accessibility) [3].

Accordingly, effective nutritional interventions require multi-level and integrated strategies rather than single-dimensional approaches. Øverby *et al.* [21] advocated understanding nutrition within a life-course framework spanning molecular mechanisms to social determinants of health, underscoring the far-reaching consequences of adolescent and young adult nutritional environments for later health trajectories.

Extension of the Developmental Origins of Health and Disease framework to adolescence

The DOHaD theory is based on the premise that adult diseases are shaped by the nutritional environment experienced during fetal development and early childhood [15]. Gluckman *et al.* [9] and Hanson & Gluckman [10] established the theoretical foundation of DOHaD by demonstrating that early developmental environments constitute a primary mechanism that determines subsequent health and disease trajectories. Subsequent studies have revealed that these mechanisms operate

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via epigenetic pathways [11].

More recent studies have extended the DOHaD framework to encompass adolescence, redefining this period as the "second window of plasticity" [20, 22]. Tohi *et al*. [20] emphasized that adolescence and young adulthood represent a phase in which dietary behaviors and social roles are reconfigured along with biological reorganization. Furthermore, this period has been identified as the critical juncture at which the intergenerational transmission of NCDs may be interrupted.

Through a systematic review, Tohi *et al*. [22] confirmed that adolescents are capable of understanding and internalizing the DOHaD concept, suggesting that education-based nutritional interventions can operate effectively in this population. This implies that nutritional interventions can function not only as risk factor reduction strategies but also as agents capable of transforming health trajectories. This extension of DOHaD represents a conceptual advancement from biological programming-focused approaches toward a broader notion of "developmental redesign" that incorporates behavioral and environmental factors [9, 10, 20]. Consequently, adolescence and young adulthood are reconceived not as periods requiring passive prevention, but as strategic windows for the active reshaping of health trajectories.

The School-to-Society Nutrition Gap conceptualized in this study functions as a structural factor that constrains this opportunity for health trajectory reshaping. Therefore, policy interventions to address this gap have significant implications for the practical application of the extended DOHaD theory.

CURRENT NUTRITIONAL STATUS AND KEY NUTRITIONAL CHALLENGES IN KOREAN ADOLESCENTS AND YOUNG ADULTS

Current nutritional risk patterns in Korean adolescence and young adults

According to the 2024 Korea National Health and Nutrition Examination Survey conducted by the Korea Disease Control and Prevention Agency, the nutritional risks faced by Korean adolescents and young adults are not isolated problems but rather manifest as structurally interconnected patterns [14]. The prevalence of breakfast skipping has steadily increased, reaching 38.3% among adolescents and 40.3% among young adults (20–29 years). The prevalence of obesity is 16.2% among middle and high school students (2023) and 29.6% among young adults, reflecting a tendency for unhealthy dietary behaviors established during adolescence to accumulate in young adulthood [14].

The proportion of individuals in the 20–29 years age group exceeding the WHO-recommended sodium intake limit (< 2,000 mg/day) reached 40.3%, while free sugar intake demonstrated an upward trend alongside increased consumption of ultra-processed foods and food delivery services (Table 1) [14]. These patterns are not unique to Korea; Moore Heslin & McNulty [6] identified irregular meal patterns, excessive consumption of ultra-processed foods, and insufficient fruit and vegetable intake as common manifestations of nutritional vulnerability across multiple national contexts.

These indicators collectively suggest a sequential risk pathway characterized by breakfast skipping, irregular meal patterns, consumption of high-energy, high-sodium, and high-sugar foods; and elevated metabolic risk [14, 17]. Adolescence and young adulthood are inherently periods of lifestyle instability due to academic pressures, employment preparation, and social transition—factors that further amplify this risk trajectory.

Nagata *et al*. [23] demonstrated that nutritional imbalances during early adolescence are closely associated with socioeconomic factors, including socioeconomic status, racial and ethnic backgrounds, and family structure, extending beyond individual food preferences. Food accessibility and choice are further constrained by differences in home, school, and community environments, thereby intensifying dietary inequality. In particular, among socioeconomically disadvantaged young adults, access to nutritious foods is limited by cost and time constraints, with consistently greater nutritional imbalances reported in this subgroup [24-26].

These findings suggest that nutritional challenges during adolescence and young adulthood represent complex public health issues in which living environments and social structures function as co-determinants, extending far beyond the realm of individual choices. Consequently, effective interventions require an integrated approach that encompasses not only in-

dividual-level education but also food environment and policy reforms [3, 6].

THE SCHOOL-TO-SOCIETY NUTRITION GAP: A STRUCTURAL ANALYSIS

The current nutritional management system in Korea operates primarily within a school-based framework for adolescents, grounded in the School Meals Act [27] and the 4th Basic Plan for Dietary Life Education (2025–2029) [28]. However, following the transition to higher education or employment, public nutritional support becomes markedly reduced, resulting in a structural gap across this life-course transition [16].

In this review, this discontinuity is conceptualized as the "School-to-Society Nutrition Gap." This concept refers to the structural discontinuity whereby systematic nutritional management provided through school meal programs and health education during adolescence is abruptly reduced as individuals transition into young adulthood, and institutional policy support undergoes substantial contraction.

Existing constructs such as "nutrition transition" [2] and "dietary trajectory" [17, 18] have tended to focus primarily on individual-level changes in dietary behavior and their outcomes. In contrast, the conceptual framework proposed in this study is distinguished by attributing such changes to structural discontinuities at the policy and environmental levels, conceptualizing the absence of life-course continuity in public nutrition support systems, rather than individual dietary behavior, as a primary underlying mechanism.

Although young adulthood is characterized by expanded autonomy, it paradoxically represents a period during which nutritional status deteriorates [6, 17]. This is attributable to the compounding effects of environmental changes—including independent living, irregular schedules, financial constraints, and time limitations—in the absence of an adequate public nutrition support system to replace the protective environment formerly provided by families and schools. Winpenny *et al.* [29] demonstrated through longitudinal research that major life transitions such as university enrollment, independent living, and entry into employment were significantly associated with adverse changes in dietary trajectories. Utter *et al.* [30] further reported that cooking skills during emerging adulthood predict long-term dietary behavior, underscoring the need for a structural support framework that sustains and reinforces these competencies following social transitions.

Nam *et al.* [31] identified structural limitations in the current school meal-based nutritional management system, particularly its failure to extend coverage beyond adolescence. Likewise, the WHO [16] identified policy gaps during the adolescent-to-adult transition and emphasized continuity in community-based nutrition support. The United Nations Children's Fund (UNICEF) [32] further argued from a systems-thinking perspective that insufficient community-level food environment intervention following school-age education may perpetuate this gap.

This evidence suggests that the School-to-Society Nutrition Gap represents a pivotal point of discontinuity in life-course nutritional management and highlights the need for a continuous and integrated nutritional management system capable of bridging this structural divide.

BEHAVIORAL SCIENCE FRAMEWORKS FOR NUTRITIONAL BEHAVIOR

The Formation–Maintenance Model

According to a systematic review by Nakabayashi *et al.* [33], which examined TTM-based nutritional interventions in adolescents, dietary behavior change is considered stable when initiated in the action stage and sustained for a minimum of 6 months during the maintenance stage. The longitudinal findings of Winpenny *et al.* [29] further demonstrated that major life transitions—including university enrollment, independent living, and entry into employment—are significantly associated with adverse changes in dietary trajectories. Chong [18] suggested that such dietary trajectories represent structural patterns formed over the course of life, whereas Arlinghaus & Stang [19] emphasized the process through which repetitive behaviors become internalized as habits and routines.

Drawing upon these theoretical foundations, this review proposes "Formation–Maintenance Model" as a conceptual framework to explain nutritional behavior

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during the present study proposes adolescence and young adulthood. This model integrates (1) the stage-based behavioral change process of the TTM [33], (2) dietary trajectory changes associated with life-course transitions [17, 18], and (3) the habituation process of repetitive behaviors [19]. Whereas the existing TTM focuses primarily on the stages of individual behavioral change, the proposed model extends this perspective by explaining the processes of behavioral formation and maintenance in a continuous manner that reflects the life-course transition from adolescence to young adulthood. Moreover, unlike existing constructs such as "nutrition transition" or "dietary trajectory"—which primarily describe resultant changes in dietary patterns—the present model is conceptualized as a framework for explicating the processes through which dietary behaviors are formed and maintained.

The Formation stage (primarily adolescence) represents the phase during which dietary behaviors are initially learned (Learn) and practiced (Practice) for the first time, while core dietary habits are established through neurodevelopment and expanding social relationships. The Maintenance stage (primarily young adulthood) constitutes the phase during which established behaviors are sustained (Sustain) in daily life. However, the risk of behavioral disruption increases during this period owing to environmental changes, such as independent living, employment, and irregular schedules [17, 19]. In particular, the life-transition points identified by Winpenny *et al.* [29] can be reinterpreted as critical transition points that demarcate the Formation and Maintenance stages.

Consequently, nutritional strategies targeting adolescents and young adults must be designed to extend beyond facilitating behavioral formation and simultaneously structure the environmental conditions and support systems necessary for sustained behavioral maintenance. This approach is consistent with the life-course integrated perspective proposed by Øverby *et al.* [21], which encompasses factors ranging from molecular mechanisms to social determinants of health.

The Socio-ecological Nutrition Model

The determinants of dietary behavior in adolescents and young adults are shaped by the interaction of individual (biological, psychological, and behavioral), interpersonal (family influence, peer pressure), environmental (school meal programs, food accessibility), and macro-level (media, food marketing, policy) factors [3, 4]. This multi-level determinant structure implies that dietary behavior change requires multi-level, rather than single-level interventions [3]. The WHO [34] has also emphasized the importance of youth-centered participatory food environment improvement strategies.

In the present study, the socio-ecological perspective is applied to nutritional behavior and reformulated as an analytical framework designated as the "Socio-ecological Nutrition Model." In contrast to existing socio-ecological models, which primarily focus on broadly explaining health behaviors, this model is specifically designed to explain, in an integrated manner, the multi-level factors influencing the formation and maintenance of dietary behaviors during adolescence and young adulthood.

Nagata *et al.* [23] demonstrated that structural factors—including racial, ethnic, and socioeconomic background—exert a significant influence on dietary behavior formation, illustrating that dietary behaviors are shaped within sociostructural contexts that extend beyond individual choice. Given that peer group influences and social norms play particularly important roles in dietary behavior formation during adolescence [19], participatory nutritional education utilizing peer leaders and social norm-based interventions have been proposed as effective strategies. Furthermore, given that engagement functions as a critical mediating variable in digital behavioral interventions change interventions [35], tailored intervention designs that reflect the digital access patterns and usage characteristics of young adults are essential. From a systems thinking perspective, the UNICEF [32] emphasize that the effectiveness of socio-ecological approaches is maximized when integrated with regional food systems and extended to community-level implementation strategies. Thus, the proposed model provides a practical foundation for dietary behavior changes in adolescents and young adults through a multi-level intervention structure that connects the individual, social, environmental, and policy domains.

Theoretical integration of behavioral science frameworks

The two behavioral science frameworks proposed in this study—the Formation–Maintenance Model and the Socio-ecological Nutrition Model—constitute the theoretical foundation of the Community-Linked Circular Nutrition Model. These frameworks explain nutritional behavior across temporal and spatial dimensions, and the proposed model is derived from the integration of these two axes.

The Formation–Maintenance Model explicates the processes by which nutritional behaviors are "formed (Learn–Practice)" and "maintained (Sustain)" during the life-course transition from adolescence to young adulthood, thereby providing the theoretical basis for the three-stage Learn-Practice-Sustain structure, which serves as the temporal life-course axis adopted in the proposed model. Meanwhile, the Socio-ecological Nutrition Model elucidates the multi-level structure through which dietary behaviors are shaped across the individual, interpersonal, environmental, and policy levels. The WHO [34] has also emphasized the importance of youth-centered participatory approaches to improving food environments and nutrition outcomes for adolescents. Moreover, given that engagement functions as a critical mediating variable for behavioral change in digital interventions [35], digital platforms serve as important intervention hubs for nutritional strategies targeting young adults. This rationale provides the basis for the spatial ecological axis of the proposed model, which comprises the interconnected settings of schools, public health centers, families, digital platforms, universities, and workplaces.

These two axes interact throughout the life-course transition process, and the School-to-Society Nutrition Gap may be interpreted as a structural discontinuity occurring at a juncture where both the temporal and spatial axes are simultaneously weakened. In Korea, a school-centered nutritional management system based on the School Meals Act [27] and the 4th Basic Plan for Dietary Life Education [28] has been established; however, as Kim [36] noted, this system has limited extensibility to young adulthood, thereby engendering structural gaps.

The Community-Linked Circular Nutrition Model proposed in the present study accordingly functions as an implementation framework that centrally coordinates community-based interventions and connects diverse settings in a circular manner, with the aim of compensating for this structural discontinuity. Evidence indicates that community-based nutritional interventions targeting adolescents are effective for improving nutrition outcomes [37] and can address multiple nutrition-related problems simultaneously [38], supporting the practical relevance of the proposed model.

In conclusion, the proposed model provides a framework for translating behavioral science theories into community-based nutrition policy and implementation strategies through the integration of the temporal axis (life-course-based behavioral change) and spatial axis (multi-level environmental intervention).

IMPLEMENTATION AND LIMITATIONS OF COMMUNITY-BASED NUTRITION STRATEGIES

School-based nutritional management policy: achievements and structural limitations

Korea's nutritional management policy for adolescents is structured around the School Meals Act, Special Act on Safety Management of Children's Dietary Life, and Basic Plan for Dietary Life Education. Article 5, Paragraph 1 of the School Meals Act stipulates nutritional standards, including macronutrient distribution ratios (carbohydrate:protein:fat = 55%–65%:7%–20%:15%–30%) [27], whereas the 4th Basic Plan for Dietary Life Education (2025–2029) identifies "sustainable dietary patterns" and "school–community integration" as core strategic directions [28]. These developments are important policy advances that correspond to the formation stage of dietary behavior during adolescence.

However, Kim *et al.* [36] has noted that current school meal nutritional standards do not adequately reflect the rapid growth and evolving dietary environment of contemporary adolescents. The WHO [34] and UNICEF [32] have similarly identified the structural limitations of school-centered policies, which remain concentrated in adolescence and fail to ensure the continuity of nutritional management into young adulthood. These limitations illustrate that the School-to-Society Nutrition Gap is structurally embedded at the policy level, underscor-

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ing the need for expansion toward a continuous nutritional management system that encompasses the entire life course.

Domestic and international case studies: transition toward participatory and integrated strategies

Nutritional programs targeting adolescents and young adults, both domestically and internationally, have increasingly shifted from knowledge transmission models to participatory and integrated approaches. Ranisavljev *et al*. [38] demonstrated that community-based, multi-strategy interventions hold promise for addressing complex nutritional problems involving undernutrition, overnutrition, and micronutrient deficiencies among adolescents in low- and middle-income countries. In particular, multicomponent approaches integrating nutrition education, physical activity, and food supplementation showed improvements in at least one nutritional outcome in the majority of included studies.

The WHO [34] has recommended youth-centered, participatory food environment improvement strategies, identifying digital platforms, peer leadership, and community linkages as core elements. Furthermore, given that engagement functions as a critical mediating factor for intervention effectiveness in digital behavioral change programs [35], tailored intervention designs that reflect the digital usage characteristics of young adults are particularly important.

Among international case studies, the National Health Service in the United Kingdom operates an adolescent healthy lifestyle program integrating online consultations, peer leadership, and family engagement, and has implemented a mobile application-based intervention model that integrates nutrition, physical activity, and sleep [34, 38].

In contrast, within the scope of this narrative review, evidence for sustained, community-based integrated nutritional intervention programs targeting Korean adolescents and young adults was limited. While some school-centered or short-term educational programs exist, community-linked integrated intervention models that account for life-course transitions have not been sufficiently developed or documented. This scarcity of domestic empirical evidence supports the view that the School-to-Society Nutrition Gap represents not merely a theoretical abstraction, but also a structural deficit observable in actual policy and practice contexts. This also identifies the core policy space in which the proposed Community-Linked Circular Nutrition Model can be applied.

Common features shared by international case studies include integrated lifestyle approaches; utilization of digital technologies; linkages across individual, social, and environmental dimensions; and the establishment of partnerships among policy, community, and industry stakeholders [37, 38]. Participatory and integrated strategies have been identified as essential elements for inducing sustainable behavioral change. However, the effectiveness of such programs may vary according to national food culture, socioeconomic context, and institutional infrastructure [32].

Accordingly, future research in Korea should pursue the development of community-based integrated nutritional intervention models that account for life-course transitions, accompanied by long-term follow-up studies to evaluate their effectiveness. This constitutes an important agenda for the empirical validation and extension of the proposed model.

A LIFE-COURSE PERSONALIZED COMMUNITY NUTRITION STRATEGY MODEL

The present study integrates the Formation–Maintenance Model, the School-to-Society Nutrition Gap framework, and the extended DOHaD conceptualization to propose the “Community-Linked Circular Nutrition Model” as a strategy for reshaping the health trajectories of adolescents and young adults.

The adolescent and young adult nutrition paradigm has undergone a progressive shift—from deficiency prevention, through food environment and overnutrition concerns, to a contemporary emphasis on sustainability and health equity (Table 2) [39, 40]. The UNICEF [32] have similarly advocated for approaches that integrate adolescent nutrition with local food systems.

Longitudinal studies by Winpenny *et al.* [29] and Chong [18] demonstrated that dietary trajectories undergo rapid changes at major life transition points, which simultaneously constitute critical windows of opportunity for intervention. Accordingly, the present

Table 2. Paradigm shift in adolescent and young adult nutrition: past, present, and future

Era	Key characteristics	Policy and academic focus	Keywords	Strategic direction
Past	Deficiency prevention	Nutrient intake, school meals, growth	Quantity/deficiency	How much to eat (supply-focused)
Present	Food environment and overnutrition focus	Food environment, behavioral economics, digital tools	Environment/overnutrition	What, why, and how to eat
Future	Sustainability- and equity-focused	Nutrition security, sustainable diets, AI-based coaching	Sustainability/equity	Personalized nutrition coaching

Based on Willett *et al.* [39] and United States Department of Agriculture [40].
AI, artificial intelligence.

study proposes a life-course personalized nutrition strategy structured around the Learn-Practice-Sustain framework (Fig. 1).

The Learn stage (adolescence) represents the phase during which foundational nutrition knowledge and dietary habits are developed through school meal programs, nutrition education, and family participation [41]. The Practice stage (transition from adolescence to young adulthood) represents the phase during which real-world dietary practices are shaped across university, occupational, and community settings, and social support networks emerge [19, 29]. The Sustain stage (young adulthood) represents the phase during which established behaviors are maintained over the long term through digital platforms and behavioral feedback mechanisms, supporting long-term behavioral stability [32].

To operationalize this strategy, the Community-Linked Circular Nutrition Model proposed in the present study is grounded in an ecosystem connecting schools, public health centers, families, digital platforms, universities, and workplaces [32, 37]. The model is guided by four core principles—Sustainability, Equity, Integration, and Digital Connectivity—with each setting performing different functions according to its corresponding life-course stage. For example, schools and public health centers serve as primary hubs during the Learn stage, universities during the Practice stage, and workplaces during the Sustain stage. Notably, families and digital platforms fulfill a “bridging” function that spans all stages, ensuring the continuity of support throughout the life course.

In digitally delivered nutritional interventions, engagement is a key determinant of effective behavior change [35]. Accordingly, mobile applications, social networking services, gamification, and peer-based support strategies may play important roles in fostering participation among adolescents and young adults and sustaining behavioral change [38]. Nagata *et al.* [23] emphasized the need to address digital access disparities in the design of digital interventions, noting that socioeconomic structural factors are deeply embedded in dietary behaviors.

For personalized nutrition strategies to be effective, nutritional equity must be integrated as a foundational principle. The WHO [34] has emphasized equitable access to healthy diets, while UNICEF [32] has argued that equity-based food environments are important foundations for sustainable healthy dietary patterns. This principle aligns with Sustainable Development Goals (SDGs 2, 3, and 10) [34].

Nutrigenomics and omics-based personalized nutrition [42] are considered future developmental directions of the model proposed in this study, rather than the core current components. Although these technologies may enable a more precise intervention design when integrated with community-based nutritional strategies, their application necessitates careful consideration of issues related to accessibility and health equity [22, 42].

CONCLUSIONS

This study is a narrative review presenting conceptual models derived from theoretical and policy integration rather than empirically validated intervention frameworks. Accordingly, their effectiveness warrants future verification through community-based interventions and longitudinal cohort studies. The principal conclusions of this review are as follows:

First, adolescence and young adulthood represent the “second window of plasticity” as delineated by the DOHaD framework—a strategic window during which

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health trajectories may be reshaped [20, 22]. Arnett's [17] concept of emerging adulthood substantiates the developmental distinctiveness of this period, and the extended DOHaD perspective emphasizes that nutritional interventions constitute a public health strategy extending beyond individual health to interrupt the intergenerational transmission of NCDs [9, 10, 20].

Second, Korean adolescents and young adults exhibit structurally interconnected nutritional risk patterns, encompassing breakfast skipping, obesity, and excessive sodium and free sugar intake [14], which reflect the complex interplay of socioepidemiological factors and food environments [23, 25]. In particular, a School-to-Society Nutrition Gap exists during the transition from school-based nutritional support to community-based services [16, 27, 36], necessitating the development of a continuous life-course nutritional management system.

Third, the Formation–Maintenance Model proposed in this study integrates adolescence and young adulthood into a continuous process of behavioral change [17, 19, 33], with the three-stage Learn-Practice-Sustain strategy providing a practical foundation for the formation and maintenance of health behaviors. Key implementation strategies can be summarized as follows: (1) constructing a behavioral formation structure grounded in school, family, and community linkages; (2) enhancing digitally participatory interventions; (3) developing peer- and family-centered social support systems; (4) developing tailored messaging centered on key nutrients and food choices; (5) establishing staged evaluation frameworks; and (6) securing long-term sustainability through policy, financial, and infrastructure foundations [6, 7, 19, 32, 35, 37, 41].

Fourth, the Community-Linked Circular Nutrition Model is grounded in a multi-level ecosystem connecting schools, public health centers, families, digital platforms, universities, and workplaces, guided by the core principles of Sustainability, Equity, Integration, and Digital Connectivity [32, 37]. By integrating nutrition equity as a central axis, the model aligns with SDG 2, 3, and 10 and the WHO [34] Nutrition for Health Framework. Nutrigenomics and omics-based personalized nutrition approaches are regarded as future developmental directions rather than core current components, and require careful application with due consideration of issues of accessibility and health equity [22, 42].

Future research should acknowledge that the models proposed in this study are conceptual frameworks grounded in a narrative review and therefore require systematic empirical verification. To this end, (1) quasi-experimental studies applying community-based nutritional interventions should be conducted to evaluate intervention effects; (2) longitudinal cohort studies tracking the life-course transition from adolescence to young adulthood should be conducted to verify the sustainability of behavioral change; (3) mixed-methods research to elucidate the causal relationship between engagement and dietary behavior change in digital platform-based interventions should be undertaken; and (4) equity-focused evaluations targeting socioeconomically disadvantaged populations should be undertaken to evaluate the differential effects and applicability of the proposed interventions.

Additionally, the development of differentiated target strategies reflecting Korea's unique socioeconomic and cultural context is warranted, along with follow-up research to evaluate the applicability and scalability of community-based multi-strategy interventions [37, 38]. Based on this accumulated evidence, the practical feasibility and policy utility of the proposed model in the present study should be verified through a phased, systematic process.

In conclusion, adolescence and young adulthood may be understood as a period of active health trajectory reshaping, and life-course-based integrated nutrition strategies represent a critical direction for extending healthy life expectancy and strengthening sustainable public health systems.

CONFLICT OF INTEREST

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

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DATA AVAILABILITY

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Research Article

Development of a simplified NOVA-based scoring tool for assessing ultra-processed food consumption among Korean young adults: a cross-sectional study

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Objectives: This study aimed to develop a NOVA-based scoring approach for evaluating ultra-processed food (UPF) intake among Korean adults and to examine its performance. Previous studies have reported that young adults have the highest levels of UPF consumption. Accordingly, this study focused on adults aged 19–40 years and developed scoring components reflecting dietary patterns specific to Korean eating habits.
Methods: Using 24-hour dietary recall data from adults aged 19–40 years in the Korea National Health and Nutrition Examination Survey (2021–2023), foods were classified according to the Korean-adapted NOVA system. The top 10 food groups accounting for ≥ 80% of cumulative UPF-derived energy were selected to construct the scoring components. The tool was operationalized using food frequency questionnaire (FFQ) data from the Gangwon cohort study (2022–2024). Intake frequencies were converted into scores ranging from 0 ("rarely or never") to 5 ("≥ 1 time/day"), and summed to generate the NOVA–UPF score (range: 0–50).
Results: Among 237 young adults (aged 20–49 years), the mean NOVA–UPF score was 22.9 ± 8.3. A positive association was observed between the NOVA–UPF score and FFQ-based UPF energy intake (Spearman's ρ = 0.629, P < 0.001). Cross-classification showed that 51.9% were classified into the same tertile and 94.9% into the same or adjacent tertiles, with a weighted kappa coefficient of 0.279.
Conclusion: This NOVA-based scoring approach may serve as a preliminary tool for assessing UPF intake in Korean young adults. Further refinement and rigorous validation using

quantitative dietary assessment methods and more diverse populations are required before broader application.

Keywords: food, processed; nutrition surveys; surveys and questionnaires; diet surveys

INTRODUCTION

Recent domestic and international studies describe ultra-processed foods (UPFs) as products manufactured using industrially processed food (PF) ingredients and a wide range of additives [1]. These foods are characterized by high energy density and increased added sugar, sodium, and saturated fat contents, while being low in dietary fiber and micronutrients [1]. Several epidemiological studies have reported that excessive UPF consumption increases the risk of major chronic diseases, including obesity [2], dyslipidemia [3], metabolic syndrome [4, 5], and coronary and cerebrovascular disorders [6]. Further, diets high in UPFs increase sugar, fat, and sodium intake, thereby lowering overall diet quality and emerging as an important public health concern [1, 7, 8].

The NOVA classification system is a representative framework for classifying foods according to their level of processing [9]. It categorizes foods and beverages into four groups based on the purpose and extent of industrial processing: (1) minimally PF, (2) processed culinary ingredients, (3) PF, and (4) UPF [1]. In Korea, UPF consumption has steadily increased due to dietary westernization and the widespread availability of convenience foods, with particularly high intake observed among young adults [10-12]. This age group has irregular eating schedules due to academic or work demands and prefers convenient, palatable foods, making them more likely to consume PFs [11, 13]. Such trends reflect changing food consumption patterns among young adults and emphasize the need for early identification and monitoring of the health impacts of UPF intake.

Globally, several countries have developed and validated UPF intake assessment tools tailored to their dietary environments, and practical instruments for rapidly assessing UPF consumption are currently employed in Brazil, Senegal, Colombia, and other countries [14-17]. However, in Korea, a standardized and simplified assessment tool remains unavailable to evaluate UPF intake. Most studies rely on complex dietary assessment methods, including 24-hour recalls or food frequency questionnaires (FFQs), which require substantial time, cost, and analytical effort [15, 16]. Further, the rapidly evolving food environment has created a gap in up-to-date data that can capture new dietary patterns and the changing trends in UPF consumption [14, 17]. Therefore, the development of a standardized tool that enables quick and simple assessment of UPF intake at the population level is warranted.

The need for a simplified UPF assessment approach reflecting Korean dietary habits has been recognized; however, existing international UPF tools are largely based on Western dietary patterns and may not adequately capture the characteristics of Korean food consumption [18]. For example, traditional fermented condiments, such as *Doenjang* and *Gochujang*, are widely used as household cooking ingredients, but their commercial production may involve added sugars and seasonings, thereby making their level of processing nontrivial [19]. These considerations emphasize the need for developing a Korea-specific scoring approach that accounts for the unique characteristics of Korean dietary culture.

In this context, the present study serves as an initial step toward constructing a UPF intake scoring tool suitable for Korea. The NOVA–UPF scoring tool was developed as an FFQ-derived scoring approach based on selected food items relevant to UPF consumption, rather than as a standalone questionnaire. Major UPF food groups commonly consumed by young adults—who exhibit relatively high UPF intake—were first identified using 24-hour recall data from the Korea National Health and Nutrition Examination Survey (KNHANES, 2021–2023) and applying the Korean-adapted NOVA classification. The association between the constructed

score and the proportion of energy from UPFs was examined using FFQ data from the Gangwon Obesity and Metabolic Syndrome (GOMS) cohort study (2022–2024) to provide preliminary evidence on its performance in the Korean population.

METHODS

Ethics statement

The written informed consent was obtained from all participants. This study was conducted with the approval of the Research Ethics Committee of Hallym University Institutional Review Board (HIRB-2021-077-2-RR-CR-R-CR-R).

1. Study design

This study was conducted as a cross-sectional study and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement, available at https://www.strobe-statement.org/.

2. Data collection

This cross-sectional study developed a simplified NOVA-based scoring tool for assessing UPF intake among young Korean adults and evaluated its performance. The study comprised two phases (Fig. 1).

Phase 1 used 24-hour dietary recall data from the KNHANES (2021–2023), a nationwide survey that annually assesses the health and nutritional status of a randomly selected representative sample of the Korean population through health examinations and nutrition surveys. This phase aimed to identify UPF items consumed by young adults. Food items were classified according to the NOVA food classification system [18, 19]. Food groups with high contributions to total energy intake were extracted among the identified UPFs, and the foundational components of the scoring tool included the top 10 food groups that collectively accounted for ≥ 80% of cumulative energy contribution. A total of 4,285 adults aged 19–40 years were initially included, whereas individuals with missing data or implausible daily energy intake (< 500 kcal or > 5,000 kcal; n = 426) were excluded, leading to a final analytic sample of 3,859 participants.

Phase 2 used FFQ data from the GOMS cohort collected between 2022 and 2024. The GOMS study is an ongoing observational cohort designed to investigate dietary and lifestyle determinants of obesity and metabolic health among Korean adults in Gangwon province [20].

The GOMS study employed a dish-based semiquantitative FFQ developed in 2009 to assess usual dietary intake over the preceding year, covering 112 food and dish items [21]. Participants reported the frequency of consumption across nine categories, ranging from "never or less than once per month" to "three times per day," along with standard portion sizes. The FFQ has been previously validated and demonstrated acceptable reproducibility and validity [21]. In the present study, alcoholic beverages were excluded from the NOVA classification, resulting in 109 items included in the analysis.

In the FFQ, food items were categorized based on processing level using the NOVA system to assess UPF intake [19]. Scores for the NOVA–UPF tool were calculated using the UPF list identified in the 24-hour recall analysis, whereas the FFQ-based UPF energy proportion was used as a reference indicator for assessing tool performance. This study analyzed 237 adults aged 20–49 years (65 men and 172 women). Individuals with insufficient

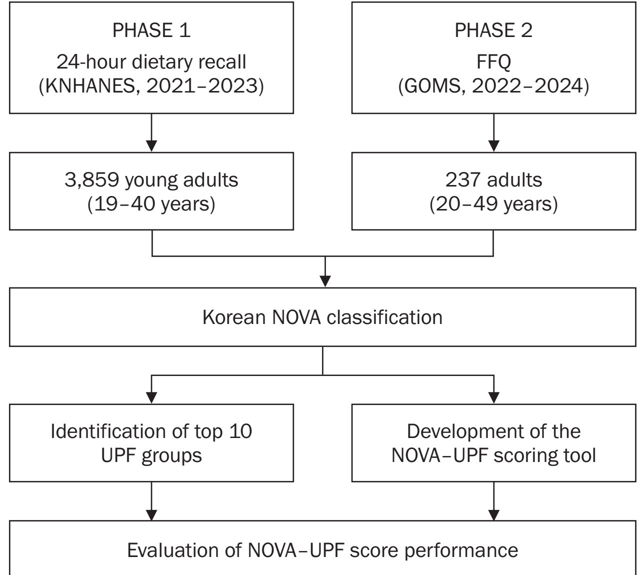

Fig. 1. Diagram of data analysis employed in the development and performance evaluation of the NOVA–UPF scoring tool. KNHANES, Korea National Health and Nutrition Examination Survey; FFQ, food frequency questionnaire; GOMS, Gangwon Obesity and Metabolic Syndrome; UPF, ultra-processed food.

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literacy, moderate or severe cognitive impairment, or participation in other clinical or observational studies were excluded [20].

3. Assessment of UPF intake and performance evaluation

1) Identification of UPF food groups using 24-hour recall data

To reflect contemporary dietary patterns, the present study used 24-hour dietary recall data from the KNHANES (2021–2023) to identify UPF food groups consumed by Korean adults aged 19–40 years. The 24-hour dietary recall method requires respondents to report all foods and beverages consumed over the previous day [22].

All reported food items were classified into the four NOVA processing levels (Groups 1–4) following the framework proposed by Monteiro *et al.* [23]. Given that the original NOVA criteria may not fully capture domestic food manufacturing processes or consumption contexts in Korea, a secondary classification was conducted using the Korean-adapted NOVA guidelines, which consider commonly consumed traditional foods such as *kimchi*, fermented soybean pastes, and side dishes [18].

Foods were re-examined using updated information on cooking methods, product names, brand information, food types, nutrient composition (particularly sugar and sodium content), and ingredient lists to better reflect recent changes in the industrial food supply [18, 19]. The classification process was conducted through expert panel discussions involving specialists in nutritional epidemiology, and discrepancies were resolved through iterative deliberation until consensus was reached. Among the classified foods, only those categorized as ultra-processed (Group 4) were retained as candidate UPF items. A total of 2,081 food items were initially evaluated, of which 949 were classified as UPFs.

Among the identified UPF items, food groups with high contributions to total daily energy intake were selected. The contribution of each UPF food group to total UPF-derived energy intake was calculated and ranked. Cumulative energy contribution was identified by sequentially summing energy contributions in descending order, and food groups accounting for approximately 80% or more of cumulative UPF-derived energy were selected as the final candidates for inclusion in the scoring tool [24].

2) Scoring of the tool using the FFQ

The NOVA–UPF scoring tool was developed based on 24-hour dietary recall data from the 2021–2023 KNHANES, using the top 10 food groups that accounted for ≥ 80% of cumulative UPF-derived energy as scoring components. FFQ food items were grouped by matching them to these 10 UPF food groups identified from the contribution analysis and the list of foods classified as NOVA Group 4 [19]. Details of how FFQ items correspond to each scoring component are provided in Supplementary Table 1.

The consumption frequency of each grouped FFQ item was scored using the frequency categories of the FFQ administered in the GOMS cohort (2022–2024). Frequency responses were converted into scores ranging from 0 (“rarely or never”) to 5 (“≥ 1 time/day”) based on a six-point scale. The scores of all items were summed to generate an individual’s NOVA–UPF total score, with higher scores indicating higher UPF consumption levels.

3) Assessment of tool performance

The performance of the NOVA–UPF scoring tool was assessed by evaluating its association with the proportion of energy intake from UPFs (%kcal), derived from FFQ data. Each FFQ item was classified according to the NOVA processing level following established criteria [19], and the percentage of total energy intake attributable to UPFs was calculated for each participant. This FFQ-based UPF energy proportion (%kcal) was utilized as the reference indicator.

To examine the extent to which the tool captured relative UPF intake, Spearman’s rank correlation coefficients were calculated between NOVA–UPF scores and the FFQ-based UPF energy proportion. In addition, both measures were categorized into tertiles to evaluate agreement in classification, and cross-classification analyses along with the weighted kappa coefficient were used to assess concordance between the two indicators.

4. Assessment of sociodemographic and lifestyle characteristics

Education level was classified into “middle school or below,” “high school graduate,” and “college or above.” Household income was categorized into “< 2 million KRW per month,” “2–4 million KRW,” and “≥ 4 million KRW.” Household composition was classified as single-person or multi-person households. Alcohol consumption was categorized as current drinking (yes/no), whereas smoking status was classified as never smoker (lifetime consumption < 100 cigarettes), former smoker, or current smoker. Physical activity was assessed following the World Health Organization guidelines, which recommend at least 150 minutes of moderate-intensity physical activity or 75 minutes of vigorous-intensity activity per week. Vigorous-intensity activity time was multiplied by two and combined with moderate-intensity time to identify total activity, after which participants were categorized into “none,” “insufficient,” and “sufficient” activity levels [25, 26].

5. Statistical analysis

KNHANES is based on a stratified, clustered, and systematic sampling design, and all statistical analyses were conducted by accounting for sampling weights, stratification variables, and clustering variables. The proportion of energy intake from UPFs (%kcal) was calculated and categorized into tertiles using the 24-hour dietary recall data from KNHANES (2021–2023). Sociodemographic characteristics and major variables of participants were summarized using descriptive statistics based on the GOMS cohort (2022–2024). Consumption frequencies for the FFQ data for each food group were converted to scores of 0 to 5, and these were summed to obtain the NOVA–UPF total score. Total scores were expressed as means and standard deviations, and differences across sociodemographic and lifestyle factors were assessed using independent t-tests and one-way analysis of variance.

Spearman’s rank correlation coefficient was used to examine the correlation between the NOVA–UPF score and the FFQ-based proportion of energy intake from UPFs. Further, both the NOVA–UPF score and the FFQ-based UPF energy proportion were categorized into tertiles, and cross-classification analysis was conducted to assess the degree of agreement between the two indicators. The proportions of participants classified into the same tertile, adjacent tertiles, and opposite tertiles were calculated. Agreement between the two classifications was further evaluated using the weighted kappa coefficient. Stata MP version 17.0 (StataCorp LLC.) was used for all statistical analyses.

RESULTS

1. Comparison of energy intake (%) from subgroups of UPF in terms of gender among adults aged 19–40 years: KNHANES in 2021–2023

Table 1 presents the adjusted mean percentage of energy intake from UPF subgroups among adults aged 19–40 years according to gender. Overall, noodles and pasta dishes contributed the largest proportion of UPF-derived energy intake (16.0%), followed by soda and beverages (15.0%), breads and bakery products (13.4%), seasonings and condiments (10.2%), and traditional sauces (9.0%). Significant gender differences were observed in several subgroups. Men had higher energy contributions from noodles and pasta dishes (17.1% in men and 14.1% in women, $P < 0.001$), traditional sauces (9.8% and 8.1%, $P = 0.013$), processed meat and packaged meat products (10.1% and 7.1%, $P < 0.001$), and convenience or ready-to-eat foods (5.5% and 4.2%, $P = 0.011$). Women had higher contributions from breads and bakery products (15.7% in women and 11.3% in men, $P < 0.001$), snack foods (8.0% and 4.7%, $P < 0.001$), frozen desserts or ice cream (3.1% and 2.0%, $P = 0.001$), and dairy products (5.4% and 3.0%, $P < 0.001$). No significant gender differences were observed for the remaining UPF subgroups. Detailed characteristics of participants according to tertiles of ultra-processed foods energy intake are provided in Supplementary Table 2.

2. Cumulative contribution of UPF subgroups based on 24-hour dietary recall data from adults aged 19–40 years: KNHANES in 2021–2023

Fig. 2 illustrates the cumulative contribution of detailed UPF subgroups to total UPF energy intake based on 24-hour recall data. The major contributing subgroups included noodles and pasta (15.4%), beverages (14.9%), and breads and baked goods (13.6%), which together

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Table 1. Comparison of energy intake (%) from UPF subgroups according to gender among adults aged 19–40 years in the KNHANES (2021–2023) (n = 3,859)

UPF subgroups (%kcal)	Total (n = 3,859)	Men (n = 1,726)	Women (n = 2,133)	*P*-value
Noodles and pasta dishes	16.0 ± 0.5	17.1 ± 0.7	14.1 ± 0.6	< 0.001
Soda, beverages	15.0 ± 0.4	15.7 ± 0.6	14.2 ± 0.5	0.060
Breads and bakery products	13.4 ± 0.4	11.3 ± 0.6	15.7 ± 0.6	< 0.001
Seasonings and condiments	10.2 ± 0.3	10.3 ± 0.4	10.1 ± 0.4	0.705
Traditional sauces	9.0 ± 0.3	9.8 ± 0.5	8.1 ± 0.4	0.013
Processed meat and packaged meat products	8.6 ± 0.3	10.1 ± 0.5	7.1 ± 0.4	< 0.001
Snack foods	6.3 ± 0.3	4.7 ± 0.4	8.0 ± 0.4	< 0.001
Convenience or ready-to-eat foods	4.9 ± 0.3	5.5 ± 0.4	4.2 ± 0.3	0.011
Dairy products	4.2 ± 0.2	3.0 ± 0.3	5.4 ± 0.3	< 0.001
Cocoa and chocolate products	3.5 ± 0.2	3.4 ± 0.4	3.6 ± 0.3	0.581
Processed fish and seafood products	2.8 ± 0.2	2.7 ± 0.2	2.8 ± 0.2	0.772
Frozen desserts or ice cream	2.5 ± 0.2	2.0 ± 0.2	3.1 ± 0.3	0.001
Processed agricultural products	2.6 ± 0.2	2.8 ± 0.3	2.4 ± 0.2	0.285
Dietary supplements	0.8 ± 0.1	1.0 ± 0.2	0.5 ± 0.1	0.059
Jams and spreads	0.2 ± 0.0	0.2 ± 0.0	0.3 ± 0.0	0.131
Processed rice cakes	0.2 ± 0.0	0.2 ± 0.1	0.2 ± 0.1	0.783
Edible oils and fats	0.2 ± 0.1	0.1 ± 0.0	0.1 ± 0.0	0.980
Pickled or preserved foods	0.1 ± 0.0	0.1 ± 0.0	0.0 ± 0.0	0.459
Food additives	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.361
Sugars and sweeteners	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.318

Adjusted mean ± SE from multivariate regression models.
All values, except for the total energy intake, are expressed as %kcal/day.
All estimates were calculated using sampling weights to account for the complex survey design of KNHANES.
P-values indicate overall differences according to gender.
UPF, ultra-processed food; KNHANES, Korea National Health and Nutrition Examination Survey.

accounted for approximately 44% of total UPF energy intake. Seasoning products (10.3%), traditional sauces (8.7%), processed meats (8.3%), and snack foods (6.6%) followed, all of which demonstrated relatively high contributions.

Conversely, chocolate products (3.6%), frozen desserts and ice cream (2.7%), processed seafood (2.8%), and dairy products (4.4%) contributed smaller proportions. Dietary supplements, jams, processed rice cakes, fats and oils, pickled products, food additives, and sugars each accounted for < 1% of total UPF energy intake. Overall, the top eight UPF subgroups contributed > 80% of total UPF-derived energy.

3. Scoring criteria for NOVA–UPF items according to consumption frequency

Table 2 shows the scoring criteria for each item included in the NOVA–UPF scoring tool. The consumption frequency for each food group was categorized into six levels, scored from 0 (“rarely or never”) to 5 (“≥ 1 time per day”). The same scoring criteria were applied to all 10 major UPF food groups, including noodles and pasta, beverages, breads and baked goods, seasoning products, processed sauces/pastes, processed meats, snack foods, ready-to-eat or convenience foods, dairy products, and chocolate products. An individual’s total NOVA–UPF score was calculated by summing the scores across all food groups, with a possible total score ranging from 0 to 50. Higher total scores indicate more frequent UPF consumption.

4. General characteristics of study participants in terms of gender based on the FFQ among adults aged 20–49 years from the GOMS cohort study in 2022–2024

Table 3 shows the characteristics of the 237 participants, comprising 27.4% (n = 65) men and 72.6% (n = 172)

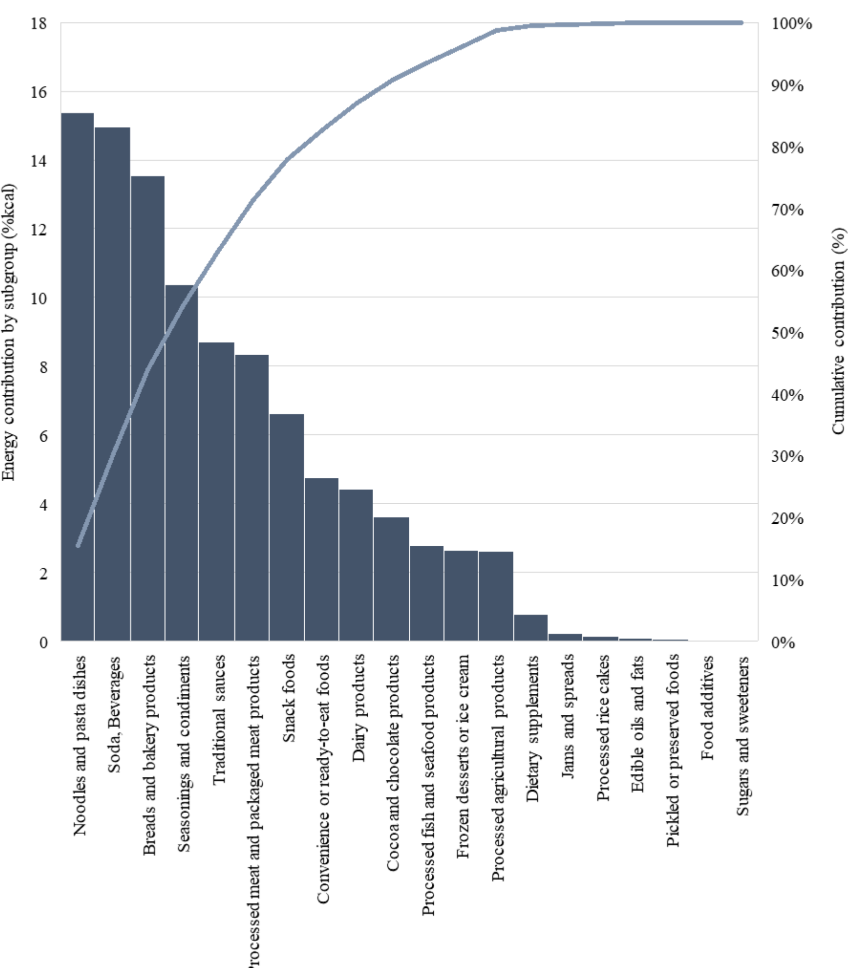

Fig. 2. Cumulative contribution of UPF subgroups based on 24-hour dietary recall data among adults aged 19–40 years in the KNHANES (2021–2023) (n = 3,859). UPF, ultra-processed food; KNHANES, Korea National Health and Nutrition Examination Survey.

Table 2. Scoring criteria for NOVA–UPF items according to consumption frequency

Food group	NOVA–UPF score						
	Rarely or never	1–3 times/month	1 time/week	2–4 times/week	5–6 times/week	≥ 1 time/day	NOVA–UPF score range
Noodles and pasta dishes	0	1	2	3	4	5	0–5
Soda, beverages	0	1	2	3	4	5	0–5
Breads and bakery products	0	1	2	3	4	5	0–5
Seasonings and condiments	0	1	2	3	4	5	0–5
Traditional sauces	0	1	2	3	4	5	0–5
Processed meat and packaged meat products	0	1	2	3	4	5	0–5
Snack foods	0	1	2	3	4	5	0–5
Convenience or ready-to-eat foods	0	1	2	3	4	5	0–5
Dairy products	0	1	2	3	4	5	0–5
Cocoa and chocolate products	0	1	2	3	4	5	0–5
Total possible score	Total possible NOVA–UPF score: 0–50						

UPF, ultra-processed food.

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women. Significant gender differences were observed in education level and smoking status (P = 0.011 and P < 0.001, respectively). Among men, 81.5% had a college-level education or higher, compared with 61.6% of women. Further, the proportion of current smokers was significantly higher among men (35.9%) than among women (8.8%).

Conversely, no significant gender differences were observed in marital status, household income, household type, alcohol consumption, or physical activity level (P > 0.05). Overall, 82.7% of participants were married or living with a partner, and 67.1% had attained a college education or higher. Further, 60.3% reported a monthly household income exceeding 4 million KRW. Current drinkers accounted for 76.8% of the sample, whereas current smokers represented 16.2%. Regarding physical activity, 35.4% met the recommended activity level, whereas 43.9% reported no physical activity and 20.7% reported insufficient activity.

Table 3. General characteristics of study participants according to gender based on FFQ data among adults aged 20–49 years in the GOMS cohort study (2022–2024) (n = 237)

Variables	Total (n = 237)	Men (n = 65)	Women (n = 172)	*P*-value
Total	237 (100.0)	65 (27.4)	172 (72.6)	
Marital status				0.925
Spouse, including common-law partner	196 (82.7)	54 (83.1)	142 (82.6)	
Without a spouse[1)]	41 (17.3)	11 (16.9)	30 (17.4)	
Education level				0.011
≤ Middle school	5 (2.1)	0 (0.0)	5 (2.9)	
High school	73 (30.8)	12 (18.5)	61 (35.5)	
≥ College	159 (67.1)	53 (81.5)	106 (61.6)	
Household income per month (million KRW)				0.913
< 2	17 (7.2)	4 (6.2)	13 (7.6)	
2–4	77 (32.5)	22 (33.9)	55 (32.0)	
> 4	143 (60.3)	39 (60.0)	104 (60.5)	
Household type (n = 236)				0.976
Single member	22 (9.3)	6 (9.2)	16 (9.4)	
Non-single	214 (90.7)	59 (90.8)	155 (90.6)	
Smoking status (n = 234)				< 0.001
Never smoker[2)]	171 (73.1)	29 (45.3)	142 (83.5)	
Former smoker	25 (10.7)	12 (18.8)	13 (7.7)	
Current smoker	38 (16.2)	23 (35.9)	15 (8.8)	
Drinking status				0.287
Current drinking	182 (76.8)	53 (81.5)	129 (75.0)	
Current abstainer[3)]	55 (23.2)	12 (18.5)	43 (25.0)	
Recommended PA levels[4)]				0.160
No PA Level	104 (43.9)	23 (35.4)	81 (47.1)	
Insufficient or inactive PA levels	49 (20.7)	18 (27.7)	31 (18.0)	
Recommended PA level	84 (35.4)	24 (36.9)	60 (34.9)	

n (%).
P-values between groups were identified using chi-squared tests.
Sample sizes vary depending on the variables.
FFQ, food frequency questionnaire; GOMS, Gangwon Obesity and Metabolic Syndrome; PA, physical activity.
[1)]Without a spouse: individuals who are separated, divorced, widowed, or never married.
[2)]Never smokers: those who have smoked < 100 cigarettes over their lifetime.
[3)]Current abstainer: no lifetime experience of alcohol consumption or no alcohol intake during the past year.
[4)]Recommended PA level: engaging in at least 150 minutes per week of moderate-intensity physical activity or 75 minutes per week of vigorous-intensity physical activity.

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5. Mean NOVA–UPF scores according to general characteristics of participants aged 20–49 years from the GOMS cohort study, 2022–2024

Table 4 shows the NOVA–UPF scores according to participants' general characteristics. The mean NOVA–UPF score for all participants was 22.9 ± 8.3 (range: 0–50), and no significant difference was observed between men and women (P = 0.500). Similarly, NOVA–UPF scores did not significantly differ according to age, marital status, education level, household income, household type, smoking status, drinking status, or physical activity level (P > 0.05). Overall, the distribution of NOVA–UPF scores remained relatively consistent across all subgroups.

6. Cross-classification of participants by tertiles of UPF energy intake (%) and NOVA–UPF scores using the FFQ from the GOMS cohort study in 2022–2024

Table 5 presents the cross-classification of participants by tertiles of the NOVA–UPF scores and FFQ-based UPF energy intake (%kcal). Overall, 51.9% of participants were classified into the same tertile, and 94.9% were classified into the same or adjacent tertiles, while 5.1% were classified into opposite tertiles. The weighted kappa coefficient was 0.279 (standard error = 0.046). In addition, a positive correlation was observed between the NOVA–UPF score and FFQ-based UPF energy intake (Spearman's ρ = 0.629, P < 0.001).

DISCUSSION

This study examined the performance of a Korean NOVA-based UPF scoring tool developed to rapidly assess UPF intake among Korean adults. Analysis of 24-hour dietary recall data from the KNHANES identified noodles, beverages, breads, seasoning products, and processed sauces/pastes as major contributors to UPF energy intake, which were subsequently used to construct the scoring components. The NOVA–UPF score was positively correlated with the proportion of energy intake from UPFs (%kcal) derived from the FFQ (Spearman's ρ = 0.629, P < 0.001). Cross-classification of tertiles showed that the largest proportion of participants was classified into the same tertile for both measures.

A notable strength of this study is that the develop-

Table 4. Mean NOVA–UPF scores according to general characteristics of participants in the GOMS cohort study (2022–2024) (n = 237)

Variables	NOVA–UPF score	P-value
Age (year)		0.610
20–29	21.3 ± 7.1	
30–39	23.6 ± 8.7	
40–49	22.8 ± 8.3	
Gender		0.500
Men	23.5 ± 8.6	
Women	22.6 ± 8.2	
Marital status		0.907
Spouse, including common-law partner	22.9 ± 8.2	
Without a spouse[1]	22.7 ± 8.7	
Education level		0.259
≤ Middle school	24.8 ± 8.7	
High school	21.6 ± 8.2	
≥ College	23.4 ± 8.3	
Household income per month (million KRW)		0.373
< 2	22.1 ± 10.0	
2–4	21.9 ± 7.8	
> 4	23.5 ± 8.3	
Household type		0.388
Single member	21.5 ± 10.0	
Non-single	23.1 ± 8.1	
Smoking status		0.343
Never smoker[2]	22.8 ± 8.3	
Former smoker	25.0 ± 9.4	
Current smoker	22.0 ± 7.6	
Drinking status		0.959
Current drinking	22.9 ± 8.2	
Current abstainer[3]	22.8 ± 8.7	
Recommended PA levels[4]		0.584
No PA Level	22.7 ± 8.7	
Insufficient or inactive PA levels	24.0 ± 7.4	
Recommended PA level	22.5 ± 8.3	

Mean ± SD.
P-values were obtained from an independent t-test or one-way ANOVA.
UPF, ultra-processed food; GOMS, Gangwon Obesity and Metabolic Syndrome; PA, physical activity.
[1]Without a spouse: individuals who are separated, divorced, widowed, or never married.
[2]Never smokers: those who have smoked < 100 cigarettes over their lifetime.
[3]Current abstainer: no lifetime experience of alcohol consumption or no alcohol intake during the past year.
[4]Recommended PA level: engaging in at least 150 minutes per week of moderate-intensity physical activity or 75 minutes per week of vigorous-intensity physical activity.

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Table 5. Cross-classification of participants by tertiles of UPF energy intake (%) and NOVA–UPF scores based on FFQ data in the GOMS cohort study (2022–2024) (n = 237)

UPF consumption (%kcal)	NOVA–UPF score			Total
	T1 (lowest)	T2 (middle)	T3 (highest)	
T1 (lowest)	53 (67.1)	20 (25.3)	6 (7.6)	79 (100)
T2 (middle)	23 (29.1)	32 (40.5)	24 (30.4)	79 (100)
T3 (highest)	6 (7.6)	27 (34.2)	46 (58.2)	79 (100)
Total	82 (34.6)	79 (33.3)	76 (32.1)	237 (100)

n (%).
The weighted kappa coefficient for agreement across tertiles was 0.279.
Spearman's correlation coefficient = 0.629, $P < 0.001$.
UPF, ultra-processed food; FFQ, food frequency questionnaire; GOMS, Gangwon Obesity and Metabolic Syndrome.

ment of the scoring components accounted for the unique characteristics of Korean dietary culture. Foods such as seasoning products and fermented sauces are widely consumed in Korea and traditionally classified as minimally processed. However, modern commercial production frequently incorporates added sugars, flavor enhancers, and stabilizers, thereby complicating classification according to NOVA criteria [27, 28]. These characteristics are not fully captured in Western-developed assessment tools [14-17], highlighting the importance of incorporating Korea-specific dietary features into tool development.

Previous international studies have reported positive correlations between NOVA-based UPF scores and reference indicators of UPF intake [14, 15]. In Senegal, a validation study demonstrated a positive linear relationship between score categories and mean UPF intake from repeated 24-hour recalls ($P < 0.001$) [15]. Similarly, a study of young women in Colombia reported a positive linear association between NOVA–UPF scores and the percentage of energy from UPFs ($P < 0.001$) [16]. Although those studies used repeated 24-hour recalls as reference measures and the present study used FFQ-based indicators, the consistent positive associations across different dietary assessment methods suggest that NOVA-based scoring approaches may have potential for ranking individuals according to relative UPF intake. The present findings provide preliminary support for the use of a simplified NOVA-based scoring tool within FFQ-based research contexts.

International UPF assessment tools generally emphasize Western-typical UPFs, including breads, fast foods, chocolate, and sugary beverages [14-16]. In contrast, our analysis showed that Korean adults derive substantial UPF energy not only from noodles, beverages, and breads but also from seasoning products and processed sauces/pastes. These differences reflect culturally distinct dietary patterns and contribute to structural variation in tool design between Korean and Western contexts. Direct comparisons across tools should therefore be interpreted with caution.

In Korea, UPF consumption has been increasing, particularly among young adults [11, 12]. The rise of single-person households has increased demand for convenience and ready-to-eat foods [12, 29], and exposure to food-related content and marketing through social media may further influence UPF consumption [12, 30-32]. Considering these trends, systematic approaches for monitoring UPF intake are needed. The observed association between the NOVA–UPF score and FFQ-based UPF energy intake suggests that this scoring tool may have potential as a preliminary assessment approach in FFQ-based epidemiologic studies. The tool should be interpreted as an FFQ-derived summary score rather than an independently administered dietary assessment instrument.

Limitations

This study has several limitations. First, both the NOVA–UPF score and the reference indicator were derived from FFQ data, indicating that the evaluation reflects internal consistency rather than true external validation. This may have contributed to a modest overestimation of the observed association, and validation against quantitative dietary assessment methods such as repeated 24-hour recalls was not performed. In ad-

dition, the weighted kappa coefficient indicated only fair agreement between the score-based classification and FFQ-derived UPF intake tertiles, suggesting limited exact concordance between the 2 measures. However, the relatively low proportion of extreme misclassification indicates that the tool may still have potential for ranking individuals according to relative UPF intake rather than for precise classification. Second, the study sample primarily comprised young adults, limiting generalizability to middle-aged or older populations. Third, participants were recruited from a specific geographic region, and caution is warranted when extrapolating the findings to the broader Korean adult population. Finally, scoring components were derived from UPF food groups identified using national 24-hour recall data; however, the ongoing diversification of UPF products in Korea suggests that the tool may not fully capture all relevant UPF categories. Further refinement and validation may be needed as food consumption patterns evolve.

Conclusion

This study evaluated the performance of a Korean NOVA-based scoring tool developed to assess UPF consumption among Korean adults. The tool was constructed by identifying major UPF-contributing food groups from national 24-hour dietary recall data and incorporating food categories reflecting Korean dietary characteristics. The positive association observed between the NOVA–UPF score and FFQ-based UPF energy intake suggests that the score may capture relative differences in UPF consumption among individuals. This study represents a preliminary analysis to explore the feasibility of applying a structured NOVA-based scoring approach within existing FFQ-based cohort data. These findings indicate that the tool should be considered a preliminary assessment approach. Further refinement and rigorous validation using quantitative dietary assessment methods and more diverse populations are required before broader application.

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CONFLICT OF INTEREST

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

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DATA AVAILABILITY

The datasets generated and analyzed during the current study are not publicly available due to confidentiality agreements and the lack of explicit participant consent for data sharing.

SUPPLEMENTARY MATERIALS

Supplementary Table 1. Categorization of food and beverage items from the semiquantitative FFQ according to the NOVA classification system
Supplementary Table 2. General characteristics of study participants according to tertiles of energy intake (%) from UPF based on 24-hour dietary recall data among adults aged 19–40 years in the KNHANES (2021–2023) (n = 3,859)

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Research Article

Association between nutrient intake and frailty status in Korean older adults: a cross-sectional study using the 9th (2022–2023) Korea National Health and Nutrition Examination Survey

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Objectives: This study evaluated the intake status of key macronutrients and micronutrients (calcium, magnesium, iron, and vitamin D) among Korean older adults and investigated their associations with frailty and its individual components.
Methods: Data from 1,246 participants (aged ≥ 65 years) in the 9th Korea National Health and Nutrition Examination Survey (2022–2023) were analyzed. Participants were classified into Robust, Pre-frail, and Frail groups based on a modified version of the Fried frailty phenotype (unintentional weight loss, exhaustion/fatigue, muscle weakness, slow gait speed, and low physical activity). Nutrient intake levels were categorized into tertiles. Multivariable logistic regression was used to estimate odds ratios (ORs) for frailty. Model 1 was adjusted for age, sex, and total energy intake. Model 2 included additional adjustments for socioeconomic factors (household composition, household income) and function-related factors (aerobic physical activity, chewing difficulty, and disease status).
Results: Total energy intake differed significantly across frailty groups in both Model 1 (P = 0.011) and Model 2 (P = 0.043). In the fully adjusted model, participants in the highest tertile of iron intake (T3) had 35% lower odds of frailty compared to those in the lowest tertile (T1) (OR = 0.65; 95% confidence interval [CI], 0.44–0.96). Iron intake maintained the strongest independent association with reduced odds of muscle weakness (T3 vs. T1: OR = 0.45; 95% CI, 0.28–0.71). Furthermore, higher protein intake per kilogram of body weight (T3) was significantly associated with lower odds of slow gait speed (OR = 0.53; 95% CI, 0.33–0.87) in the minimally adjusted model. Vitamin D, calcium, and magnesium were not significantly associated with overall frailty after full adjustment.
Conclusion: Insufficient intake of protein and iron is associated with increased odds of frailty and its functional components in Korean older adults. These findings underscore the critical need for evidence-based nutritional interventions and policy development to prevent and manage frailty at the population level.

Keywords: frailty; elderly; Korea; nutrient status; protein

INTRODUCTION

Globally, many countries—including Korea—are experiencing rapid demograph-

ic shifts driven by low birth rates and population aging. In 2025, Korea attained super-aged society status, with individuals aged 65 and older comprising 20.3% of the total population; this proportion is projected to reach 29.9% by 2035 and 40.1% by 2050 [1]. Japan reached this milestone in 2005 [2], and United Nations (UN) projections indicate that the global proportion of older adults will surpass 20% by 2070 [3]. These demographic shifts underscore an urgent need for comprehensive, multifaceted strategies to address the health and well-being of older adults at both national and international levels.

Frailty is characterized by heightened vulnerability to external stressors resulting from diminished physiological reserves with advancing age; it is a pivotal determinant of adverse health outcomes and increased morbidity [4, 5]. Importantly, frailty differs from inevitable physiological aging in that it is potentially reversible and preventable. Evidence indicates that frailty can be mitigated through modifiable lifestyle factors, such as improved nutritional intake, regular physical activity, and smoking cessation [5-7]. Nutritional management, in particular, is central to maintaining physical function and is essential for both the prevention and management of frailty.

According to the 2020 Dietary Reference Intakes for Koreans [8], a substantial proportion of individuals aged 75 and older consume protein below the estimated average requirement: 40.5% of males and 59.9% of females. Insufficient intake of key micronutrients, particularly calcium, is also more prevalent in this age group compared to other age cohorts [8]. Such nutritional deficiencies are mechanistically linked to frailty. Community-based research [9] has demonstrated that insufficient intakes of protein and vitamin D are associated with significantly increased risks of frailty, with odds ratios (ORs) of 2.4 and 1.6, respectively. Moreover, a systematic review [10] indicates that frailty risk is exacerbated by the combined effects of multiple micronutrient deficiencies. Calcium, magnesium, and iron are essential for neuromuscular signaling, skeletal integrity, and oxygen transport; inadequate intake can exacerbate muscle weakness and exhaustion, both clinical hallmarks of frailty [10]. A meta-analysis of over 30,000 participants further identified low serum vitamin D levels as an independent biomarker of frailty risk [11]. Collectively, these findings highlight the necessity of integrated nutritional management—addressing both the quantity and quality of protein intake and ensuring micronutrient balance—for effective frailty prevention.

Despite these insights, research specifically investigating the relationship between nutrient intake and frailty among Korean older adults remains limited. Building upon prior evidence [8-11], the present study aims to comprehensively assess the intake status of macronutrients and specific micronutrients (calcium, magnesium, iron, and vitamin D) in this population, utilizing data from the 9th Korea National Health and Nutrition Examination Survey (KNHANES IX, 2022–2023). Furthermore, it seeks to elucidate the associations between the intake levels of these nutrients and individual frailty components.

METHODS

Ethics statement

This study used data from the KNHANES IX (2022–2023). In KNHANES, written informed consent was obtained from all participants and/or their legal guardians. The KNHANES protocol was approved by the Research Ethics Review Committee of the Korea Disease Control and Prevention Agency (IRB Nos. 2018-01-03-4C-A and 2022-11-16-R-A). The present study was a secondary analysis of publicly available, de-identified KNHANES data; therefore, no additional ethical approval was sought, and additional informed consent was not required.

1. Study design

This investigation employed a cross-sectional design utilizing government-approved, nationally representative data. The study is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (https://www.strobe-statement.org/).

2. Study population

Data were sourced from the KNHANES IX (2022–2023). Of the initial 3,502 participants aged ≥ 65 years, exclusions were made for: (1) diagnosed chronic kidney disease (n = 479) due to its impact on nutrient metabolism; (2) missing data for any key variables, including frailty phenotype components, socioeconomic factors, func-

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tion-related factors, or nutrient intake (n = 1,766), using a complete-case analysis to uphold data integrity; and (3) implausible energy intakes (≤ 500 or > 5,000 kcal/day; n = 11), which may bias nutritional analysis. After these exclusions, 1,246 participants remained for the final analysis.

3. Variables and measurements

1) Frailty assessment

Frailty was evaluated using the five criteria established by Fried *et al.* [12], adapted to accommodate the available variables in the KNHANES and following validated protocols from previous studies [13-16] to ensure methodological consistency. The five components assessed were: unintentional weight loss, exhaustion/fatigue, muscle weakness, slow gait speed, and low physical activity. Muscle weakness was defined according to the Asian Working Group for Sarcopenia (AWGS) 2019 guidelines [17], thereby enhancing physiological relevance for the Korean older adult population. Component definitions were as follows:

A. Unintentional weight loss: self-reported loss of ≥ 3 kg or more within the past year [13-15].
B. Exhaustion/fatigue: self-reported experience of feeling "very much" stress in daily life [13-15].
C. Muscle weakness: handgrip strength < 28 kg for males or < 18 kg for females, as defined by the AWGS 2019 guidelines [17].
D. Slow gait speed: assessed using the EuroQol-5 Dimension mobility dimension, where participants reported: "having some problems in walking about" or being "confined to bed" [13-15].
E. Low physical activity: walking < 120 minutes per week [15].

Based on these criteria, participants were classified as frail (≥ 3 criteria), pre-frail (1–2 criteria), or robust (0 criteria). For analyses examining the association between nutrient intake tertiles and frailty risk, the pre-frail and frail groups were combined into a non-robust category (≥ 1 criterion).

2) General characteristics

General characteristics were derived from the KNHANES health questionnaire and categorized as socioeconomic factors (household composition, household income) and function-related factors (aerobic physical activity, chewing difficulty, and disease status).

Household composition was classified as single-person or multi-person. Household income (quartiles), aerobic physical activity (active/inactive), and chewing difficulty (comfortable/uncomfortable) followed the original KNHANES definitions. Disease status was categorized as "absent" or "present," with the latter defined as having at least one of the following: hypertension, diabetes, dyslipidemia, or obesity (BMI ≥ 25 kg/m^2 according to Korean criteria). Obesity was included due to its strong association with chronic metabolic disease. Grouping these factors enabled a comprehensive assessment of participants' overall health status.

3) Nutrient intake

Dietary intake was assessed using 24-hour recall data, with a focus on nutrients frequently insufficient in older adults—protein, vitamin D, calcium, magnesium, and iron. For macronutrients, the percentage of total energy intake from carbohydrate, protein, and fat (E%) was calculated and compared with the acceptable macronutrient distribution ranges (AMDR) to assess adequacy. To characterize intake distribution, daily nutrient amounts were categorized into tertiles: lowest (T1), middle (T2), and highest (T3).

4. Statistical analysis

All statistical analyses were conducted using SAS software (version 9.4; SAS Institute Inc.), with statistical significance set at $P < 0.05$. The complex sampling design of KNHANES was addressed by applying integrated weights, strata, and clusters in accordance with the KNHANES multi-year data integration guidelines. For the combined 2022–2023 dataset, integrated weights were calculated. Specific sampling weights were assigned depending on the analysis: household and health interview/examination weights (wt_hs/itvex) and nutrition survey weights (wt_ntr) were used for analyses of general characteristics and nutrient intake, while integrated health and nutrition survey weights (wt_tot) were used for analyses involving associations with frailty components.

To compare characteristics across frailty groups, con-

tinuous variables were reported as means ± standard errors (SE) and assessed using complex samples linear regression. Categorical variables were presented as frequencies and percentages and compared using the Rao–Scott chi-square test. Row percentages were used to indicate the prevalence of each frailty status within subgroups.

Nutrient intakes across frailty groups were compared using two adjusted models. Model 1 was adjusted for age, sex, and total energy intake; Model 2 included further adjustments for socioeconomic factors (household composition, household income) and function-related factors (aerobic physical activity, chewing difficulty, disease status). Total energy intake was excluded from the covariates when analyzing energy intake or macronutrient energy contribution ratios (E%) to prevent over-adjustment, as it is inherently accounted for in these variables. Bonferroni correction was applied for post hoc comparisons.

Associations between nutrient intake tertiles and frailty risk, as well as its individual components, were evaluated using complex samples multiple logistic regression to estimate ORs and 95% confidence intervals (CIs). The lowest tertile (T1) served as the reference group for comparisons. While all nutritional variables—including the AMDR for macronutrients—were initially screened, analyses of individual frailty components focused on nutrients (such as protein, vitamin D, and iron, etc.) with established biological and statistical relevance for a more targeted investigation.

RESULTS

1. General characteristics

The distribution of participant characteristics by frailty status is detailed in Table 1. Among the 1,246 participants, 518 (41.6%) were classified as robust, 655 (52.6%) as pre-frail, and 73 (5.8%) as frail. The mean age was 72.3 years, with age increasing significantly across frailty groups ($P < 0.0001$). The prevalence of frailty was higher in those aged ≥ 75 years (9.4%) than in those aged 65–74 years (2.7%) ($P < 0.0001$). Frailty status differed significantly by sex ($P < 0.001$): males were more likely to be robust (50.4%), while females were more likely to be pre-frail (54.7%) or frail (6.5%). Notably, the prevalence of frailty in females (6.5%) was nearly double that observed in males (3.6%).

Regarding household composition, single-person households represented 31.5% of the robust, 61.3% of the pre-frail, and 7.2% of the frail groups ($P < 0.0001$). The proportion of frail participants was also significantly higher among those with lower household income ($P < 0.0001$).

Participants reporting chewing difficulty had a higher prevalence of frailty (9.1%) compared to those without chewing difficulty (3.4%) ($P < 0.0001$). Within the frail group, the proportions of individuals with aerobic physical inactivity and with at least one chronic disease were significantly higher than among physically active or disease-free participants ($P < 0.05$).

2. Nutrient intake

Table 2 summarizes daily nutrient intakes according to frailty status. In Model 1 (adjusted for age and sex), mean total daily energy intake was highest in the robust group (1,691.57 kcal), followed by the pre-frail (1,668.46 kcal) and frail (1,489.75 kcal) groups, with a significant difference among groups ($P = 0.011$). This trend persisted in Model 2, which additionally adjusted for socioeconomic (household composition, household income) and function-related factors (aerobic physical activity, chewing difficulty, disease status), remaining statistically significant ($P = 0.043$). The proportion of energy derived from carbohydrates (E%) was highest in the frail group (68.14%; $P = 0.035$ in Model 1), although this difference was not significant after full adjustment in Model 2 ($P = 0.133$). Notably, iron intake was lowest in the frail group (7.75 mg) compared to the pre-frail (9.04 mg) and robust (9.10 mg) groups, a difference that remained significant in both Model 1 ($P < 0.001$) and Model 2 ($P = 0.001$).

3. Nutrient intake status and frailty risk

Table 3 displays the associations between nutrient intake tertiles and the odds of frailty. In Model 1 (adjusted for age, sex, and energy intake), participants in the highest tertile (T3) for protein intake per kilogram of body weight, vitamin D intake, and iron intake exhibited significantly lower odds of frailty compared to those in the lowest tertile (T1). However, after further adjustment for

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Table 1. General characteristics of the study population

Variables	Total (n = 1,246)	Robust (n = 518)	Pre-frail (n = 655)	Frail (n = 73)	*P*-value[1)]
Age (year)	72.3 ± 0.2	71.3 ± 0.3	72.9 ± 0.2	75.5 ± 0.7	< 0.0001
Age group (year)					
65–74	789	375 (49.3)	391 (48.1)	23 (2.7)	< 0.0001
≥ 75	457	143 (35.2)	264 (55.3)	50 (9.4)	
Sex					
Male	571	276 (50.4)	272 (46.1)	23 (3.6)	< 0.001
Female	675	242 (38.7)	383 (54.7)	50 (6.5)	
Household composition					
Single-person households	273	82 (31.5)	169 (61.3)	22 (7.2)	< 0.0001
Multi-person households	973	436 (46.7)	486 (48.4)	51 (4.9)	
Household income (quartile)					
Low	541	172 (33.7)	326 (59.0)	43 (7.3)	< 0.0001
Middle low	388	176 (46.8)	195 (49.3)	17 (3.9)	
Middle high	196	99 (51.4)	88 (44.2)	9 (4.4)	
High	121	71 (58.0)	46 (37.7)	4 (4.3)	
Aerobic physical activity[2)]					
Inactive	835	289 (36.5)	481 (56.4)	65 (7.1)	< 0.0001
Active	411	229 (58.1)	174 (40.2)	8 (1.6)	
Chewing difficulty					
Not uncomfortable	843	398 (50.2)	413 (46.4)	32 (3.4)	< 0.0001
Discomfort	403	120 (30.6)	242 (60.3)	41 (9.1)	
Disease status[3)]					
Absent	261	134 (51.1)	112 (42.9)	15 (6.0)	0.033
Present	985	384 (42.1)	543 (52.9)	58 (5.0)	

Mean ± SE, n, or n (%).
[1)]*P*-values indicate overall differences across robust, pre-frail, and frail groups.
[2)]Aerobic physical activity was classified as “Active” (≥ 150 minutes of moderate-intensity activity, ≥ 75 minutes of vigorous-intensity activity, or an equivalent combination per week, where 1 minute of vigorous activity equals 2 minutes of moderate activity), and “Inactive” (not meeting these criteria).
[3)]Disease status was classified as “present” for participants diagnosed with at least one of the following: hypertension, diabetes, dyslipidemia, or those identified with obesity (body mass index ≥ 25 kg/m^2).

socioeconomic and function-related factors in Model 2, only the association with iron intake remained statistically significant. Specifically, participants in the highest iron intake tertile (≥ 9.8 mg/day) had 35% lower odds of frailty compared to those in the lowest tertile (< 6.3 mg/day) (OR = 0.65; 95% CI, 0.44–0.96; *P* = 0.031).

4. Nutrient intake and frailty-related criteria

Table 4 presents the ORs for individual frailty components according to nutrient intake tertiles. In Model 1, participants in the highest protein intake group (≥ 1.1 g/kg/day) had significantly lower odds of muscle weakness (OR = 0.58; 95% CI, 0.35–0.96; *P* = 0.036) and slow gait speed (OR = 0.53; 95% CI, 0.33–0.87; *P* = 0.011) compared to those in the lowest intake group. Additionally, higher total energy and vitamin D intakes were associated with reduced odds of slow gait speed, whereas higher calcium intake (T3) was linked to lower odds of muscle weakness. However, these associations were no longer significant in Model 2, which included additional adjustments for socioeconomic and function-related factors.

In contrast, iron intake maintained a consistent, independent association with muscle weakness. The highest iron intake tertile (T3) was associated with a 60% lower odds of muscle weakness in Model 1 (OR = 0.40; 95% CI, 0.25–0.64; *P* < 0.001) and a 55% lower odds in Model 2 (OR = 0.45; 95% CI, 0.28–0.71; *P* = 0.001). Although high-

Table 2. Daily nutrient intakes by frailty group among older adults

Variables	Model 1[1)]				Model 2[1)]			
	Robust (n = 518)	Pre-frail (n = 655)	Frail (n = 73)	*P*-value[2)]	Robust (n = 518)	Pre-frail (n = 655)	Frail (n = 73)	*P*-value[2)]
Total energy intake (kcal/day)[3)]	1,691.57 ± 27.67[a]	1,668.46 ± 28.40[a]	1,489.75 ± 61.64[b]	0.011	1,731.37 ± 39.16[a]	1,738.84 ± 42.21[a]	1,570.54 ± 66.40[b]	0.043
Carbohydrate (E%)[3)]	64.88 ± 0.73[a]	65.76 ± 0.54[ab]	68.14 ± 1.12[b]	0.035	64.26 ± 0.80[a]	64.52 ± 0.74[ab]	66.70 ± 1.14[b]	0.133
Protein (E%)[3)]	14.72 ± 0.23[a]	14.44 ± 0.18[a]	13.96 ± 0.44[a]	0.236	14.74 ± 0.25[a]	14.75 ± 0.26[a]	14.42 ± 0.44[a]	0.756
Fat (E%)[3)]	19.01 ± 0.53[a]	17.95 ± 0.42[ab]	16.68 ± 0.87[b]	0.040	19.36 ± 0.60[a]	18.71 ± 0.55[ab]	17.57 ± 0.85[b]	0.149
Protein (g/kg/day)	0.99 ± 0.02[a]	0.96 ± 0.01[a]	0.97 ± 0.04[a]	0.437	1.01 ± 0.02[a]	1.01 ± 0.02[a]	1.02 ± 0.04[a]	0.976
Vitamin D (μg/day)	2.90 ± 0.22[a]	2.69 ± 0.27[a]	2.54 ± 0.37[a]	0.650	3.38 ± 0.25[a]	3.37 ± 0.37[a]	3.21 ± 0.40[a]	0.923
Calcium (mg/day)	515.27 ± 13.73[a]	496.68 ± 13.01[a]	471.96 ± 26.36[a]	0.273	527.34 ± 17.81[a]	527.64 ± 23.00[a]	507.93 ± 28.95[a]	0.750
Magnesium (mg/day)	324.17 ± 5.29[a]	311.74 ± 4.92[a]	308.41 ± 9.85[a]	0.143	321.67 ± 6.48[a]	314.24 ± 7.37[a]	314.32 ± 10.65[a]	0.545
Iron (mg/day)	9.10 ± 0.23[a]	9.04 ± 0.25[a]	7.75 ± 0.31[b]	< 0.001	9.39 ± 0.30[a]	9.57 ± 0.35[a]	8.30 ± 0.36[b]	0.001

Mean ± SE.
[1)]Model 1: Adjusted for age, sex, and total energy intake. Model 2: Model 1 plus adjustments for socioeconomic factors (household composition, household income) and function-related factors (aerobic physical activity, chewing difficulty, disease status).
[2)]*P*-values indicate overall differences across robust, pre-frail, and frail groups.
[3)]Total energy intake was excluded from the adjustment variables when analyzing energy intake or macronutrient energy proportions (E%) to prevent multicollinearity.
[ab]Different superscripts indicate significantly different means ($P < 0.05$, Bonferroni).

er iron intake was also associated with a 44% reduction in the odds of slow gait speed in Model 1 (OR = 0.56; 95% CI, 0.36–0.86; $P = 0.009$), this association did not persist after full adjustment in Model 2.

DISCUSSION

This study examined the associations between macronutrient and key micronutrient (calcium, magnesium, iron, and vitamin D) intakes and frailty components among Korean older adults, utilizing nationally representative data from KNHANES IX (2022–2023).

A higher prevalence of frailty was observed among participants aged 75 years and older compared to those aged 65–74 years ($P < 0.0001$), consistent with global evidence that frailty risk increases with advancing age [18, 19]. This pattern likely reflects age-related declines in physiological reserves and heightened vulnerability to stressors characteristic of the aging process in the Korean population. The prevalence of frailty was also significantly higher in females (6.5%) than in males (3.6%) ($P < 0.001$), with the proportion of females increasing across frailty categories. These results corroborate previous evidence that, despite longer life expectancy, females are more susceptible to conditions such as sarcopenia and osteoporosis, which elevate frailty risk [20-23]. Additionally, as frailty status progressed, participants were more likely to be in single-person households, have lower income, be physically inactive, and experience chewing difficulties. These findings underscore that frailty results from a complex interplay of biological aging, socioeconomic factors, and health behaviors [18, 24, 25]. In particular, reduced masticatory efficiency limits dietary diversity [26, 27] and adversely affects nutrient intake.

Progression from robust to pre-frail and frail status was associated with significant reductions in total energy and micronutrient intake, especially iron. These lower intakes were associated with increased odds of frailty. Notably, participants in the highest protein intake tertile (≥ 1.1 g/kg/day) had 36% lower odds of frailty than those in the lowest tertile (< 0.8 g/kg/day) in Model 1. This aligns with the recommended protein intake for older adults (1.0–1.2 g/kg/day) [28, 29], highlighting the importance of adequate protein consumption. Conversely, the lowest tertile (< 0.8 g/kg/day) indicates that many

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Table 3. Associations between nutrient intake tertiles and the odds of frailty among older adults

Variables[1)]	Category	Model 1[2)]	Model 2[2)]
Total energy intake (kcal/day)[3)]	T1 (< 1,306.6)	1.00 (ref.)	1.00 (ref.)
	T2 (1,306.6–<1,825.2)	0.83 (0.59–1.15)	0.86 (0.61–1.22)
	T3 (≥ 1,825.2)	0.78 (0.56–1.09)	0.92 (0.65–1.30)
Carbohydrate (E%)[3)]	T1 (< 61.2)	1.00 (ref.)	1.00 (ref.)
	T2 (61.2–<70.6)	1.12 (0.82–1.53)	1.09 (0.78–1.52)
	T3 (≥ 70.6)	1.35 (0.96–1.91)	1.13 (0.81–1.59)
Protein (E%)[3)]	T1 (< 12.8)	1.00 (ref.)	1.00 (ref.)
	T2 (12.8–<15.6)	0.87 (0.62–1.21)	1.02 (0.73–1.44)
	T3 (≥ 15.6)	0.83 (0.59–1.18)	1.00 (0.70–1.45)
Fat (E%)[3)]	T1 (< 14.2)	1.00 (ref.)	1.00 (ref.)
	T2 (14.2–<20.8)	0.76 (0.56–1.04)	0.92 (0.67–1.26)
	T3 (≥ 20.8)	0.72 (0.51–1.03)	0.84 (0.60–1.19)
Protein (g/kg/day)	T1 (< 0.8)	1.00 (ref.)	1.00 (ref.)
	T2 (0.8–<1.1)	0.70 (0.49–0.99)*	0.79 (0.57–1.11)
	T3 (≥ 1.1)	0.64 (0.42–0.99)*	0.80 (0.52–1.23)
Vitamin D (μg/day)	T1 (< 0.7)	1.00 (ref.)	1.00 (ref.)
	T2 (0.7–<2.7)	0.80 (0.55–1.17)	0.88 (0.61–1.26)
	T3 (≥ 2.7)	0.68 (0.47–0.97)*	0.78 (0.55–1.11)
Calcium (mg/day)	T1 (< 348.7)	1.00 (ref.)	1.00 (ref.)
	T2 (348.7–<570.2)	0.99 (0.65–1.49)	1.06 (0.72–1.57)
	T3 (≥ 570.2)	0.87 (0.58–1.32)	1.08 (0.72–1.60)
Magnesium (mg/day)	T1 (< 248.1)	1.00 (ref.)	1.00 (ref.)
	T2 (248.1–<355.4)	0.80 (0.54–1.17)	0.87 (0.59–1.26)
	T3 (≥ 355.4)	0.78 (0.51–1.18)	0.92 (0.59–1.43)
Iron (mg/day)	T1 (< 6.3)	1.00 (ref.)	1.00 (ref.)
	T2 (6.3–<9.8)	0.83 (0.57–1.20)	0.88 (0.61–1.28)
	T3 (≥ 9.8)	0.53 (0.36–0.79)**	0.65 (0.44–0.96)*

Odds ratio (95% confidence interval).
The lowest tertile (T1) served as the reference group.
The non-robust group comprises the combined pre-frail and frail groups; the robust group is used as the reference category.
1)Nutrients were categorized into tertiles (T1–T3) based on their distribution within the study population.
2)Model 1: Adjusted for age, sex, and total energy intake. Model 2: Model 1 plus adjustments for socioeconomic factors (household composition, household income) and function-related factors (aerobic physical activity, chewing difficulty, disease status).
3)Total energy intake was excluded from the adjustment variables when analyzing energy intake or macronutrient energy proportions (E%) to prevent multicollinearity.
*$P < 0.05$, **$P < 0.01$.

female Korean older adults do not meet these recommendations, consistent with previous studies [8, 30, 31]. Furthermore, as frailty progressed, carbohydrate intake exceeded the recommended range (50%–65% of total energy intake) [32], with the frail group averaging above the 65% upper limit in both models (68.14% and 66.70%, respectively). Frailty prevalence was highest among those in the highest carbohydrate intake tertile, suggesting that frailty progression is linked to a macronutrient imbalance—an overreliance on carbohydrates relative to protein and fat. Such quantitative and qualitative dietary imbalances may promote involuntary weight loss and functional decline, creating a cycle that accelerates the progression of frailty [7, 33, 34]. Although protein intake is a recognized factor in frailty [35, 36], its independent association disappeared after full adjustment (Model 2), indicating substantial confounding by socioeconomic and functional variables. Thus, interventions should address both energy quantity and nutrient quality, with a focus on adequate protein intake to prevent

Table 4. Associations between nutrient intake tertiles and frailty-related criteria among older adults

Variables	Model 1[1)]					Model 2[1)]				
	Weight loss (220, 16.7%)	Muscle weakness (273, 18.3%)	Low physical activity (121, 9.5%)	Slow gait speed (454, 35.3%)	Exhaustion/fatigue (30, 2.3%)	Weight loss (220, 16.7%)	Muscle weakness (273, 18.3%)	Low physical activity (121, 9.5%)	Slow gait speed (454, 35.3%)	Exhaustion/fatigue (30, 2.3%)
Total energy intake (kcal/day)[2)]										
T1 (< 1,306.6)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
T2 (1,306.6–<1,825.2)	0.89 (0.61–1.30)	0.86 (0.59–1.26)	1.04 (0.57–1.90)	0.74 (0.53–1.02)	0.59 (0.22–1.59)	0.89 (0.61–1.29)	0.88 (0.60–1.31)	1.02 (0.56–1.86)	0.75 (0.54–1.05)	0.65 (0.24–1.76)
T3 (≥ 1,825.2)	0.89 (0.59–1.33)	0.69 (0.45–1.05)	1.06 (0.58–1.96)	0.61 (0.42–0.88)**	1.36 (0.51–3.61)	0.88 (0.59–1.33)	0.78 (0.51–1.20)	1.10 (0.60–2.01)	0.71 (0.48–1.04)	1.56 (0.56–4.35)
Protein (g/kg/day)										
T1 (< 0.8)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
T2 (0.8–<1.1)	0.78 (0.52–1.17)	0.98 (0.65–1.50)	1.37 (0.82–2.29)	0.56 (0.40–0.78)***	0.91 (0.35–2.40)	0.82 (0.54–1.23)	1.11 (0.74–1.65)	1.46 (0.89–2.38)	0.62 (0.44–0.86)	0.95 (0.37–2.42)
T3 (≥ 1.1)	1.27 (0.76–2.14)	0.58 (0.35–0.96)*	0.93 (0.40–2.15)	0.53 (0.33–0.87)*	0.82 (0.19–3.46)	1.37 (0.80–2.35)	0.70 (0.42–1.17)	1.01 (0.45–2.26)	0.68 (0.41–1.10)	0.89 (0.24–3.38)
Vitamin D (μg/day)										
T1 (< 0.7)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
T2 (0.7–<2.7)	1.05 (0.72–1.54)	0.79 (0.53–1.18)	0.68 (0.39–1.18)	0.81 (0.57–1.15)	0.84 (0.32–2.17)	1.05 (0.70–1.56)	0.87 (0.58–1.28)	0.69 (0.40–1.18)	0.93 (0.66–1.31)	0.84 (0.32–2.19)
T3 (≥ 2.7)	0.99 (0.67–1.48)	0.71 (0.45–1.11)	0.92 (0.53–1.57)	0.62 (0.44–0.88)**	0.84 (0.30–2.37)	0.97 (0.65–1.46)	0.80 (0.51–1.25)	0.95 (0.56–1.62)	0.75 (0.52–1.07)	0.89 (0.33–2.35)
Calcium (mg/day)										
T1 (< 348.7)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
T2 (348.7–<570.2)	0.67 (0.45–1.01)	0.99 (0.68–1.44)	1.59 (0.86–2.93)	0.76 (0.53–1.08)	1.43 (0.51–3.97)	0.68 (0.45–1.01)	1.05 (0.73–1.51)	1.54 (0.84–2.82)	0.81 (0.58–1.13)	1.46 (0.52–4.08)
T3 (≥ 570.2)	1.00 (0.62–1.61)	0.55 (0.35–0.87)*	1.32 (0.65–2.70)	0.67 (0.44–1.00)	1.73 (0.56–5.37)	1.04 (0.63–1.70)	0.65 (0.41–1.01)	1.37 (0.70–2.70)	0.83 (0.56–1.24)	1.98 (0.66–5.89)
Magnesium (mg/day)										
T1 (< 248.1)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
T2 (248.1–<355.4)	0.76 (0.50–1.17)	0.77 (0.54–1.09)	1.26 (0.69–2.29)	0.87 (0.61–1.23)	0.98 (0.31–3.10)	0.78 (0.51–1.18)	0.83 (0.58–1.20)	1.30 (0.70–2.41)	0.95 (0.67–1.34)	1.01 (0.33–3.09)
T3 (≥ 355.4)	0.79 (0.45–1.40)	0.65 (0.40–1.07)	1.30 (0.61–2.81)	0.71 (0.47–1.09)	1.82 (0.44–7.56)	0.83 (0.47–1.49)	0.73 (0.45–1.20)	1.38 (0.63–3.05)	0.86 (0.56–1.33)	2.02 (0.52–7.93)
Iron (mg/day)										
T1 (< 6.3)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
T2 (6.3–<9.8)	0.66 (0.43–1.01)	0.92 (0.60–1.05)	0.82 (0.49–1.37)	0.77 (0.53–1.14)	0.58 (0.18–1.87)	0.65 (0.43–1.00)	0.97 (0.63–1.50)	0.85 (0.50–1.45)	0.82 (0.56–1.21)	0.58 (0.18–1.86)

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Table 4. Continued

Variables	Model 1[1)					Model 2[1)				
	Weight loss (220, 16.7%)	Muscle weakness (273, 18.3%)	Low physical activity (121, 9.5%)	Slow gait speed (454, 35.3%)	Exhaustion/fatigue (30, 2.3%)	Weight loss (220, 16.7%)	Muscle weakness (273, 18.3%)	Low physical activity (121, 9.5%)	Slow gait speed (454, 35.3%)	Exhaustion/fatigue (30, 2.3%)
T3 (≥ 9.8)	0.61 (0.36–1.02)	0.40 (0.25–0.64)***	0.73 (0.37–1.43)	0.56 (0.36–0.86)**	1.41 (0.43–4.61)	0.62 (0.37–1.06)	0.45 (0.28–0.71)***	0.81 (0.42–1.56)	0.72 (0.45–1.13)	1.55 (0.48–5.01)

Odds ratio (95% confidence interval).
The lowest tertile (T1) served as the reference group. The non-robust group comprises the combined pre-frail and frail groups; the robust group is used as the reference category.
Outcomes were defined as follows: 1) Weight loss: self-reported ≥ 3 kg loss in the past year; 2) muscle weakness: handgrip strength < 28 kg in males and < 18 kg in females; 3) low physical activity: < 120 minutes/week of walking time; 4) slow gait speed: difficulty walking or bedridden most of the day; 5) exhaustion: self-reported feeling "very much" stress in daily life. The numbers and percentages in parentheses under the column headers indicate the number and percentage of participants (n, %) exhibiting each component.
[1)]Model 1: Adjusted for age, sex, and total energy intake. Model 2: Model 1 plus adjustments for socioeconomic factors (household composition, household income) and function-related factors (aerobic physical activity, chewing difficulty, disease status).
[2)]Total energy intake was excluded from the adjustment variables when analyzing energy intake or macronutrient energy proportions (E%) to prevent multicollinearity.
*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

frailty.

Among micronutrients, only iron intake remained independently associated with frailty after adjusting for all confounders. Although associations with protein and vitamin D were no longer significant in the fully adjusted model, participants in the highest iron intake tertile (T3) had 35% lower odds of frailty compared to those in the lowest tertile (T1). This enduring association suggests that iron deficiency may serve as an independent risk factor, not merely a consequence of reduced dietary or protein intake. Our findings also confirmed that lower iron intake was significantly associated with deficits in muscle strength and gait speed. These results are consistent with the Concord Health and Aging in Men Project, which found that higher iron intake reduced frailty risk by 48% even after controlling for dietary quality and protein intake [37]. Iron plays a distinct physiological role relative to protein, serving as a cofactor for mitochondrial oxidative phosphorylation and facilitating oxygen transport via hemoglobin and myoglobin [13, 37]. Consequently, iron deficiency can impair muscle bioenergetics and oxygen delivery, leading to fatigue and reduced gait speed before clinical anemia manifests [38, 39]. Thus, maintaining adequate iron status is essential for optimal physical function [40, 41] and serves as a key regulator that complements protein's structural role in frailty prevention [37].

In the age- and sex-adjusted model, higher intakes of energy, protein, and vitamin D were associated with reduced risk of functional vulnerability, such as impaired gait and muscle weakness, consistent with previous studies [42-44]. However, these associations did not persist after full adjustment, suggesting the importance of multifaceted influences and nutrient interactions in maintaining physical function among older adults.

In summary, frailty prevention in older adults requires comprehensive nutritional strategies. While macronutrients like protein build the structural foundation for muscle, our results underscore the unique, independent role of iron in overall frailty and in functional domains such as muscle strength and gait speed. Although not all components of frailty were associated with nutrient intake, the sustained significance of iron underscores its central role in maintaining physical performance.

These findings suggest that nutritional assessment

and interventions in older adults should prioritize both qualitative and quantitative factors, specifically monitoring iron status as an independent target alongside total nutrient intake. Further longitudinal research is warranted to determine the impact of combined nutritional interventions on delaying frailty progression.

Limitations

Several limitations of this study should be acknowledged. First, the relatively small number of participants in the frail group (n = 73) may have reduced statistical power to detect more subtle associations and limited the generalizability of the results. Second, the cross-sectional study design precludes establishing causality, and the potential for reverse causality—where physical decline influences nutrient intake—cannot be excluded. Thus, longitudinal studies are warranted to clarify the observed temporal relationships. Third, dietary intake was assessed using a self-reported 24-hour recall method, introducing the risk of recall bias and potential discrepancies between reported and actual intake.

Despite these limitations, this study offers important contributions by providing a detailed analysis of frailty, subdivided into its individual components, and highlighting the critical role of nutrition in key physical function indicators—specifically, muscle strength (grip strength) and gait speed (walking speed). Drawing on integrated intervention frameworks from the United States [45] and Japan [46], and standardized nutritional screening policies in the United Kingdom [47] and Australia [48], there is a clear need for South Korea to establish a comprehensive intervention strategy. Such a strategy should integrate screening, service linkage, and functional indicator-based evaluation. The present findings provide foundational data to inform and guide public health policies targeting older adults in Korea.

Conclusion

Preventing or delaying frailty in older adults necessitates a multifaceted approach that extends beyond caloric supplementation alone. Comprehensive nutritional interventions and supportive policy measures should prioritize enhancing the quality of protein intake—to provide the structural basis for maintaining muscle mass—and optimizing iron status, which is a critical functional regulator of physical performance. Implementing such integrated strategies is essential for effectively preserving physical function and reducing the burden of frailty at the population level.

CONFLICT OF INTEREST

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

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None.

DATA AVAILABILITY

The data supporting the findings of this study are publicly available from the official KNHANES website (https://knhanes.kdca.go.kr/).

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Research Article

한국 독거노인의 무상급식 이용에 따른 영양상태 및 식생활 관련 주관적 인식 비교: 단면 연구

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A comparative study on nutritional status and diet-related subjective perceptions according to free meal service utilization among older adults living alone in Korea: a cross-sectional study

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Objectives: To assess whether the use of free meal services is associated with diet quality among older adults living alone in Incheon, Korea, by comparing the Nutrition Quotient for the Elderly (NQ-E), index of nutritional quality (INQ), and mean adequacy ratio (MAR).
Methods: A cross-sectional survey was conducted from March 5 to April 24, 2025 using one-to-one interviews and partially self-administered questionnaires. After excluding cases with missing responses or energy intake of < 500 kcal/day, 119 participants were analyzed (56 men and 63 women). A single 24-hour recall was used to calculate INQ and MAR. NQ-E was evaluated using total and subdomain scores. Group comparisons and sex-stratified multiple linear regression analyses were performed.
Results: Diet-quality indicators were higher among service users than among non-users. INQ for thiamin and riboflavin was significantly higher in men than in women. Meanwhile, INQ for zinc, vitamin A, riboflavin, and folate was higher in women than in men. In both sexes, MAR was higher among users than among non-users (men: 0.8 ± 0.2 vs. 0.6 ± 0.2; women: 0.7 ± 0.2 vs. 0.5 ± 0.2; P < 0.001 for all). Differences in NQ-E total scores were small. Among women, the practice subdomain score was higher in users than in non-users (66.0 ± 16.4 vs. 55.2 ± 15.5; P = 0.016), and the proportion in upper grades was greater (P = 0.030). Regression analysis showed that service use was negatively associated with NQ-E in men (P = 0.007) and positively associated with MAR in women (P = 0.010).
Conclusion: Use of free meal services was associated with improved diet quality, as reflected by MAR and INQ for specific nutrients, and with higher NQ-E practice scores observed in women than in men. Policies should prioritize food-insecure groups and support sustained participation.

Keywords: aged; independent living; food services; nutrition assessment

INTRODUCTION

2025년 우리나라는 65세 이상 노인인구 비율이 20.3%에 이르러 초고령사회에 진입하였고, 2035년에는 29.9%까지 증가할 것으로 전망된다[1]. 또한 65세 이상 독거노인의 비율은 2020년 19.8%에서 2024년 22.1%로 지속적으로 상승하였다[2]. 이러한 인구학적 변화는 노인의 지역사회 돌봄 수요를 키우며, 영양 불균형의 위험도 가중시킬 수 있다. 선행연구에 따르면 노인의 영양소 섭취 부족은 근감소, 미각(짠맛, 신맛) 감각 기능 저하, 인지기능 저하 등 다양한 건강 문제와 연관되는 것으로 보고되었다[3-5]. 이에 따라 노년기 균형 잡힌 영양 섭취의 중요성이 강조되고 있다.

위와 같은 위험은 식사 준비와 섭취 환경의 제약이 큰 집단에서 더욱 두드러질 수 있다. 특히 독거노인은 식사 준비 부담, 외식 및 장보기 접근성 저하 등 환경적 제약에 취약하다. 국민건강영양조사 제6–7기(2013–2016)자료를 활용한 연구에 따르면 독거노인은 가족 동거노인에 비해 결식률이 높았으며, 평균 영양소 적정비(mean adequacy ratio, MAR) 또한 유의하게 낮아 전반적인 식사의 질이 취약한 것으로 나타났다[6]. 이러한 근거들은 독거노인이 지역사회 영양지원에서 우선 고려해야 할 취약집단임을 시사한다.

이러한 취약성을 보완하기 위한 방안으로, 우리나라에서는 지자체 주도의 무상급식 서비스가 운영되어 왔다. 무상급식 서비스는 경로식당, 복지관 등 지역사회 기반 시설을 중심으로 노인에게 무료 또는 실비 수준의 식사를 제공하는 집단급식 지원 사업으로, 현재는 전국적으로 시행되어 노인 대상 무료 단체급식소는 약 1,124개소에 달한다[7]. 본 사업은 주로 기초생활수급자, 차상위계층, 저소득 독거노인 등 결식 우려가 있는 노인을 대상으로 하며, 지역 및 운영 주체에 따라 제공 방식과 접근성에 차이가 존재한다[8]. 이러한 특성으로 인해 무상급식 서비스 이용이 노인의 식생활과 영양 상태에 미치는 영향은 지역적 맥락과 대상자 특성에 따라 상이할 가능성이 있다.

최근 국내 연구에서는 노인 대상 식사배달 및 무상급식 서비스와 관련하여 만족도와 영향 요인, 대체식 제공의 운영 평가, 이용 노인의 건강 및 영양 상태에 대한 현황 분석 등이 보고되었다[9-12]. 또한 무상급식 서비스의 이용이 노인의 우울 수준 감소와 유의한 관련성을 보인다는 연구 결과도 제시되어, 해당 서비스가 영양적 측면뿐 아니라 정서적 측면과도 연계될 수 있음을 시사하였다[13]. 그러나 기존 연구는 배달 서비스의 만족 요인 분석과 이용자 집단을 대상으로 한 단면적 현황 평가에 주로 초점을 두어, 동일 시점에서 이용자와 비이용자를 직접 비교하고 식행동, 섭취의 질 및 주관적 인식을 통합적으로 분석한 근거가 상대적으로 부족하며, 그 결과 무상급식 서비스의 실효성 평가 근거는 아직 미흡하다.

본 연구는 인천 지역 독거노인을 대상으로 무상급식 서비스 이용 여부에 따른 식행동과 영양 섭취의 질 그리고 주관적 건강 및 영양상태 인식의 차이를 규명하여 무상급식 서비스의 실효성을 평가하고 향후 영양 지원 정책과 프로그램 개선을 위한 기초자료를 제공하는 것을 목적으로 한다.

METHODS

Ethics statement

The written informed consent was obtained from all participants or their guardians for the survey. The study protocol was approved by the Institutional Review Board of Inha University (IRB No. 241125-9A).

1. 연구설계

본 연구는 인천광역시 독거노인을 대상으로 한 단면 설문조사 연구로, STROBE statement (https://www.strobe-statement.org/) 보고지침을 준수하여 기술하였다.

2. 연구 대상 및 기간

본 연구의 대상자는 만 65세 이상의 독거노인으로 인천광역시에 소재한 M종합사회복지관(42명), B노인복지관(33명), D경로당(20명), J경로당(12명), S종교단체(15명)를 이용하며, 연구의 목적과 취지를 이해하고 자발적으로 참여에 동의한 자를 대상으로 하였다. 설문 조사는 2025년 3월 5일부터 4월 24일까지 실시되었으며, 무상급식 서비스 이용 여부에 따라 두 집단으로 구분하였다. 무상급식 서비스 이용군은 정기적으로 무상급식 서비스를 제공받고 있는 노인들이며, 비이용군은 과거부터 현재까지 무상급식 서비스를 전혀 이용한 적이 없는 노인들로 구성하였다.

3. 자료 수집 및 구성

1) 설문조사

본 연구는 Nutrition Quotient for the Elderly (NQ-E) 평가 문항 및 24시간 회상법을 포함한 설문지를 활용하여 1:1 면접조사 방식으로 진행되었다. 읽기 및 쓰기에 어려움이 없는 대상자는 일부 문항에 대해 자가기입 방식으로 응답하였으며, 시력 저하나 신체적 불편 등으로 자가 응답이 어려운 경우에는 연구자가 설문 문항을 읽어주고 구두 응답을 받아 기록하였다. 총 122부의 설문지를 회수하였고, 이 중 응답이 미비한 2부를 제외하였으며, 총 에너지 섭취량이 500 kcal/day 미만인 1부를 제외하여 119부(남자 56명, 여자 63명)를 최종 분석에 활용하였다. 설문 완료 후 모든 참여자에게 동일한 보상(쌀 1 kg)을 제공하였다.

2) 설문구성 및 신체정보

본 연구에 사용된 설문지는 연구 목적에 맞추어 구성하였으며,

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식사습관·식생활 인식 관련 일부 문항은 국민건강영양조사 제9기(2022–2024) 영양조사 지침서를 참고하였다[14]. 설문 항목은 일반적 특성(10문항), NQ-E (20문항) [15], 24시간 회상법, 식사습관 및 영향 요인(10문항), 무상급식 서비스 이용 및 인식(17문항)으로 구성되었다. 일반적 특성(10문항)은 성별, 연령, 학력, 신장, 체중, 만성질환 수, 주택 소유 형태, 주관적 경제 형편, 가족·지인과의 연락빈도, 혼자 식사 준비 가능 여부로 구성되어, 대상자의 인구사회학적 및 사회경제적 배경 정보를 파악하였다. 식사습관 및 영향 요인(10문항)은 식사 횟수, 외식 빈도와 같은 기본적인 식생활 행태에 관한 문항과 함께 건강 및 영양상태 자각, 경제적 어려움, 가족·이웃의 도움 부족, 치아·소화 등 건강 문제가 식사에 미치는 영향을 평가하여 식생활 곤란에 대한 주관적 인식을 함께 측정하였다. 무상급식 서비스 이용 및 인식(17문항)은 무상급식 서비스의 필요성, 이용 여부, 이용 기간 및 빈도, 만족도, 효과 인식, 인지도, 이용 장벽, 개선 요구 사항 등을 포함하여, 서비스에 대한 전반적인 인식을 평가하였다. 본 연구에서 사용된 설문지는 여러 조사 도구로 구성된 혼합형 설문지로, 전체 설문에 대해 단일 신뢰도 계수를 산출하는 데에는 한계가 있다. 이에 따라 신뢰도 분석은 Likert 척도로 구성된 문항들에 한하여 Cronbach's alpha를 산출하였으며, 그 결과 식사습관 및 영향 요인 문항 약 0.7, 무상급식 서비스 이용 및 인식 문항 0.6으로 기준치에 근접한 수준의 내적 일관성이 확인되었다.

신장과 체중은 자가보고 방식으로 수집되었으며, 이를 바탕으로 체질량지수(body mass index, BMI)는 체중(kg)을 신장(m)의 제곱으로 나누어 산출하였다. BMI 분류는 대한비만학회의 판정 기준에 따라서 18.5 kg/m^2 미만은 저체중, 18.5–22.9 kg/m^2는 정상체중, 23.0–24.9 kg/m^2는 과체중, 25.0–29.9 kg/m^2는 1단계 비만, 30.0–34.9 kg/m^2는 2단계 비만, 35.0 kg/m^2 이상은 고도비만으로 판정하였다[16].

3) 식품섭취 조사 및 영양지표 산출

식품섭취 조사는 24시간 회상법을 활용하여 진행하였으며, 연구자가 직접 참여자와 일대일 면담을 통해 수행하였다. 조사 시에는 대상자가 조사 전일 동안 섭취한 음식에 대해 아침, 점심, 저녁, 간식 순으로 회상하도록 유도하였으며, 각 식사에 대해서는 섭취 장소, 음식의 종류, 섭취량을 구체적으로 응답하도록 안내하였다. 참여자의 구두 응답을 연구자가 직접 기록하고, 응답 내용을 재확인하여 누락이나 불일치가 없도록 하였다. 조사는 연구 참여에 자발적으로 동의하고, 의사소통이 가능한 노인을 대상으로 실시하였다. 수집된 식이섭취 자료는 식품별 영양성분 DB구축사업의 자료[17]와 Can-Pro 6.0 Web version (The Korean Nutrition Society)을 활용하여 주요 영양소 함량을 분석하였다. 식사의 질 평가는 NQ-E와 index of nutritional quality (INQ), MAR을 활용하여 수행하였다.

NQ-E는 타당도가 입증된 체크리스트로 개인 또는 집단의 식사의 질과 식행동을 평가하는 간이 영양판정 도구이다. 현재 사용되는 NQ-E는 2015년에 노인을 대상으로 개발되었고 [18], 이를 기반으로 2021년에 노인의 식생활 변화를 반영하여 체크리스트를 업데이트하고, 영양지수의 구성타당도를 검증하여 개정되었다[19]. 개정된 NQ-E 기준을 적용하여 총점은 상(≥ 58.546), 중(44.724–58.545), 하(≤ 44.723)로 구분하였다. 하위 영역의 기준은 균형 상(≥ 54.650), 중(34.188–54.649), 하(≤ 34.187), 절제 상(≥ 75.000), 중(30.800–74.999), 하(≤ 30.799), 실천 상(≥ 71.225), 중(53.525–71.224), 하(≤ 53.524)로 적용하여 판정하였다.

INQ는 에너지 1,000 kcal에 해당하는 식이 내 개별 영양소 함량을, 1,000 kcal당 해당 영양소의 권장섭취량에 대한 비율로 나타내어 영양소의 섭취 밀도를 평가하는 지표이다. 해당 영양소의 1,000 kcal당 섭취량을 연령 및 성별에 따른 권장섭취량과 비교하여 산출하였다. INQ 값이 1 이상이면 해당 영양소가 권장수준 이상으로 섭취되었음을 의미하고 1 미만이면 해당 영양소가 권장섭취량보다 부족하게 섭취되었음을 의미한다.

MAR은 영양소별로 권장량에 대한 섭취량의 비율을 계산하고 1 이상의 값은 모두 1로 간주하여 산출된 NAR의 평균값으로 식사의 전반적인 질적 수준을 평가할 수 있는 종합지표이다. 본 연구에서는 국민건강영양조사(2010–2013년)에서 섭취 부족률이 25% 이상으로 보고되어 NQ-E 개발 기준에 채택된 13개 주요 영양소(단백질, 칼슘, 인, 철, 아연, 비타민 A, 티아민, 리보플라빈, 비타민 B_6, 비타민 B_{12}, 나이아신, 비타민 C, 엽산) [18]를 대상으로 MAR을 산출하였다.

4. 통계 분석

수집된 자료는 IBM SPSS Statistics 29 (IBM Corp.)를 사용하여 분석하였다. 전반적인 경향을 파악하기 위해 빈도, 백분율, 평균과 표준편차를 산출하였으며, 사회·경제·신체 요인 및 건강 및 영양 자각 정도에 관한 문항은 Likert 5점 척도로 변환하여 분석하였다. 건강 및 영양 상태 인식은 '매우 나쁨(1)'에서 '매우 좋음(5)'까지로 평가하였으며, 사회·경제·신체 요인 인식은 '매우 영향 있음(1)'에서 '전혀 영향 없음(5)'까지로 평가하였다. 각 문항에서 긍정적인 응답은 높은 점수, 부정적인 응답은 낮은 점수로 반영하였다. 범주형 변수 간의 차이를 검정하기 위해 기대빈도가 5 미만인 경우에는 Fisher의 정확 검정, 그 외에는 카이제곱 검정을 실시하였다. 연속형 변수는 Mann-Whitney U 검정을 통해 집단 간의 유의성을 분석하였다. 통계적 유의수준은 $P < 0.05$로 하였다. 또한 성별로 층화하여 무상급식 이용을 독립변수로 한 다중선형회귀분석을 MAR과 NQ-E 각각에 대해 실시하여 회귀계수를 추정하였다. 공변량은 단계적 접근법 (stepwise method)으로 선정하되 연령과 학력은 통제변수로 고정하여 포함하였으며, 에너지 섭취량, 식품안보, 아침식사 빈

도, 연락빈도, 신체적 어려움을 포함하였다. 공선성 문제를 확인하기 위해 분산팽창지수를 검토하였고, 회귀모형의 적합도는 수정된 결정계수(adjusted R^2) 및 Durbin-Watson 통계량을 활용하여 수행하였다.

RESULTS

1. 대상자의 일반적 특성

연구 참여자의 일반적 및 신체적 특성은 무상급식 이용 여부에 따라 Table 1에 제시하였다. 평균 연령은 남성 76.2 ± 6.8세, 여성 81.8 ± 6.8세였으며, 이용군과 비이용군 간 연령 차이는 유의하지 않았다. 학력 수준은 남성에서 유의한 차이가 관찰되었으며(P < 0.001), 이용군은 중학교 졸업 비율이 상대적으로 높았고, 비이용군은 고등학교 졸업 비율이 더 높은 경향을 보였다. 여성의 경우 학력 수준에 따른 유의한 차이는 확인되지 않았다. 주거 소유 형태는 남녀 모두에서 유의한 차이가 관찰되었으며(P < 0.001), 비이용군에서는 자가 소유 비율이, 이용군에서는 월세 거주 비율이 상대적으로 높게 나타났다. 경제형편은 남성에서 유의한 차이가 나타났으며(P = 0.001), 비이용군은 '보통'이라고 응답한 비율이, 이용군은 '나쁨'이라고 응답한 비율이 상대적으로 높았다. 여성의 경우 경제형편에 따른 유의한 차이는 나타나지 않았다. 식사 준비 능력, 만성질환 수, 신장, 체중, BMI 분류에서는 남녀 모두에서 무상급식 이용 여부에 따른 유의한 차이가 관찰되지 않았다.

2. 영양섭취 수준: INQ 및 MAR 비교

24시간 식사 회상법을 통해 산출한 INQ와 MAR을 무상급식 서비스 이용 여부에 따라 비교한 결과는 Table 2에 제시하였다. 남성의 경우 비타민 B_1 (P = 0.037)과 비타민 B_2 (P = 0.024)의 INQ에서 이용군이 비이용군보다 유의하게 더 높은 수준으로 관찰되었다. 남성의 MAR도 이용군(0.8 ± 0.2)이 비이용군(0.6 ± 0.2)보다 유의하게 더 높은 수준으로 관찰되었다(P < 0.001). 여성의 경우 아연(P = 0.012), 비타민 A (P < 0.001), 비타민 B_2 (P = 0.019), 엽산(P = 0.032)의 INQ에서 이용군이 비이용군보다 유의하게 더 높은 수준으로 관찰되었다. 여성의 MAR 역시 이용군(0.7 ± 0.2)이 비이용군(0.5 ± 0.2)보다 유의하게 더 높은 수준으로 관찰되었다(P < 0.001).

3. NQ-E 기반 식사의 질 평가: NQ-E 총점 및 하위영역 등급

무상급식 서비스 이용 여부에 따른 NQ-E 및 하위 영역(균형, 절제, 실천)의 점수와 등급 분포를 비교한 결과를 Table 3에 제시하였다. 남성의 경우 무상급식 이용군과 비이용군 간 NQ-E 총점과 하위 영역 점수(균형, 절제, 실천) 및 등급 분포('상', '중', '하')에서 통계적으로 유의한 차이는 관찰되지 않았다. 여성의 경우에는 하위영역 중 실천 점수가 무상급식 이용군(66.0 ± 16.4)이 비이용군(55.2 ± 15.5)보다 유의하게 높게 나타났다 (P = 0.016). 또한 실천 등급 분포에서도 이용군에서는 '상' 등급 비율(36.4%)이 높고, 비이용군에서는 '하' 등급 비율(50.0%)이 유의적으로 높게 관찰되었다(P = 0.030). 한편 여성에서는 NQ-E 총점과 균형·절제 영역의 점수 및 등급 분포에서 두 집단 간 유의한 차이가 관찰되지 않았다.

4. 무상급식 이용과 영양지표의 관련성

1) NQ-E 관련성

무상급식 서비스 이용 여부와 NQ-E 간의 관계를 성별로 구분하여 다중선형회귀분석을 수행한 결과를 Table 4에 제시하였다. 남성의 경우 회귀모형의 설명력은 39.0%였으며, 무상급식 서비스 이용은 NQ-E 점수와 유의한 음의 관련이 관찰되었다(P = 0.007). 반면 여성의 경우 회귀모형의 설명력은 22.0%였으며, 무상급식 서비스 이용 여부와 NQ-E 점수 간 유의한 관련은 관찰되지 않았다(P = 0.719).

2) MAR 관련성

무상급식 서비스 이용 여부와 MAR 간의 관계를 성별로 구분하여 다중선형회귀분석을 수행한 결과를 Table 5에 제시하였다. 남성의 경우 회귀모형의 설명력은 62.3%였으며, 무상급식 서비스 이용은 MAR과 양의 관련 경향을 보였으나 통계적으로 유의하지 않았다(P = 0.085). 반면 여성의 경우 회귀모형의 설명력은 63.5%였으며, 무상급식 서비스 이용과 MAR 간 유의한 양의 관련이 관찰되었다(P = 0.010).

5. 식생활 관련 주관적 인식

1) 건강·영양·경제·사회·신체 요인 인식

무상급식 서비스 이용 여부에 따른 건강, 영양 상태 및 경제적·사회적·신체적 요인이 식사에 미치는 영향에 대한 주관적 인식 차이를 비교한 결과는 Table 6에 제시하였다. 건강 상태 인식은 여성에서 이용군의 '매우 좋음'과 '좋음' 응답은 각각 24.2%, 18.2%로 전체의 42.4%를 차지하였고, 비이용군에서는 '매우 좋음' 응답이 없었으며 '좋음'은 23.3%였다. 반대로 비이용군의 '매우 나쁨'과 '나쁨' 응답은 각각 10.0%, 36.7%로 전체의 46.7%를 차지하여 부정적 인식 비율이 더 높게 관찰되었다(P = 0.017). 남성에서는 유의한 차이가 관찰되지 않았다(P = 0.179). 영양 상태 인식은 여성 이용군에서 '좋음'과 '매우 좋음' 응답은 각각 21.2%, 18.2%로 전체의 39.4%였고, '보통'은 48.5%인 반면 비이용군에서는 '좋음' 10.0%, '매우 좋음' 3.3%였으며, '나쁨'과 '매우 나쁨' 응답이 전체의 40.0%로 부정적 인식 비율이 더 높게 관찰되었다(P = 0.031). 남성에서는 유의한 차이가 관찰되지 않았고(P = 0.330), 두 집단 모두에서 '보통' 응답이 가장 높은 비율(이용군 43.8%, 비이용군 58.3%)을 보였다.

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Table 1. General and physical characteristics of study participants

Variable	Men				Women			
	Total (n = 56)	Users (n = 32)	Non-users (n = 24)	*P*-value[1)]	Total (n = 63)	Users (n = 33)	Non-users (n = 30)	*P*-value[1)]
Number of participants	56 (100)	32 (57.1)	24 (42.9)	-	63 (100)	33 (52.4)	30 (47.6)	-
Age (year)	76.2 ± 6.8	75.3 ± 6.8	77.5 ± 6.7	0.277	81.8 ± 6.8	82.8 ± 5.6	80.7 ± 7.7	0.324
Education level				< 0.001				0.307
No formal education	5 (8.9)	5 (15.6)	0 (0.0)		14 (22.2)	7 (21.2)	7 (23.3)	
Elementary school graduate	9 (16.1)	5 (15.6)	4 (16.7)		22 (34.9)	13 (39.4)	9 (30.0)	
Middle school graduate	12 (21.4)	12 (37.5)	0 (0.0)		17 (27.0)	6 (18.2)	11 (36.7)	
High school graduate	20 (35.7)	6 (18.8)	14 (58.3)		10 (15.9)	7 (21.2)	3 (10.0)	
University graduate	9 (16.1)	4 (12.5)	5 (20.8)		0 (0.0)	0 (0.0)	0 (0.0)	
Graduate school or above	1 (1.8)	0 (0.0)	1 (4.2)		0 (0.0)	0 (0.0)	0 (0.0)	
Housing ownership type				< 0.001				< 0.001
Owned	29 (51.8)	6 (18.8)	23 (95.8)		29 (46.0)	8 (24.2)	21 (70.0)	
Lease	4 (7.1)	4 (12.5)	0 (0.0)		10 (15.9)	5 (15.2)	5 (16.7)	
Monthly rent	18 (32.1)	17 (53.1)	1 (4.2)		20 (31.7)	16 (48.5)	4 (13.3)	
Facility	2 (3.6)	2 (6.3)	0 (0.0)		0 (0.0)	0 (0.0)	0 (0.0)	
Unknown	3 (5.4)	3 (9.4)	0 (0.0)		4 (6.3)	4 (12.1)	0 (0.0)	
Economic status				0.001				0.293
Very good	2 (3.6)	1 (3.1)	1 (4.2)		0 (0.0)	0 (0.0)	0 (0.0)	
Good	6 (10.7)	3 (9.4)	3 (12.5)		7 (11.1)	4 (12.1)	3 (10.0)	
Average	31 (55.4)	12 (37.5)	19 (79.2)		32 (50.8)	16 (48.5)	16 (53.3)	
Poor	15 (26.8)	14 (43.8)	1 (4.2)		21 (33.3)	13 (39.4)	8 (26.7)	
Very poor	2 (3.6)	2 (6.3)	0 (0.0)		3 (4.8)	0 (0.0)	3 (10.0)	
Frequency of contact with family/friends				0.276				0.091
Hardly ever	7 (12.5)	6 (18.8)	1 (4.2)		7 (11.1)	4 (12.1)	3 (10.0)	
1–2 times a month	9 (16.1)	3 (9.4)	6 (25.0)		3 (4.8)	1 (3.0)	2 (6.7)	
1–2 times a week	14 (25.0)	7 (21.9)	7 (29.2)		15 (23.8)	4 (12.1)	11 (36.7)	
Almost every day	22 (39.3)	14 (43.8)	8 (33.3)		33 (52.4)	22 (66.7)	11 (36.7)	
Several times a day	4 (7.1)	2 (6.3)	2 (8.3)		5 (7.9)	2 (6.1)	3 (10.0)	
Meal preparation ability				0.398				0.071
Not difficult at all	26 (46.4)	14 (43.8)	12 (50.0)		35 (55.6)	23 (69.7)	12 (40.0)	
Slightly difficult	15 (26.8)	8 (25.0)	7 (29.2)		20 (31.7)	8 (24.2)	12 (40.0)	
Fairly difficult	8 (14.3)	7 (21.9)	1 (4.2)		7 (11.1)	2 (6.1)	5 (16.7)	
Almost unable	5 (8.9)	2 (6.3)	3 (12.5)		1 (1.6)	0 (0.0)	1 (3.3)	
Completely unable	2 (3.6)	1 (3.1)	1 (4.2)		0 (0.0)	0 (0.0)	0 (0.0)	
Number of chronic diseases				0.259				0.718
None	11 (19.6)	8 (25.0)	3 (12.5)		3 (4.8)	1 (3.0)	2 (6.7)	
1 chronic disease	16 (28.6)	9 (28.1)	7 (29.2)		18 (28.6)	8 (24.2)	10 (33.3)	
2 chronic disease	12 (21.4)	4 (12.5)	8 (33.3)		13 (20.6)	7 (21.2)	6 (20.0)	
3 or more chronic diseases	17 (30.4)	11 (34.4)	6 (25.0)		29 (46.0)	17 (51.5)	12 (40.0)	
Height (cm)	165.6 ± 5.6	165.0 ± 6.6	166.4 ± 3.7	0.405	154.0 ± 5.6	152.8 ± 6.3	155.3 ± 4.6	0.085
Weight (kg)	64.9 ± 7.4	64.4 ± 8.9	65.5 ± 4.8	0.435	54.2 ± 9.3	53.2 ± 7.0	55.3 ± 11.4	0.490
BMI (kg/m^2)[2)]				0.730				0.110
Underweight	1 (1.8)	1 (3.1)	0 (0.0)		6 (9.5)	2 (6.1)	4 (13.3)	
Normal	23 (41.1)	13 (40.6)	10 (31.3)		27 (42.9)	13 (39.4)	14 (46.7)	
Pre-obese	17 (30.4)	10 (31.3)	7 (29.2)		17 (27.0)	13 (39.4)	4 (13.3)	
Obese Class I	13 (23.2)	6 (18.8)	7 (29.2)		11 (17.5)	5 (15.2)	6 (20.0)	
Obese Class II	2 (3.6)	2 (6.3)	0 (0.0)		2 (3.2)	0 (0.0)	2 (6.7)	
Obese Class III	0 (0.0)	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)	0 (0.0)	

n (%) or Mean ± SD.

BMI, body mass index.

[1)]*P*-values were estimated using Fisher's exact test and the Mann-Whitney U test.

[2)]Obesity classification: underweight (< 18.5 kg/m^2), normal (18.5–22.9 kg/m^2), pre-obesity (23.0–24.9 kg/m^2), obesity class I (25.0–29.9 kg/m^2), obesity class II (30.0–34.9 kg/m^2), and obesity class III (≥ 35 kg/m^2).

Table 2. Nutritional quality indices (INQ, MAR) from 24-hour dietary recall

Variable	Men				Women			
	Total (n = 56)	Users (n = 32)	Non-users (n = 24)	*P*-value[1)]	Total (n = 63)	Users (n = 33)	Non-users (n = 30)	*P*-value[1)]
INQ[2)]								
Protein (g)	1.3 ± 0.3	1.3 ± 0.4	1.2 ± 0.3	0.655	1.1 ± 0.3	1.2 ± 0.2	1.1 ± 0.3	0.165
Ca (mg)	1.0 ± 0.4	1.1 ± 0.4	0.9 ± 0.4	0.132	0.7 ± 0.3	0.7 ± 0.4	0.6 ± 0.3	0.536
P (mg)	1.8 ± 0.4	1.8 ± 0.4	1.9 ± 0.3	0.529	1.4 ± 0.3	1.4 ± 0.2	1.3 ± 0.4	0.322
Fe (mg)	2.1 ± 1.7	2.0 ± 0.8	2.1 ± 2.5	0.055	1.6 ± 0.5	1.7 ± 0.6	1.4 ± 0.4	0.074
Zn (mg)	0.9 ± 0.3	0.9 ± 0.3	0.9 ± 0.3	0.817	0.9 ± 0.3	1.0 ± 0.3	0.8 ± 0.4	0.012
Vitamin A (μg RAE)	0.8 ± 0.7	0.9 ± 0.9	0.6 ± 0.5	0.180	0.7 ± 0.6	0.9 ± 0.7	0.5 ± 0.4	< 0.001
Vitamin B_1 (mg)	1.3 ± 0.4	1.3 ± 0.4	1.2 ± 0.3	0.037	1.3 ± 0.5	1.4 ± 0.5	1.2 ± 0.5	0.296
Vitamin B_2 (mg)	1.1 ± 0.5	1.2 ± 0.6	1.0 ± 0.3	0.024	1.1 ± 0.3	1.2 ± 0.3	1.0 ± 0.4	0.019
Vitamin B_6 (mg)	0.3 ± 0.3	0.3 ± 0.3	0.3 ± 0.3	0.791	0.2 ± 0.2	0.2 ± 0.2	0.2 ± 0.2	0.231
Vitamin B_{12} (μg)	1.5 ± 1.2	1.5 ± 1.4	1.4 ± 1.0	0.631	1.2 ± 1.8	0.8 ± 0.5	1.5 ± 2.5	0.308
Niacin (NE) (mg)	1.0 ± 0.4	0.9 ± 0.4	1.1 ± 0.3	0.059	0.9 ± 0.3	0.9 ± 0.4	0.8 ± 0.3	0.052
Vitamin C (mg)	1.2 ± 2.0	1.3 ± 2.3	1.1 ± 1.7	0.132	0.9 ± 0.9	0.9 ± 0.9	0.8 ± 1.0	0.104
Folate (DFE) (μg)	1.0 ± 0.6	1.1 ± 0.7	1.0 ± 0.5	0.631	0.8 ± 0.4	0.9 ± 0.4	0.7 ± 0.3	0.032
MAR[3)]	0.7 ± 0.2	0.8 ± 0.2	0.6 ± 0.2	< 0.001	0.6 ± 0.2	0.7 ± 0.2	0.5 ± 0.2	< 0.001

Mean ± SD.
INQ, index of nutritional quality; MAR, mean adequacy ratio; μg RAE, μg retinol activity equivalent; NE, niacin equivalent; DFE, dietary folate equivalent.
1)*P*-values were estimated using the Mann-Whitney U test.
2)INQ was calculated as the ratio of nutrient intake per 1,000 kcal to the recommended intake per 1,000 kcal.
3)Nutrient adequacy ratio (NAR) was calculated by dividing nutrient intake by the recommended intake, with values restricted to 1. MAR represents the mean NAR across 13 nutrients: protein, calcium, phosphorus, iron, zinc, vitamin A, vitamin B_1, vitamin B_2, vitamin B_6, vitamin B_{12}, niacin, vitamin C, and folate.

경제적 요인은 남성의 경우 '거의 영향 없음'은 이용군 9.4%, 비이용군 41.7%였고, '영향 있음' 이상('영향 있음'과 '매우 영향 있음') 응답 비율은 이용군 37.6%, 비이용군 12.5%였다(P = 0.041). 여성의 경우 이용군에서 '전혀 영향 없음' 33.3%, '영향 없음' 3.0%, '영향 있음' 이상 39.4%로 나타났으며, 비이용군에서는 '전혀 영향 없음' 6.7%, '영향 없음' 16.7%, '영향 있음' 이상 36.7%로 나타났다(P = 0.013). '영향 있음' 이상 비율은 이용군 39.4%, 비이용군 36.7%로 유사한 수준으로 관찰되었다. 사회적·신체적 요인에 대해서는 남녀 모두에서 유의한 차이가 관찰되지 않았다.

2) 자각된 건강 상태, 영양 상태 및 식생활 관련 주관적 인식차이

무상급식 서비스 이용 여부에 따른 자각된 건강 상태, 영양 상태 및 식생활 관련 주관적 인식차이를 Fig. 1에 제시하였다. 남성의 경우 이용군과 비이용군 간 평균 점수는 각 항목에서 유사하게 나타났으며, 모든 항목에서 통계적으로 유의한 차이는 확인되지 않았다. 자각된 건강 및 영양 상태는 두 집단 모두 약 3점대 중반으로 '보통' 수준이었고, 경제적·사회적·신체적 요인에 대한 인식은 대체로 '보통'과 '영향 없음' 사이에 분포하였다. 여성의 경우 건강 상태(P < 0.05), 영양 상태(P < 0.01), 사회적 요인(P < 0.05), 신체적 요인(P < 0.05)에서 이용군은 비이용군보다 통계적으로 유의하게 더 긍정적인 인식을 보여 평균 점수가 높게 관찰되었다. 한편 경제적 요인에서는 두 집단 간 유의한 차이가 관찰되지 않았다(P = 0.265).

DISCUSSION

본 연구에서는 인천광역시에 거주하는 독거노인을 대상으로 무상급식 서비스 이용 여부에 따른 영양상태, 식습관, 경제·사회·신체 요인 인식을 비교하였다. 무상급식 이용군은 비이용군보다 INQ에서 남성 이용군의 비타민 B_1, 비타민 B_2, 여성 이용군의 아연, 비타민 A, 비타민 B_2, 엽산이 유의하게 높게 관찰되었으며, MAR 역시 남녀 모두 이용군이 더 높게 관찰되었다. 이러한 결과는 서울시 취약계층 노인에게 맞춤형 영양교육과 보충식품 제공을 4개월간 제공했을 때 에너지, 단백질, 비타민, 무기질 섭취가 유의하게 증가하고 식품불안정성 개선이 관찰된 국내 근거와 방향이 일치한다[20]. 또한 MacMillan Uribe 등[21]은 기부연동형 커뮤니티 식사 프로그램(pay-what-you-can)에서 제공된 식사의 질(HEI-2020)이 전날 동일 끼니의 자가섭취식보다 우수함을 보고했으며, 이는 제공식의 질적 우위가 MAR 향상과 연관될 수 있음을 시사한다. 한편 Ullevig 등[22]은 미국 가정배달식사(home-delivered meals, HDM) 연구에서 3개월 추적 후 영양위험도 감소와 마그네슘(26%→44%)·아연(42%→65%)의 권장섭취량 충족률 개선이 관찰되어, 영양지원

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Table 3. Total and subdomain scores and levels of the NQ-E

Variable	Total (n = 56)	Men		*P*-value[1)]	Total (n = 63)	Women		*P*-value[1)]
		Users (n = 32)	Non-users (n = 24)			Users (n = 33)	Non-users (n = 30)	
NQ-E score								
Nutrition Index	53.9 ± 15.2	50.2 ± 14.5	58.9 ± 14.9	0.051	56.2 ± 13.5	59.3 ± 12.0	52.8 ± 14.4	0.107
Balance	47.8 ± 20.2	44.0 ± 19.0	53.0 ± 20.9	0.143	52.3 ± 17.5	55.9 ± 17.6	48.4 ± 16.9	0.132
Moderation	53.3 ± 37.2	45.7 ± 37.2	63.3 ± 35.3	0.098	61.2 ± 33.3	54.1 ± 32.0	69.0 ± 33.4	0.162
Practice	63.7 ± 18.1	61.3 ± 21.3	66.8 ± 12.5	0.337	60.9 ± 16.7	66.0 ± 16.4	55.2 ± 15.5	0.016
NQ-E score (level)				0.354				0.590
High	22 (39.3)	10 (31.3)	12 (50.0)		29 (46.0)	17 (51.5)	12 (40.0)	
Medium	21 (37.5)	13 (40.6)	8 (33.3)		22 (34.9)	11 (33.3)	11 (36.7)	
Low	13 (23.2)	9 (28.1)	4 (16.7)		12 (19.0)	5 (15.2)	7 (23.3)	
Balance score (level)				0.615				0.242
High	21 (37.5)	12 (37.5)	9 (37.5)		28 (44.4)	18 (54.5)	10 (33.3)	
Medium	20 (35.7)	10 (31.3)	10 (41.7)		25 (39.7)	11 (33.3)	14 (46.7)	
Low	15 (26.8)	10 (31.3)	5 (20.8)		10 (15.9)	4 (12.1)	6 (20.0)	
Moderation score (level)				0.329				0.141
High	23 (41.1)	11 (34.4)	12 (50.0)		28 (44.4)	11 (33.3)	17 (56.7)	
Medium	13 (23.2)	7 (21.9)	6 (25.0)		26 (41.3)	17 (51.5)	9 (30.0)	
Low	20 (35.7)	14 (43.8)	6 (25.0)		9 (14.3)	5 (15.2)	4 (13.3)	
Practice score (level)				0.243				0.030
High	21 (37.5)	11 (34.4)	10 (41.7)		15 (23.8)	12 (36.4)	3 (10.0)	
Medium	19 (33.9)	9 (28.1)	10 (41.7)		24 (38.1)	12 (36.4)	12 (40.0)	
Low	16 (28.6)	12 (37.5)	4 (16.7)		24 (38.1)	9 (27.3)	15 (50.0)	

Mean ± SD or n (%).
NQ-E, Nutrition Quotient for the Elderly.
[1)]*P*-values were estimated using the chi-square test or Fisher's exact test (if expected counts < 5) for categorical variables, and the Mann-Whitney U test for continuous variables.

Table 4. Multiple linear regression of the NQ-E in relation to free meal service use

	Variable	B (unstandardized)	SE	β (standardized)	t	*P*-value
Men	(Intercept)	45.059	22.649	-	1.990	0.052
	Use of free meal service	−11.170	3.948	−0.368	−2.829	0.007
				Adjusted R^2 = 0.390, F = 5.389		
Women	(Intercept)	37.161	25.796	-	1.441	0.155
	Use of free meal service	1.323	3.657	0.05	0.362	0.719
				Adjusted R^2 = 0.220, F = 3.180		

NQ-E, Nutrition Quotient for the Elderly; B, unstandardized coefficient; SE, standard error; β, standardized coefficient; t, t-statistic testing.
The model was adjusted for age, education level (ref.: rarely/never attended school), energy intake, food security status (ref.: sufficient quantity and variety), breakfast frequency (ref.: 5–7 days/week), contact frequency (ref.: rarely/almost never), and physical difficulty (ref.: none/no effect on eating).

서비스 참여가 영양 상태 지표 개선에 기여할 가능성을 시사했지만, 총에너지와 다수 영양소 평균 섭취의 단기 변화는 통계적으로 유의하지 않은 결과도 확인되었다. 따라서 단기간의 섭취 개선은 일관되게 확인되지 않으며, 효과의 크기와 일관성은 프로그램 유형, 기간, 제공 식사 구성 등에 따라 달라질 수 있다. 더불어 체계적 문헌고찰에 따르면 Walton 등[23]은 HDM과 일부 집단급식 개입에서, Campbell 등[24]은 HDM 개입에서 섭취·영양지표 개선이 보고되었으나, 지역, 대상, 개입설계의 이질성으로 근거의 전반적 일관성에는 한계가 있다고 평가한다. 즉, 효과의 방향성은 긍정적이나 효과의 크기와 재현성은 운영방식과 조건에 의해 좌우될 수 있음을 시사한다.

여성 이용군은 비이용군에 비해 NQ-E 실천 영역 평균점수가 유의하게 높은 것으로 보고되었다. 이러한 결과는 Kim & Hur [25]가 전국 독거노인 자료에서 NQ-E가 사회경제적 특성, 건강

Table 5. Multiple linear regression of the MAR in relation to free meal service use

	Variable	B (unstandardized)	SE	β (standardized)	t	*P*-value
Men	(Intercept)	0.736	0.209	-	3.525	< 0.001
	Use of free meal service	0.064	0.036	0.180	1.757	0.085
			Adjusted R^2 = 0.623, F = 12.364			
Women	(Intercept)	0.696	0.277	-	2.513	0.015
	Use of free meal service	0.105	0.039	0.251	2.684	0.010
			Adjusted R^2 = 0.635, F = 14.468			

MAR, mean adequacy ratio; B, unstandardized coefficient; SE, standard error; β, standardized coefficient; t, t-statistic testing.
The model was adjusted for age, education level (ref.: rarely/never attended school), energy intake, food security status (ref.: sufficient quantity and variety), breakfast frequency (ref.: 5–7 days/week), contact frequency (ref.: rarely/almost never), and physical difficulty (ref.: none/no effect on eating).

Table 6. Perceived health, nutrition, and diet-related factors by free meal service use

Variable	Total (n = 56)	Men		*P*-value[1)]	Total (n = 63)	Women		*P*-value[1)]
		Users (n = 32)	Non-users (n = 24)			Users (n = 33)	Non-users (n = 30)	
Perceived health status				0.179				0.017
Very poor	5 (8.9)	4 (12.5)	1 (4.2)		3 (4.8)	0 (0.0)	3 (10.0)	
Poor	10 (17.9)	7 (21.9)	3 (12.5)		21 (33.3)	10 (30.3)	11 (36.7)	
Fair	15 (26.8)	6 (18.8)	9 (37.5)		18 (28.6)	9 (27.3)	9 (30.0)	
Good	19 (33.9)	9 (28.1)	10 (41.7)		13 (20.6)	6 (18.2)	7 (23.3)	
Very good	7 (12.5)	6 (18.8)	1 (4.2)		8 (12.7)	8 (24.2)	0 (0.0)	
Perceived nutritional status				0.330				0.031
Very poor	1 (1.8)	1 (3.1)	0 (0.0)		2 (3.2)	1 (3.0)	1 (3.3)	
Poor	4 (7.1)	4 (12.5)	0 (0.0)		14 (22.2)	3 (9.1)	11 (36.7)	
Fair	28 (50.0)	14 (43.8)	14 (58.3)		30 (47.6)	16 (48.5)	14 (46.7)	
Good	17 (30.4)	9 (28.1)	8 (33.3)		10 (15.9)	7 (21.2)	3 (10.0)	
Very good	6 (10.7)	4 (12.5)	2 (8.3)		7 (11.1)	6 (18.2)	1 (3.3)	
Perceived economic factors				0.041				0.013
Not at all influential	16 (28.6)	10 (31.3)	6 (25.0)		13 (20.6)	11 (33.3)	2 (6.7)	
Hardly influential	13 (23.2)	3 (9.4)	10 (41.7)		6 (9.5)	1 (3.0)	5 (16.7)	
Neutral	12 (21.4)	7 (21.9)	5 (20.8)		20 (31.7)	8 (24.2)	12 (40.0)	
Influential	13 (23.2)	10 (31.3)	3 (12.5)		17 (27.0)	11 (33.3)	6 (20.0)	
Very influential	2 (3.6)	2 (6.3)	0 (0.0)		7 (11.1)	2 (6.1)	5 (16.7)	
Perceived social factors				0.084				0.121
Not at all influential	29 (51.8)	16 (50.0)	13 (54.2)		32 (50.8)	21 (63.6)	11 (36.7)	
Hardly influential	14 (25.0)	5 (15.6)	9 (37.5)		7 (11.1)	2 (6.1)	5 (16.7)	
Neutral	6 (10.7)	4 (12.5)	2 (8.3)		11 (17.5)	5 (15.2)	6 (20.0)	
Influential	5 (8.9)	5 (15.6)	0 (0.0)		10 (15.9)	5 (15.2)	5 (16.7)	
Very influential	2 (3.6)	2 (6.3)	0 (0.0)		3 (4.8)	0 (0.0)	3 (10.0)	
Perceived physical factors				0.349				0.117
Not at all influential	24 (42.9)	14 (43.8)	10 (41.7)		24 (38.1)	17 (51.5)	7 (23.3)	
Hardly influential	8 (14.3)	4 (12.5)	4 (16.7)		6 (9.5)	4 (12.1)	2 (6.7)	
Neutral	11 (19.6)	4 (12.5)	7 (29.2)		10 (15.9)	4 (12.1)	6 (20.0)	
Influential	11 (19.6)	8 (25.0)	3 (12.5)		18 (28.6)	6 (18.2)	12 (40.0)	
Very influential	2 (3.6)	2 (6.3)	0 (0.0)		5 (7.9)	2 (6.1)	3 (10.0)	

n (%).
[1)]*P*-values were estimated using Fisher's exact test.

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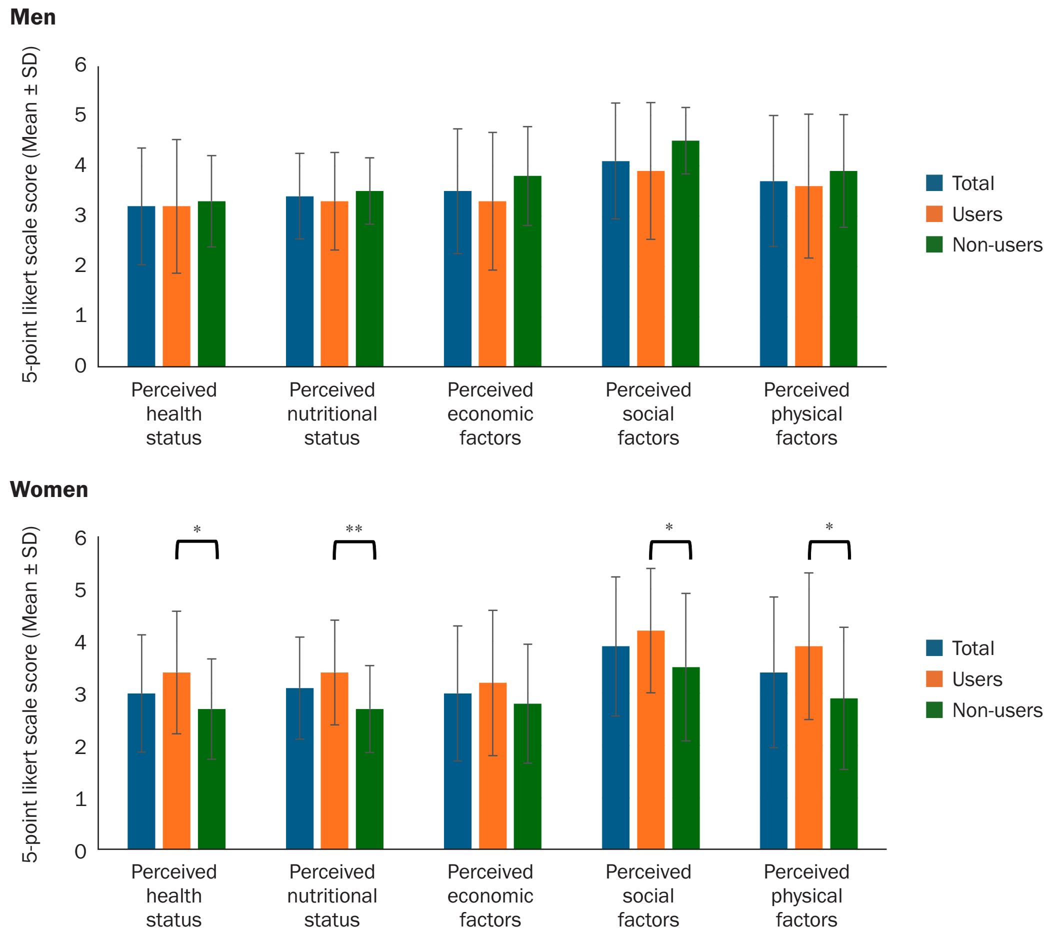

Fig. 1. Perceived health, nutritional status, and diet-related factors according to free meal service use among men and women. *P*-values were estimated using the Mann-Whitney U test. Perceived health and nutritional status were rated on a 5-point likert scale: 1 = very poor, 2 = poor, 3 = fair, 4 = good, 5 = very good. Perceived economic, social, and physical factors were rated on a 5-point likert scale: 1 = very influential, 2 = influential, 3 = neutral, 4 = hardly influential, 5 = not at all influential. *$P < 0.05$, **$P < 0.01$.

행태, 사회적 지지 요인과 유의하게 관련된다고 보고한 바와 일치하며, Seo [26]도 창원시 여성노인을 대상으로 사회적 노쇠가 심할수록 NQ-E가 낮고, 건강한 식생활 노력, 운동시간, 우울, 주관적 건강 등 식생활 관련 지표가 불리하게 나타났다고 보고하여 본 연구와 방향이 부합한다. 또한 지역사회 노인 자료에서 여성이 남성보다 NQ-E의 절제·식행동 점수가 높고, 소득, 교육수준에 따라 다양성, 절제 점수가 달라지는 경향이 보고되어 본 연구의 여성에서 관찰된 유의한 차이를 뒷받침한다[27]. 한편 행동, 지각 지표는 개입 형태와 참여 방식에 민감하므로 해석에 주의가 필요하다. 실제로 Lee 등[28]은 대면 집단 급식과 대면 활동을 결합한 전통형에서는 6개월 추적 시 식품불안정과 자가평가 건강 및 외로움 지표에서 통계적으로 유의한 변화가 확인되지 않았지만, 포장식과 온라인 활동을 병행한 비대면 참여형에서는 식품불안정이 감소하고 자가평가 건강 개선이 유의하게 관찰되었다고 보고하였다. 다만 행동, 지각 지표에 대한 근거는 연구설계, 대상, 평가지표의 이질성과 핵심 정보의 불충분 보고로 인해 일관된 일반화에 한계가 있다는 지적이 있다[24, 29]. 따라서 본 연구의 결과는 행동적 실효성의 단서로 해석 가능하되, 인과성 판단에는 추가 연구가 필요하다.

다중선형회귀분석에서 남성은 무상급식 이용과 NQ-E 사이에 음의 관련, 여성은 무상급식 이용과 MAR 사이에 유의한 양의 관련이 나타났다. 지역 노인을 대상으로 한 연구에서는 NQ-E가 교육수준, 소득이 단변량에서는 유의했으나, 다중선형회귀에서는 유의성이 약화되었다[30]. 반면 Kim & Hur [25]의 전국독거노인 자료 분석에서는 다중선형회귀에서 저소득층(수급/차상위)은 유의하지 않았고, 무학이 아님, 경제상태 만족도

높음, 식비 비중이 높은 경우 등 체감 경제 지표가 유의했다. 이러한 결과는 NQ-E가 단기간의 섭취 변화보다는 평소의 식생활 양상과 인식, 생활환경을 반영하는 지표임을 시사한다. 본 연구의 일반 특성에서 남성 비이용군의 교육수준이 높고 주관적 경제형편이 상대적으로 양호했던 점을 고려하면, NQ-E 점수는 무상급식 이용 여부뿐만 아니라 개인의 기존 식생활 여건에 영향을 받을 가능성이 있다. NAR과 MAR은 24시간 회상법을 기반으로 한 섭취 중심의 영양상태 지표로, 무상급식 이용에 따른 실제 섭취량 증가가 비교적 직접적으로 반영될 수 있다. 반면 NQ-E는 식행동과 식생활 환경을 포함한 설문 기반 평가도구이므로, 무상급식 이용 여부와는 독립적으로 나타날 가능성이 있다. 이러한 지표 특성의 차이로 인해 무상급식 이용군에서 섭취 기반 지표는 개선된 반면, NQ-E에서는 상대적으로 낮은 점수가 관찰되었을 가능성이 있다. 이는 무상급식 서비스가 단기적인 영양소 섭취 개선에는 기여할 수 있으나, 평소 식생활 전반을 반영하는 지표에는 즉각적인 변화로 나타나지 않을 수 있음을 시사한다.

여성에서 관찰된 무상급식 이용과 MAR의 양의 관련은 Tsofliou 등[31]이 보고한 영국 lunch club 참석일의 에너지 및 다수 영양소 섭취가 비참석일보다 유의하게 높다는 결과와 방향이 같다. 참석일의 섭취 증가는 당일 MAR에 반영될 수 있다. 식사 지원에 대한 체계적 문헌 고찰에서는 섭취와 일부 영양상태, 식품군(다양성) 지표의 개선을 보고하는 한편 연구설계, 대상, 평가 도구의 이질성과 개입 빈도, 내용 보고의 불충분으로 근거의 전반적 일관성에 제약이 있음을 지적한다. 이는 행동 지표(NQ-E)와 섭취 지표(MAR)가 프로그램 특성, 대상 특성에 따라 서로 다른 시간척도, 경로로 반응할 수 있음을 시사한다[29]. NQ-E는 대상의 성별, 사회경제 요인 영향에 민감한 지표로 해석되며, MAR은 제공식의 질과 프로그램 참여 효과와 상대적으로 직접적인 연관이 시사된다.

본 연구에서 이용군은 영양 불균형 개선, 경제적 부담 완화, 사회적 고립 감소, 신체·정신 건강 증진을 비이용군보다 더 긍정적으로 인식하였다. HDM 무작위 배정 연구에서는 15주 추적 시 식사 제공군의 외로움 점수가 대기군보다 낮았고, 특히 주 1회 배달군보다 매일 배달군에서 '서비스가 외로움 개선에 도움이 되었다'는 자가평가가 더 높게 보고되어 본 연구에서 관찰된 사회적 고립 감소 인식과 방향이 같다[32]. 경제적 부담 완화 인식 또한 노인의 식품미보장이 독거, 저소득, 주관적 건강 불량과 유의하게 연관되고, 무료급식 이용이 식품미보장 가능성을 유의하게 낮춘다는 보고와 맥락을 같이한다[33]. 더불어 연령집단 분석에서 여성, 독거, 건강상태 불량이 식품미보장과 연관되는 결과[34]와 저소득, 저학력, 독거 노인에서 식품불안정과 저작불편이 높고, 식품불안정이 저작불편과의 관계를 부분 매개한다는 결과[35]는 경제, 건강 취약성이 인식 차이에 영향을 미칠 수 있음을 시사한다. 다만 위 HDM 근거는 배달식 개입 연구인 반면 본 연구는 대면 집합급식에 대한 주관적 인식 조사이므로 개입 형태가 달라 직접 일반화에는 주의가 필요하다[32]. 정책적으로는 식품 미보장 고위험군(독거, 저소득, 주관적 건강 불량)을 선별, 연계하고, 대면 집합급식 맥락에서 영양교육, 개별상담, 또래 상호작용 활동, 소그룹 대화, 동행, 안부 확인 등을 강화하여 지속적 참여와 사회적 고립감 완화를 도모할 필요가 있다.

한편, 서비스의 효과가 지속되기 위해서는 운영 및 위생관리 측면의 기반 강화도 필수적이다. Sung & Lee [36]의 운영 실태 연구에 따르면 운영자 보고에서 배달형 서비스의 건강식 제공이 인력, 조리시설, 예산 한계로 어렵다는 점이 확인되었다. 또한 경로당 서비스의 건강식 제공의 주요 장애요인으로 인력 부족, 조리시설 한계, 시간 부족이 확인되었다. Choi 등[37]은 전반적 위생·안전관리 수준은 높았지만, 세부 항목 가운데 생채소 소독, 조리온도 기록 등은 이행 수준이 낮아 개선이 필요한 영역으로 확인되었다. 가정배달 급식 영역에서 Choi & Yi [38]는 중요도-수행도 분석을 통해 '중요도는 높으나 수행은 낮은' 위생 항목으로 배식, 폐기 시간 기준 설정, 회수 용기 완전 건조가 확인되어 지속적인 교육과 통합 위생관리 매뉴얼 등 표준화의 필요를 제안하였다. 또한 Choi & Yi [39]는 생산-포장-보관-배달 단계별 위생지식 수행도 평가에서 위생지식과 위생수행에서 종사자 점수가 자원봉사자보다 유의하게 높다고 보고하며, 자원봉사자를 포함한 전 단계 참여 인력을 대상으로 반복적 위생 교육을 시행하고, 교육 후 이해, 실천 여부에 대한 지속 모니터링과 피드백을 통한 재교육 등 체계적 통제의 도입을 요구하였다. 정책 보고서에서도 지역 간 격차, 인력 부족, 질 관리 한계가 지적되며, 공급 역량 제고가 병행되어야 함이 강조된다[40,41]. 따라서 단기적으로는 메뉴의 다양화와 위생 취약 항목 보완을 우선 시행하고, 중·장기적으로는 인력, 시설, 예산 확충과 교육, 모니터링을 포함한 표준화된 위생, 품질 관리를 병행하는 접근이 요구된다.

Limitations

본 연구는 다음과 같은 제한점을 가진다. 첫째, 본 연구는 단면연구 설계로 인해 무상급식 이용이 영양상태나 인식에 인과적으로 미치는 영향을 단정할 수 없다. 둘째, 분석 대상자가 인천광역시에 한정되어 있고, 표본 수가 충분하지 않아 연구 결과를 전체 독거노인 집단으로 일반화하는데 제한이 있을 수 있다. 셋째, 24시간 회상법과 설문조사는 응답자의 기억에 의존하기 때문에 회상 오류나 편향의 가능성이 있으며, 이는 자료의 정확성과 신뢰도에 일정 부분 영향을 미쳤을 수 있다. 그럼에도 불구하고, 본 연구는 독거노인을 대상으로 무상급식 서비스 이용 여부에 따른 영양상태와 인식의 차이를 분석함으로써 정책 설계에 참고할 수 있는 근거를 제시했다. 향후에는 보다 다양한 지역과 인구집단을 포함한 후속 연구를 통해 무상급식 참여 과정

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에서의 변화와 장기적 효과를 심층적으로 규명할 필요가 있다.

Conclusion

본 연구는 인천 지역 독거노인을 대상으로 무상급식 서비스 이용 여부에 따른 영양지표(NQ-E, INQ, MAR)와 관련 인식지표를 비교, 분석하였다. 분석 결과, 무상급식 서비스는 영양 상태와 식사 관련 인식에 긍정적 영향을 줄 수 있음을 시사하였다. 따라서 무상급식 서비스는 독거, 저소득, 주관적 건강 불량, 식품불안정 등 고위험군 중심의 우선 배정 체계를 마련할 필요가 있다. 또한, 영양밀도 제고, 저작, 연하 곤란 및 기호도 반영 메뉴, 저염, 저당 조리 지침의 제도화와 함께 영양교육 및 상담, 또래 상호작용 등 맞춤형 지원과 사회적 교류 강화가 병행될 때 서비스의 실효성이 더욱 높아질 것으로 판단된다.

CONFLICT OF INTEREST

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

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DATA AVAILABILITY

The survey data that support the findings of this study are not publicly available due to ethical and privacy considerations, as participants did not provide consent for public data sharing. However, anonymized data that do not contain identifiable individual-level information are available from the authors upon reasonable request.

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Research Article

노인 대상 디지털 기반 자가영양관리 영양교육 프로그램 개발을 위한 요구도 조사

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A needs assessment for the development of a digital-based self-nutrition management education program for older adults in Korea: a cross-sectional study

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Objectives: This study aimed to investigate the current status of nutrition management and digital utilization, the demand for e-learning nutrition education, and the factors influencing e-learning nutrition education among older adults.
Methods: A total of 500 older adults aged 65–84 years, registered as panelists with a professional survey agency, participated in an online survey. Chi-square and independent samples t-tests were used to examine gender differences. Correlations between participants' general characteristics and the major variables were analyzed. Based on the results, a moderated regression analysis was conducted to identify how the general characteristics significantly associated with the intention to use e-learning nutrition education functioned as moderators.
Results: Significant gender differences were observed in nutrition education experience, interest and practice of nutrition management, barriers, and digital device utilization (all $P < 0.05$). Exploratory factor analysis identified four sub-factors for education needs: 'Self-directed well-being practice education', 'Dietary therapy for major chronic diseases', 'Nutri-

tion strategy for longevity and anti-aging', and 'Enhancing nutrition literacy education'. In Model 1, the need for digital education, interest in nutrition management, and gender were significantly associated with usage intention (all $P < 0.05$), whereas health-promoting behavior showed marginal significance ($P = 0.06$). Although the Model 2 interaction was significant, the change in explanatory power was negligible (Delta $R^2 = 0.003$), and all interaction terms were non-significant ($P > 0.05$), indicating that the relationships are not moderated by gender.
Conclusion: Although older adults exhibited high interest in nutrition management, their experience with nutrition education was limited. Significant gender differences in educational needs and health-promoting behaviors highlight the importance of tailored strategies. Enhancing digital accessibility and providing gender-specific, competency-based content are essential to effectively translate interest into behavioral change. This study underscores the importance of integrating gender-specific approaches, individual digital competencies, and inducement of health-promoting behaviors when developing e-learning nutrition education programs for older adults.

Keywords: education, distance; aged; needs assessment; health literacy; health behavior

INTRODUCTION

Global Industry Analysts의 보고서에 따르면, 글로벌 디지털 헬스케어 시장은 2020년 1,529억 달러에서 연평균 성장률 18.8%로 성장하여 2027년 5,088억 달러 규모에 이를 것으로 전망되고 있다[1]. 이 중 서비스 부문이 디지털 헬스케어 시장을 장악했으며 2023년에는 935억 달러, 2024년에는 1,228억 달러의 매출을 올릴 것으로 전망했다[2]. 더불어 World Health Organization이 발표한 자료에서 디지털 헬스케어는 만성질환 부담 증가에 대한 대응책으로 장기적인 건강 관리와 비용 대비 효과적인 수단이며 보건의료 서비스의 효과성, 질, 접근성을 크게 향상시키고 개인이 자신의 건강과 웰빙에 대해 더욱 큰 주체성을 갖도록 돕는다고 보고하였다[3]. 이와 같이 디지털 헬스케어의 발전은 만성질환 관리를 위한 해결방안으로 인식되고 있으며, 이에 따라 환자 대상의 의료 서비스가 건강관리를 목적으로 한 일반 수요자 중심의 서비스로 확장되고 있다[2, 4]. 이러한 변화는 특정한 집단에 대한 치료를 넘어, 불특정 다수의 개인 건강 데이터를 활용한 맞춤 서비스를 제공하는 형태로의 변화를 촉발하고 있다.

United Nations의 세계인구전망(2024) 보고서에서 2023년 전 세계에서의 65세 이상 인구가 2023년 8.1억 명에서 2100년 24.4억 명으로의 급증이 전망되었다[5]. 한국의 노인 인구는 2024년 19.2%에서 2025년 20.4%로 증가하여 초고령사회에 진입하였으며, 세계적인 고령화 흐름속에서 한국의 노인인구 부양부담은 2054년 Organisation for Economic Co-operation and Development 국가 중 가장 높은 수준을 보일 것으로 전망되고 있다[6, 7]. 한국의 노인 인구 급증으로 인한 부양부담으로 건강보험 급여비 비중이 2025년 48.9%에서 2070년 78.8%까지 증가함에 따라 막대한 국민 의료비, 장기 요양 서비스의 수요가 예측되고 있다[8]. 이러한 상황은 생산연령인구의 노인 부양 비용 증가, 국가 재정 부담, 의료 시스템의 지속가능성, 돌봄 서비스 지원 고갈 등의 사회경제적 문제로 작용할 수 있다[9]. 따라서 노인세대의 건강 관리는 사회적으로 중요한 부분이며, 노인이 생활속에서 질환, 건강 및 영양상태를 관리할 수 있는 환경 조성이 필요하다.

국가데이터처[10]의 '한국의 SDG 이행보고서 2025'에 따르면 노인의 영양섭취 부족자 비율이 2015년 8.3%로 계속 상승 추세를 보이다가 2020년 24.5%에서 2021년(22.8%), 2022년(18.2%) 소폭 감소하였으나, 2023년 19.3%로 다시 증가하였다. 이렇듯 노인세대의 영양섭취가 개선되는 듯 보였으나, 노인들은 노화로 인한 신체활동 제약, 저작 장애, 치아 결손의 경험을 통해 영양섭취의 어려움이 발생하게 됨과 동시에 고령화, 1인가구의 증가로 최근 노인세대 영양섭취 부족률이 다시 상승한 것으로 보인다[10-12]. 특히 독거노인의 경우 식사 패턴이 단순화되어 다양한 영양소 섭취 부족, 탄수화물 위주의 식단으로 이루어져 식사의 양과 질이 하락하게 되므로 노인세대에 대한 지속적인 영양관리가 필요하다[13]. 이와 관련된 선행연구를 통해 영양불량 상태인 노인의 영양관리는 체중, 영양상태, 신체 기능, 단백질 및 에너지 섭취, 근력을 개선하는 효과를 가져오며[14], 건강, 영양교육 프로그램은 노인의 영양지식과 식태도를 개선시킬 수 있음을 확인하였다[15]. 따라서 노인들이 스스로 건강을 관리하고 개선하도록 돕기 위해서는, 자립적인 영양관리 환경 조성과 지원을 바탕으로 건강행동의 지속성을 높이는 자기주도적 영양교육이 필요하다.

최근 정보통신 기술의 발전으로 키오스크 주문, 스마트폰 결제, 디지털 헬스케어 등의 디지털화가 급속도로 진행됨에 따라, 기존의 대면 중심의 매체에서 벗어나 동영상, 카드뉴스, 인포그래픽과 같은 비대면 중심의 매체의 활용이 증가하고 있으며, 이러한 변화는 노인 대상 영양교육 분야에도 적용되고 있다[16, 17]. 노인 대상 디지털 기반 개인 맞춤형 영양관리는 전화 또는 화상 영양상담과 영양정보 제공을 통한 자기주도학습, Internet of Things를 이용한 식사 및 수분 섭취 알림 등과 같은 방법으로 영양실조, 근감소증, 허약, 체중관리 등 노인세대에서 흔히 발생할 수 있는 영양적 문제 개선에 도움이 될 수 있다[18]. 또한, 건강관리 목적의 디지털 매체는 접근의 편리성에 더하여 사용자의 실제 생활을 반영한 개인별 건강상태 확인, 맞춤형 솔루션 제공이 가능하다[19, 20]. 이렇듯 디지털 기반 교육이 노인의 영양문제 개선을 위한 새로운 소통 방식으로 자리매김함에 따라, 생활밀착형 디지털 교육의 개발 방안은 노인 대상 디지털 기반 영양교육의 상용화를 효과적으로 촉진할 수 있을 것이라 기대된다.

이에 본 연구는 전국 만 65–84세 노인을 대상으로 온라인 설문조사를 실시하여 영양교육 및 관리 실태, 디지털 활용 및 문해력, 디지털 기반 영양교육 요구도를 확인하고, 디지털 영양교육 이용의사와 관련된 요인을 파악하고자 하였다. 이를 통해 노인의 자립적인 영양관리를 지원하기 위한 매체 구축의 일환으로, 노인 대상 디지털 기반 영양교육 프로그램 개발의 구체적 방안을 제시하고자 하였다.

METHODS

Ethics statement

This study was approved by the Institutional Review Board (IRB) of Chungnam National University (IRB No. 202411-SB-169-01). All participants were informed of the study purposes and protocols, and they provided written informed consent.

1. 연구설계

본 연구는 단면적 설문조사 연구로 STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) 보고지침을 참고하여 기술하였다(https://www.strobe-statement.org/).

2. 연구대상 및 기간

본 연구에서는 노인의 디지털 기반 자가영양관리 교육과정에 대한 교육 요구도를 파악하고자 설문조사 전문기관(㈜마크로밀 엠브레인)에 의뢰하여 2025년 5월 20일부터 5월 24일까지 총 5일간의 자료 수집을 수행하였다. 연구 대상은 해당 기관에 등록된 1,792,865명의 패널 중 전국의 만 65세 이상 85세 미만의 노인으로서, 스마트폰 사용이 가능하고 설문 내용을 이해하여 스스로 응답할 수 있는 자를 비확률 표본추출(nonprobability sampling) 방식 중 목적표본추출(purposive sampling)을 통해 선정되었다. 표본크기는 G-power 3.1.9.7 software를 사용하여 χ^2 tests (goodness-of-fit tests: contingency tables) 기준 효과크기(w) = 0.3, 유의수준(α) = 0.05, 검정력 = 0.95로 설정하여 산출하였으며, 산출된 최소 표본 수는 280명이었다. 본 조사를 통해 수집된 500명의 응답 자료는 누락 없이 모두 최종 분석 자료로 활용되었다.

3. 연구내용 및 방법

1) 일반적 특성

일반적 특성은 대상자의 성별, 나이, 거주지역, 교육수준, 진단질환의 5개 문항으로 구성하였다. 주관적 건강상태의 경우 Likert 5점 척도(1점: 전혀 그렇지 않다, 5점: 매우 그렇다)를 활용하여 조사하였다.

2) 건강증진행위

대상자가 더 높은 수준의 건강을 위해 건강한 생활 양식을 유지하고자 지속적으로 실천하는 행동의 정도를 파악하기 위해 선행연구[21-23]를 참고하였다. 본 도구는 6개의 하위 요인으로 영양 6문항, 스트레스 관리 5문항, 대인관계 지지 6문항, 운동 2문항, 건강책임 11문항, 자아실현 5문항의 총 35문항으로 구성되었다. 본 문항은 Likert 5점 척도(1점: 전혀 그렇지 않다, 5점: 매우 그렇다)를 이용하여 질문하였으며, 총점이 35–175점이고 점수가 높을수록 건강증진행위 수행 정도가 높은 것으로 해석된다.

3) 영양관리 실태 및 디지털 영양교육 요구도

디지털 기반 영양교육에 대한 대상자의 요구도를 측정하기 위해 선행연구[24-27]를 기반으로 척도를 활용하되 본 연구의 목적과 대상의 특성에 맞춰 문구의 가독성을 높이고 문맥을 조정하였다. 예를 들어, ‘건강 또는 영양에 관한 정보는 어디에서 얻으십니까?’라는 포괄적인 개념을 ‘주로 어떤 방법을 통해 영양관리에 대한 정보를 얻으십니까?’로 실천 영역으로 구체화하여 응답자의 이해를 돕고자 하였다. 또한 만 65세 이상 85세 미만 노인을 대상으로 진행한 표적집단면접(focus group interview; FGI) 결과[28]를 반영하여 설문 문항을 개발하였다. FGI 내용 분석 결과, 참여자들 대부분은 영양교육 경험이 부족하였으며, 경험이 있는 경우에는 주로 병원이나 지자체(보건소)에서 이루어진 것으로 확인되었다. 이에 ‘영양교육 경험 여부’, ‘교육 제공 기관’을 묻는 문항을 추가하였다. 또한 참여자들의 영양 관련 기초 지식 및 정확한 정보의 부족이 영양관리의 방해 요인으

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로 도출되어 이에 영양관리 시 느끼는 어려움에 관한 문항을 포함하였다. 면접 참여자들은 디지털 기반 영양교육에 대해 전반적으로 긍정적인 태도를 보임에 따라 '디지털 영양교육 프로그램의 필요도'와 '향후 이용의사'를 측정하는 문항도 반영하여 총 5개의 문항으로 구성하였다. 이 중 영양관리 관심도, 디지털 영양교육 주제 요구도, 디지털 영양교육 방식 선호도, 디지털 영양교육 제공 형식 선호도, 디지털 기반 자가영양관리 교육 필요도, 디지털 기반 자가영양관리 교육 이용의사 정도 항목의 경우 Likert 5점 척도(1점: 전혀 그렇지 않다, 5점: 매우 그렇다)를 사용하여 조사하였다.

4) 디지털 기기 활용도

조사대상자의 스마트폰 이용실태와 활용정도를 파악하기 위하여 모바일 기기 활용 및 이용수준에 관한 선행연구[29-32]를 참고하였다. 문항은 디지털 기기에 대한 주관적 사용 능력, 디지털 기기 사용 불편 정도, 디지털 기기 활용 정도 등의 22개로 구성하였다. 이 중 주관적 스마트폰 사용 능력, 디지털 기기 사용 불편 정도 항목은 Likert 5점 척도(1점: 전혀 그렇지 않다, 5점: 매우 그렇다)를 활용하여 조사하였다.

4. 자료분석

수집된 자료는 SPSS Statistics ver. 29.0.2.0 (IBM Co.)을 사용하였으며, 통계적 유의성은 P < 0.05로 정의하였다. 연구대상자의 일반적 특성, 영양관리 실태 및 디지털 영양교육 요구도, 디지털 기기 활용도 분석을 위해 빈도분석 및 기술통계분석을 실시하였다. 남성과 여성 집단별 차이를 비교분석하기 위해 독립표본 t-검정 및 카이제곱 검정을 이용하여 분석하였다. 디지털 기반 영양교육 주제 요구도 항목 간의 상관관계를 바탕으로 유사한 항목들을 그룹화(reduction)하기 위해 주성분 분석을 통한 탐색적 요인분석을 실시하였다. 요인추출은 고유값(eigen value) 1.0 이상을 기준으로 4개의 요인이 추출되었으며, 고유값 범위는 1.050–7.807이었다. 요인 간 독립성 확보를 위해 베리맥스(Varimax) 회전 방식을 사용하였고, 분석 결과 도출된 영역 구조를 바탕으로 요인별 요구도 점수를 산출하여 교육 주제의 우선순위를 비교하였다. 각 요인에 포함된 문항들의 요인 적재값(factor loading)은 0.507–0.832 사이로 나타나 해당 항목들이 각 요인에 적절하게 군집화됨을 확인하였고, 전체 누적 분산 설명력은 67.183%였다. 공통성(communality) 값이 모두 0.4 이상으로 나타났고, 변수 간의 상관성 여부를 검증하기 위하여 표본적합도(Kaiser-Meyer-Olkin; KMO) 측도와 Bartlett 구형성 검증을 실시하고 내적 일관성 검증을 위해 Cronbach's α값을 사용하여 신뢰도 분석을 수행하였다. 측정항목들의 Cronbach's α값은 전체적으로 0.8 이상의 높은 신뢰도를 보였으므로 본 연구에 사용된 측정척도는 내적 일관성을 지닌 것으로 판단하였다[33]. 연구대상자의 일반적 특성(성별, 연령, 교육수준)과 주요 연구변수(영양관리 관심도, 주관적 디지털 이용능력, 건강증진행위, 디지털 영양교육 필요도 및 이용의사) 간의 관련성을 파악하기 위해 Pearson의 상관관계 분석(Pearson correlation analysis)을 실시하였다. 이후 디지털 기반 영양교육 이용의사에 관련된 요인을 파악하기 위해 조절회귀분석을 실시하였다. 분석의 첫 번째 단계에서 상관분석 결과 종속변수와의 유의미한 연관성이 확인된 일반적 특성(성별)과 독립변수(영양관리 관심도, 디지털 기반 영양교육 필요도, 주관적 디지털 이용능력, 건강증진행위)를 모두 투입하여 주효과를 파악하였다. 두 번째 단계에서는 성별의 조절효과를 검증하기 위해 각 독립변수와 조절변수의 상호작용항(interaction term)을 추가로 투입하여 설명력의 유의미한 증가를 확인하였다.

RESULTS

1. 대상자의 일반적 특성

연구대상자의 일반적 특성은 Table 1과 같다. 대상자의 성별은 남성과 여성 각 250명(50.0%)이었고, 평균 연령은 68.29 (± 3.36)세였다. 교육 수준은 전문대 또는 대학교 졸업이 266명(53.2%)으로 가장 많았다. 거주지역에서 서울이 166명(33.2%), 인천과 경기가 160명(32.0%)으로 대상자의 50% 이상이 서울/경기/인천에 거주하는 것으로 나타났다. 건강증진행위 수준에서 전체 대상자들은 평균 3.56 (± 0.43)점으로 나타났고, 남성보다 여성에서 건강증진행위 평균 수준이 높게 나타났다(t = –2.102, P < 0.05). 이어서 대상자의 진단질환으로는 고혈압 214명(31.1%), 이상지질혈증 179명(26.0%), 당뇨 96명(13.9%) 등의 순이었다. 구체적으로 살펴보면, 남성의 경우 고혈압(34.8%), 당뇨(16.4%), 비만(7.4%)에서 여성의 고혈압(27.5%), 당뇨(11.6%), 비만(6.5%) 비중보다 상대적으로 높게 나타난 반면, 여성의 이상지질혈증(30.6%), 소화기질환(7.1%)의 비중이 남성보다 높은 양상을 보여 성별 간 진단질환 유형의 유의한 차이를 확인하였다(χ^2 = 22.038, P < 0.01).

2. 영양관리 행태 및 건강 관련 특성: 영양관리 실천 현황

연구대상자의 영양교육 경험, 영양관리 관심도, 영양관리 여부, 영양정보 출처, 영양관리 장애요인에 관해 조사한 결과를 영양관리 실천 현황으로 명명하여 Table 2에 나타냈다. 영양교육 경험에 대해 대상자 전체 중 22.6%가 '경험해봤다'고 응답했고, 여성의 영양교육 경험 비율은 남성에 비해 유의적으로 높았다 (P < 0.05). 전체 대상자들의 영양관리 관심도 평균 수준은 3.64 (± 0.74)점이었고 남성 평균 3.54 (± 0.75)점, 여성 평균 3.73 (± 0.73)점으로 나타나 여성의 관심도가 더 높다는 것을 알 수 있었다(P < 0.01). 영양관리 실천 여부의 경우, 전체 대상자 중 65.8%가 '실천하고 있다'고 답했으며, 여성(72.8%)이 남성(58.8%)보다 많이 실천하고 있는 것으로 나타났다(P < 0.001).

Table 1. General characteristics

Variables	Men (n = 250)	Women (n = 250)	Total (n = 500)	χ^2/t-value
Age (year)	68.66 ± 3.65	67.93 ± 3.00	68.29 ± 3.36	6.024*
60s	173 (69.2)	197 (78.8)	370 (74.0)	
70s	72 (28.8)	50 (20.0)	122 (24.4)	
80s	5 (2.0)	3 (1.2)	8 (1.6)	
Education				20.940***
Middle school or below	4 (1.6)	8(3.2)	12 (2.4)	
High school	58 (23.2)	102 (40.8)	160 (32.0)	
College or university	150 (60.0)	116 (46.4)	266 (53.2)	
Graduate school or above	38 (15.2)	24 (9.6)	62 (12.4)	
Residence area				13.149*
Seoul	71 (28.4)	95 (38.0)	166 (33.2)	
Incheon/Gyeonggi	79 (31.6)	81 (32.4)	160 (32.0)	
Daejeon/Sejong/Chungcheong	30 (12.0)	22 (8.8)	52 (10.4)	
Busan/Ulsan/Gyeongnam	32 (12.8)	18 (7.2)	50 (10.0)	
Daegu/Gyeongsang/Gangwon	28 (11.2)	17 (6.8)	45 (9.0)	
Gwangju/Jeolla/Jeju	10 (4.0)	17 (6.8)	27 (5.4)	
Diagnosed conditions[1),2)]				22.038**
Hypertension	117 (34.8)	97 (27.5)	214 (31.1)	
Hyperlipidemia	71 (21.1)	108 (30.6)	179 (26.0)	
Diabetes mellitus	55 (16.4)	41 (11.6)	96 (13.9)	
Obesity	25 (7.4)	23 (6.5)	48 (7.0)	
Gastrointestinal diseases	15 (4.5)	25 (7.1)	40 (5.8)	
Others	10 (3.0)	15 (4.2)	25 (3.6)	
No disease	43 (12.8)	44 (12.5)	87 (12.6)	
Total[3)]	336 (100.0)	353 (100.0)	689 (100.0)	
Health promotion activities[4)]	3.52 ± 0.44	3.60 ± 0.42	3.56 ± 0.43	–2.102*

Mean ± SD or n (%).
Health promotion activities: 35 items; total score range, 35–175 points.
[1)]Multiple choice.
[2)]This multi-item scale allows multiple responses for the seven diagnosed conditions.
[3)]Percentages are based on total responses, not respondents (n = 250 per gender); thus, the sum of n values exceeds the sample size due to multiple responses.
[4)]Measured on a 5-point Likert scale (1 = not at all, 5 = very much).
*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$ by chi-square test or independent t-test.

또한, 대상자들은 인터넷(54.7%)을 통해 영양정보를 탐색하는 경우가 가장 많았다. 영양관리 장애요인에 대해 전체 대상자들은 '혼자 꾸준하게 영양관리 하기가 어려움' 20.2%, '내가 영양관리를 잘하고 있는지 확인이 어려움' 19.4%, '나에게 필요한 영양정보인지 판단하기 어려움' 14.6%, '영양관리 방법에 대한 정보 부족' 10.1% 등의 순으로 확인되었다. 남성의 경우 '내가 영양관리를 잘하고 있는지 확인이 어려움' 18.6%, '혼자 꾸준하게 영양관리 하기가 어려움' 17.7%, '나에게 필요한 영양정보인지 판단하기 어려움' 17.1% 등의 순으로 답했다. 여성의 영양관리 장애요인은 전체 대상자에서의 조사 결과와 유사하게 나타나 성별 간 분포의 차이를 나타냈다(χ^2 = 33.035, $P < 0.001$).

3. 디지털 활용 행태

디지털 활용 행태로 명명하여 대상자들의 주관적 디지털 이용 능력, 디지털 기능 활용 여부, 디지털 기기 사용 불편도에 관해 조사한 결과는 Table 3과 같다. 전체 대상자들의 주관적 디지털 이용 능력 평균 수준은 3.59 (± 0.68)점이었고, 대상자들의 65.0% 이상에서 디지털 기능 활용이 가능한 것으로 확인되었다. 대다수의 디지털 기능 이용에서 성별 간 격차는 크지 않았으나, 앱(app) 관리 및 생활 서비스 예약 부분에 있어 남성이 여성보다 더 활발하게 기능을 활용하는 것으로 나타났다. 먼저 앱

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Table 2. Current status of nutrition management

Variables	Men (n = 250)	Women (n = 250)	Total (n = 500)	χ^2/t-value
Experienced in nutrition education	45 (18.0)	68 (27.2)	113 (22.6)	6.048*
Interest in nutrition management	3.54 ± 0.75	3.73 ± 0.73	3.64 ± 0.74	–2.796**
Practicing nutrition management	147 (58.8)	182 (72.8)	329 (65.8)	10.887***
Sources of nutrition information[1]				1.552
Internet	82 (55.8)	98 (53.8)	180 (54.7)	
TV/radio	26 (17.7)	38 (20.9)	64 (19.5)	
Family/friends/colleagues	20 (13.6)	27 (14.8)	47 (14.3)	
Hospital/public health center	13 (8.8)	15 (8.2)	28 (8.5)	
Newspaper/magazine/book	6 (4.1)	4 (2.2)	10 (3.0)	
Total	250 (100.0)	250 (100.0)	500 (100.0)	
Nutritional management obstacles[2),3),4)]				33.035***
Difficulty maintaining nutrition management alone	84 (17.7)	105 (22.8)	189 (20.2)	
Difficulty assessing own nutrition management	88 (18.6)	93 (20.2)	181 (19.4)	
Difficulty determining relevance of nutrition information	81 (17.1)	56 (12.1)	137 (14.6)	
Lack of information in nutrition management	61 (12.9)	33 (7.2)	94 (10.1)	
Financial difficulty in food purchasing	36 (7.6)	51 (11.1)	87 (9.3)	
Lack of knowledge about food and nutrition	46 (9.7)	29 (6.3)	75 (8.0)	
Uncertainty about starting nutrition management	31 (6.5)	26 (5.6)	57 (6.1)	
Lack of time for nutrition management	14 (3.0)	19 (4.1)	33 (3.5)	
Difficulty understanding related terms	3 (0.6)	4 (0.9)	7 (0.7)	
Others	4 (0.8)	6 (1.3)	10 (1.1)	
No barriers	26 (5.5)	39 (8.5)	65 (7.0)	
Total[5]	474 (100.0)	461 (100.0)	935 (100.0)	

n (%) or Mean ± SD.
1)Measured on a 5-point Likert scale (1 = not at all, 5 = very much).
2)Only respondents who practiced nutrition management were included.
3)Results are based on multiple choice.
4)This multi-item scale allows multiple responses for the eleven nutritional management obstacles.
5)Percentages are based on total responses, not respondents (n = 250 per gender); thus, the sum of n values exceeds the sample size due to multiple responses.
*P < 0.05, **P < 0.01, ***P < 0.001 by chi-square test or independent t-test.

검색 및 설치의 경우 남성이 94.4%로 여성(87.6%)보다 유의하게 높은 이용률을 보였으며(χ^2 = 7.057, P < 0.01), 숙박 또는 병원 예약 항목에서도 남성(70.8%)이 여성(62.0%)에 비해 이용 비중이 통계적으로 높았다(χ^2 = 4.339, P < 0.05). 반면에 메시지 수신 및 발신, 정보 검색, 동영상 시청 및 SNS 활용 등 나머지 항목에서는 성별 간의 비율 차이가 관찰되었으나 통계적으로 유의미한 수준은 아니었다. 디지털 기기 이용도를 감소시키는 이유에 따른 평균값을 비교한 결과, '개인정보 활용에 동의를 구하는 것'만이 3.09 (± 1.13)점이었고, 이외의 다른 항목들의 경우 3점 이하로 조사되었다. 또한, 각 항목의 평균 점수에 따라 성별 차이를 살펴본 결과, 남성은 '비밀번호를 기억하는 것의 어려움' (t = 2.205)에서 여성보다 높게 나타났고(P < 0.05), 여성은 '어플(앱) 설치를 원하지 않음' (t = –2.191), '스마트폰 용어를 몰라 어려움' (t = –2.064), '스마트폰 조작의 어려움' (t = –2.183)의 항목에서 남성보다 불편함을 느끼는 것으로 확인되었다(P < 0.05).

4. 디지털 기반 영양교육 요구도

1) 영양교육 주제 요구도의 요인분석 결과

디지털 영양교육 주제 요구도 변수의 하위 요인 구조를 파악하고 문항을 축소하기 위해 탐색적 요인분석을 실시하였다(Table 4). 요인적재량은 총 17개 문항 모두 0.5 이상이었고, KMO는 0.919이었으며, Bartlett 구형성 검정 결과 χ^2 = 4,692.066, df = 136, P < 0.001로 요인분석에 적합한 자료임이 확인되었다. 디지털 기반 영양교육 주제 요구도의 하위요인은 '자기주도적 웰빙 실천 교육', '주요 만성질환을 위한 식이요법', '건강수명 연장을 위한 노화방지 영양관리 전략', '영양 문해력 증진 교

Table 3. Digital device usage behaviors

Variables	Men (n = 250)	Women (n = 250)	Total (n = 500)	χ^2/t-value
Subjective digital skills[1)]	3.59 ± 0.65	3.60 ± 0.72	3.59 ± 0.68	−0.131
Digital function use				
Receiving messages	250 (100.0)	250 (100.0)	500 (100.0)	0.000
Sending messages	249 (99.6)	250 (100.0)	499 (99.8)	1.002
Information searching & retrieval	249 (99.6)	249 (99.6)	498 (99.6)	0.000
Photo or video shooting	249 (99.6)	247 (98.8)	496 (99.2)	1.008
Default setting	244 (97.6)	237 (94.8)	481 (96.2)	2.681
Data transfer & sharing	240 (96.0)	240 (96.0)	480 (96.0)	0.000
Wireless internet setup	239 (95.6)	232 (92.8)	471 (94.2)	1.794
Video viewing	230 (92.0)	238 (95.2)	468 (93.6)	2.137
App search & installation	236 (94.4)	219 (87.6)	455 (91.0)	7.057**
Social media	202 (80.8)	187 (74.8)	389 (77.8)	2.605
Accommodation/medical reservation	177 (70.8)	155 (62.0)	332 (66.4)	4.339*
Others	1 (4.5)	0 (0.0)	1 (1.8)	3.996
Total[2)]	250 (100.0)	250 (100.0)	500 (100.0)	
Difficulties in using digital devices				
Personal data consent	3.11 ± 1.11	3.07 ± 1.15	3.09 ± 1.13	0.356
Difficulty remembering passwords	2.66 ± 1.16	2.44 ± 1.07	2.55 ± 1.12	2.205*
Unwilling to install apps	2.43 ± 1.05	2.64 ± 1.07	2.50 ± 1.02	−2.191*
Unfamiliar with smartphone terms	2.40 ± 1.00	2.59 ± 1.03	2.53 ± 1.07	−2.064*
Redirected to unwanted screen	2.31 ± 0.99	2.41 ± 0.97	2.36 ± 0.98	−1.093
Difficulty operating smartphone	2.18 ± 0.83	2.35 ± 0.89	2.27 ± 0.86	−2.183*
Difficulty reading content	2.16 ± 0.87	2.06 ± 0.89	2.11 ± 0.88	1.221
Unsure where to click	1.96 ± 0.81	2.00 ± 0.86	1.98 ± 0.83	−0.482
Accidental payment from wrong touch	1.98 ± 0.89	1.90 ± 0.81	1.94 ± 0.85	1.107
Total	2.36 ± 0.71	2.38 ± 0.69	2.37 ± 0.70	

n (%) or Mean ± SD.
1)Measured on a 5-point Likert scale (1 = not at all, 5 = very much).
2)Percentages are based on the number of respondents for each gender (n = 250) and refer to the “Yes” responses for each individual item.
*P < 0.05, **P < 0.01 by chi-square test or independent t-test.

육’의 총 4가지로 추출되었다. 디지털 기반 영양교육 주제 요구도 요인 1은 소화장애 관리, 변비관리, 수분섭취 관리, 영양제 관련 교육, 건강기능식품 관련 교육, 기호식품 관련 교육의 6개 문항을 포함하여 ‘자기주도적 웰빙 실천 교육’으로 명명하였다. 요인 2는 당뇨관리, 고혈압 관리, 이상지질혈증 관리, 비만 관리의 4개 문항을 포함하여 ‘주요 만성질환을 위한 식이요법’으로 명명하였으며, 요인 3은 염증예방 관리, 근손실 관리, 치매예방 관리, 관절염 관리를 포함하는 4개의 문항들로 ‘건강수명 연장을 위한 노화 방지 영양관리 전략’으로 명명하였다. 요인 4는 주요 식품 교육, 주요 영양소 교육, 영양정보의 정확성 및 신뢰성 판단 교육의 3개 문항을 포함하여 ‘영양 문해력 증진 교육’으로 명명하였다. 도출된 요인별 요구도의 평균 점수를 비교한 결과, 요인 3 ‘건강수명 연장을 위한 노화 방지 영양관리 전략’의 요구도(4.00 ± 0.03)가 가장 높게 나타났으며, 이어 요인 2 ‘주요 만성질환을 위한 식이요법’ (3.76 ± 0.82), 요인 4 ‘영양 문해력 증진 교육’ (3.59 ± 0.04), 요인 1 ‘자기주도적 웰빙 실천 교육’ (3.41 ± 0.76) 순으로 나타났다.

2) 영양교육 운영 방식 요구도

영양교육 필요도 및 이용의사, 제공 방식, 운영기관, 적정 교육 시간(1회 기준)에 관한 조사결과는 Table 5에 나타내었다. 대상자의 디지털 기반 영양교육 필요도에서 남성은 3.89 (± 0.62)점, 여성은 3.78 (± 0.77)점으로 나타나 성별에 따른 통계적 유의성은 관찰되지 않았다(t = 1.788, P > 0.05). 반면, 향후 교육 프로그램에 대한 이용의사에서 남성이 3.98 (± 0.64)점으로 여성의 3.81 (± 0.75)점보다 유의하게 높게 나타나, 성별에 따라 통계적인 유의성을 보였다(t = 2.770, P < 0.01). 영양교육 제공 방식에서 전체 대

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Table 4. Factor analysis of needs for digital-based nutrition education topic (n = 500)

Variables[1)]	Values	Factor loading	Cronbach's α	Eigen value (variance, %)
Factor 1. Self-directed well-being practice education	3.41 ± 0.76			
Supplement education	3.64 ± 0.87	0.607	0.861	7.807 (45.923)
Functional food education	3.59 ± 0.90	0.540		
Hydration management	3.48 ± 0.95	0.725		
Digestive disorder management	3.43 ± 0.98	0.813		
Constipation management	3.31 ± 1.07	0.773		
Preferred food education	2.99 ± 1.16	0.528		
Factor 2. Dietary therapy for major chronic diseases	3.76 ± 0.82			
Hyperlipidemia management	3.94 ± 0.91	0.655	0.812	1.351 (7.949)
Hypertension management	3.87 ± 1.01	0.774		
Diabetes mellitus management	3.81 ± 1.02	0.798		
Obesity management	3.42 ± 1.13	0.507		
Factor 3. Nutrition strategy for longevity and anti-aging	4.00 ± 0.03			
Dementia prevention management	4.17 ± 0.88	0.566	0.826	1.213 (7.136)
Muscle loss management	4.00 ± 0.81	0.758		
Arthritis management	3.93 ± 0.87	0.647		
Inflammation prevention management	3.92 ± 0.80	0.798		
Factor 4. Enhancing nutrition literacy education	3.59 ± 0.04			
Nutrition information evaluation training	3.78 ± 0.79	0.696	0.835	1.050 (6.174)
Major nutrients education	3.50 ± 0.94	0.818		
Major foods education	3.50 ± 0.95	0.832		
Total	3.66 ± 0.64			

Mean ± SD.
[1)]Measured on a 5-point Likert scale (1 = not at all, 5 = very much).
Kaiser-Meyer-Olkin = 0.919, Cronbach's α = 0.924, Bartlett's test of sphericity χ^2 = 4,692.066, df = 136, P < 0.001, total accumulation variance explanation = 67.183%.

상자들은 동영상 제공(3.81 ± 0.69), 실시간 온라인 교육(3.51 ± 0.81), 인포그래픽 및 카드뉴스(3.48 ± 0.79) 등의 순으로 선호도를 나타냈고, 남성이 실시간 온라인 교육(t = 2.212)에 있어 여성보다 통계적으로 유의미하게 높은 결과를 보였다(P < 0.05). 운영기관에서 대상자의 전체 중 60.0%가 구청, 행정복지센터, 보건소 등과 같은 지자체를 가장 선호하고 있었고, 1회 적정 교육 시간의 경우 5분 이상 30분 미만이 68.2%으로 가장 높게 나타났다.

5. 영양관리 관심도, 디지털 기반 영양교육 필요도, 주관적 디지털 이용능력, 건강증진행위와 디지털 기반 영양교육 이용의사 간의 관련성

1) 주요 변수들과 디지털 기반 영양교육 이용의사 간의 상관관계

디지털 기반 영양교육 이용의사와 대상자의 일반적 특성, 주요 변수(영양관리 관심도, 디지털 영양교육 필요도, 주관적 디지털 이용능력, 건강증진행위) 간의 상관관계를 분석한 결과는 Table 6과 같다. 먼저 일반적 특성에 따른 영양교육 이용의사와의 관계를 살펴보면, 성별(r = 0.123, P < 0.01)은 이용의사와 유의미한 정(+)의 상관관계를 보였으나, 연령과 교육수준에서는 통계적으로 유의한 상관성을 나타내지 않았다. 디지털 기반 영양교육 이용의사와 가장 높은 상관관계를 보인 변수는 교육필요도(r = 0.651, P < 0.001)였으며, 이어 영양관리 관심도(r = 0.280, P < 0.001), 건강증진행위(r = 0.250, P < 0.001), 주관적 디지털 이용능력(r = 0.139, P < 0.01) 순으로 모두 유의미한 상관관계를 보였다.

2) 성별에 따른 디지털 영양교육 이용의사의 조절효과

디지털 영양교육 이용의사와 관련 요인들에 대한 성별의 조절효과를 검증하기 위해 조절회귀분석을 실시한 결과는 Table 7과 같다. 분석에 앞서 독립변수 간의 다중공선성 문제를 방지하기 위해 연속형 변수들은 평균변환(mean centering)을 실시하였다. 먼저 주효과를 분석한 Model 1의 회귀모형은 통계적으로 유의했으며(F = 82.469, P < 0.001), 설명력은 45.5%로 나타났

Table 5. Needs for digital-based nutrition education modalities

Variables	Men (n = 250)	Women (n = 250)	Total (n = 500)	χ^2/t-value
Need for education[1)]	3.89 ± 0.62	3.78 ± 0.77	3.83 ± 0.70	1.788
Intention to use education[1)]	3.98 ± 0.64	3.81 ± 0.75	3.90 ± 0.70	2.770**
Educational delivery methods[1)]				
Video lecture	3.87 ± 0.64	3.75 ± 0.74	3.81 ± 0.69	1.942
Live online classes	3.59 ± 0.78	3.43 ± 0.84	3.51 ± 0.81	2.212*
Infographics and card news	3.52 ± 0.76	3.43 ± 0.83	3.48 ± 0.79	1.300
1:1 text message counseling	3.05 ± 0.82	3.02 ± 0.83	3.04 ± 0.83	0.433
In-person lecture	3.04 ± 0.87	2.99 ± 0.95	3.02 ± 0.91	0.689
Operating institution				7.044
Local government agencies	136 (54.4)	164 (65.6)	300 (60.0)	
Hospital	56 (22.4)	45 (18.0)	101 (20.2)	
Senior-related institutions	35 (14.0)	27 (10.8)	62 (12.4)	
Colleges and universities	20 (8.0)	12 (4.8)	32 (6.4)	
Recommended training duration (per session)				2.662
Less than 5 minutes	15 (6.0)	11 (4.4)	26 (5.2)	
5–30 minutes	176 (70.4)	165 (66.0)	341 (68.2)	
30 minutes or more	59 (23.6)	74 (29.6)	133 (26.6)	
Total	250 (100.0)	250 (100.0)	500 (100.0)	

Mean ± SD or n (%).
1)Measured on a 5-point Likert scale (1 = not at all, 5 = very much).
*P < 0.05, **P < 0.01 by chi-square test or independent t-test.

Table 6. Pearson correlation coefficients among the predictor variables and intention to use digital nutrition education

Variables	1	2	3	4	5	6	7	8
1. Gender	1							
2. Age	0.108**	1						
3. Education level	0.202***	−0.056	1					
4. Intention to use education	0.123**	0.062	0.057	1				
5. Need for education	0.080	0.013	0.049	0.651***	1			
6. Nutrition management interest	−0.124**	−0.046	0.207***	0.280**	0.233***	1		
7. Subjective digital skills	−0.006	−0.024	0.110**	0.139**	0.137**	0.165***	1	
8. Health promotion activities	−0.067	0.073	0.065	0.250***	0.206***	0.422***	0.225***	1

Pearson correlation coefficients were calculated controlling for gender, age, and educational level.
**P < 0.01, ***P < 0.001.

다(R^2 = 0.455, adjusted R^2 = 0.449). 분석결과, 디지털 영양교육 필요도(β = 0.596, P < 0.001), 영양관리 관심도(β = 0.118, P < 0.01), 성별(β = −0.097, P < 0.01)이 이용의사와 유의미한 관련성을 보이고 있었다. 또한 건강증진행위(β = 0.072, P = 0.06)는 유의수준 0.05에서 통계적 유의성에서 제외되었으나, 경계적 유의성(marginal significance)을 보여 건강증진행위와 디지털 영양교육 이용의사 간의 일정한 관련성이 존재할 가능성을 확인하였다. 성별과 상호작용항을 투입한 Model 2의 설명력은 45.8%였고, 회귀모형도 통계적으로 유의하게 나타났으나(F = 45.952, P < 0.001), Model 1에 비해 설명력 변화량($\triangle R^2$)이 0.003에 불과하여 큰 변화는 없었다($\triangle F$ = 0.621, P = 0.648). 또한, 모든 상호작용항(관심도 × 성별, 필요도 × 성별, 디지털능력 × 성별, 건강증진행위 × 성별)의 유의수준이 0.05 이상으로 나타나 디지털 영양교육 이용의사와 주요 요인들 간의 관련성은 성별에 의해 조절되지 않는 것으로 확인되었다.

DISCUSSION

본 연구는 전국 만 65세 이상 85세 미만의 노인을 대상으로 영양교육 및 관리 실태, 디지털 활용 및 문해력, 디지털 기반 영양

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Table 7. Moderator regression analysis for factors influencing intention to use digital nutrition education

Independent variable	Model 1				Model 2			
	B	Standard error	β	t	B	Standard error	β	t
Gender[1)]	−0.194	0.067	−0.097	−2.876**	−0.193	0.068	−0.097	−2.859**
Nutrition management interest	0.118	0.038	0.118	3.142**	−0.045	0.120	−0.045	−0.373
Need for digital nutrition education	0.596	0.035	0.596	17.103***	0.617	0.123	0.617	5.010***
Subjective digital skills	0.022	0.034	0.022	0.647	0.058	0.116	0.058	0.500
Health promotion activities	0.072	0.038	0.072	1.884	0.065	0.124	0.065	0.526
Nutrition management interest × gender					0.108	0.076	0.170	1.434
Need for digital nutrition education × gender					−0.012	0.073	−0.020	−0.167
Subjective digital skills × gender					−0.020	0.070	−0.033	−0.292
Health promotion activities × gender					0.004	0.077	0.006	0.046
R^2	0.455				0.458			
Adjusted R^2	0.449				0.448			
F	82.469***				45.952***			

Dependent variable: intention to use digital nutrition education.
[1)]Gender coded as men = 1, women = 0.
**$P < 0.01$, ***$P < 0.001$.

교육 요구도, 디지털 영양교육 이용의사와의 연관성을 지닌 요인들을 탐색하고자 하였다. 설문 결과, 디지털 기반 영양교육 이용의사는 주요 변수(영양관리 관심도, 디지털 기반 영양교육 필요도, 주관적 디지털 이용능력, 건강증진행위)간 양의 상관관계가 있는 것으로 나타났으며, 디지털 기반 영양교육 이용의사와 관련성을 보인 요인으로는 영양관리 관심도, 디지털 기반 영양교육 필요도, 건강증진행위인 것으로 확인되었다. 이에 본 연구의 결과를 바탕으로 노인 대상 디지털 기반 자가영양관리 교육 프로그램 개발을 위한 구체적인 방안을 도출하였다.

대상자의 77.4%가 영양교육에 대한 경험이 없었으나, 영양관리에 대한 관심도는 평균 3.64 (± 0.74)점으로 보통 이상이었고, 65.8%는 실제로 영양관리를 실천하고 있었다. 그러나, 대상자들은 혼자 꾸준히 영양관리를 실천하는 데 어려움을 느끼고 있으며, 자신의 방법에 대한 확인 부족을 장애요인으로 선택하고 있었다. 이러한 결과들로 교육 경험은 부족하지만 자가영양관리에 대한 관심과 실천 의지는 높다는 것으로 해석되며, 교육 지속성과 정보 해석 능력 강화가 요구된다. 또한 다수의 대상자들은 디지털 교육의 장점으로 시·공간에 대한 부담 감소(31.3%)와 높은 접근성(17.6%)을 선택하여, 제약이 적고 유연한 교육을(학습 장벽이 낮은 교육을) 선호하였다. Briazu 등[34]의 연구에서도 맞춤형 식단 정보가 대상자의 식태도와 식행동을 변화시킨 바 있으며, 디지털 기반의 자율적인 교육이 학습 주체성과 교육 만족도를 향상시킨다는 결과도 이를 뒷받침한다[35, 36]. 따라서 디지털 기반의 영양교육은 학습장벽이 낮고 유연하며, 대상자의 특성과 진단 결과에 기반한 맞춤형 정보 제공이 핵심이 되어야 할 것이다.

디지털 기반 영양교육 주제 요구도의 변수를 요약 및 축소하고, 그 내적 구조를 파악하고자 탐색적 요인분석을 실시한 결과, '자기주도적 웰빙 실천 교육' 요인은 수분섭취, 영양제, 건강기능식품, 변비 등의 문항으로 구성되어 있어, 개인이 영양 관련 정보를 습득하여 실제 생활속에서 스스로 행동할 수 있는 자가관리 능력을 반영한 결과로 해석된다. 이는 Hong [37]의 연구에서 건강 관련 문해력이 자가관리 실천과 관련된 요인으로 확인되었으며, Jeon [38]의 연구에서도 노인 학습자들은 자신이 무엇을 원하고 필요로 하는지 정확하게 인지하고 있는 경우가 많다고 보고하여 본 연구와 유사한 양상을 보였다. 고혈압 관리, 당뇨병 관리, 이상지질혈증 관리, 비만 관리의 문항은 고령화로 인한 만성질환 관리의 필요성[2]과 만성질환 관리를 위한 정보 제공이 노인에게 식태도 및 식행동 변화에 긍정적인 효과를 줄 수 있으므로[39] 이를 포함한 '주요 만성질환을 위한 식이요법'이 도출된 것으로 보인다. 세 번째 요인으로 추출된 '건강수명 연장을 위한 노화방지 영양관리 전략'은 노인세대에 흔히 나타나는 영양불량, 근감소, 허약 등의 영양문제에 대한 해결 욕구[18]와 영양관리를 통한 근력, 에너지 및 단백질 섭취 변화를 통한 영양상태 개선에 대한 기대감[14]이 작용한 것으로 생각된다. 주요 식품 및 영양소 교육과 영양정보에 대한 분별력 향상 교육 문항이 포함된 '영양 문해력 증진 교육'은 영양 관련 정보에 대한 기초적인 지식과 비판적인 태도를 기르는 연습을 통해 미디어에 노출된 부정확한 영양 관련 정보를 선별하고, 개인에게 필요한 정보를 주체적으로 취하고자 하는 요구가 반영된 것으로 판단된다. 이와 관련된 선행논문에서도 노인세대의 이해 수준을 고려한 시각 자료 기반의 건강 관련 정보 제공이

건강 증진에 도움을 줄 수 있음을 보고하였다[37]. 따라서 본 연구에서 도출된 요인들이 반영된 디지털 기반의 영양교육은 대상자의 실제 생활 맥락을 고려한 실천 중심의 교육으로 개발될 가능성을 보여준다.

이와 더불어 여성의 건강증진행위 수준은 남성보다 높은 것으로 나타났으며, 이는 여성이 남성에 비해 건강관리에서 더 높은 주체성과 사회적 자원 활용 역량을 지니고 있는 것으로 보인다. 이와 관련한 선행연구[40]에서도 성별에 따라 디지털 정보화 수준과 디지털 기기를 사용하는 목적의 차이가 있는 것으로 나타나, 영양교육 프로그램 개발 시 성별에 따라 차별화된 교육 프로그램의 개발이 필요할 것으로 생각된다. Kim [41]의 연구에서도 성별에 따라 건강기능식품에 대한 관심도, 인지도, 신뢰도, 지식, 만족도의 차이를 보였고, Egele & Stark [42]의 연구에서는 남성과 여성이 식품구매, 습관에 관한 건강신념에 있어서 차이가 있음을 확인하였다. 이에 영양교육 프로그램은 단순히 건강상태나 질병상태뿐만 아니라 성별에 따른 건강관리 역량을 고려하여 개발될 필요가 있으며, 특히 남성에게는 이해하기 쉬우면서도 다양한 정보를 제공하고, 여성에게는 보다 구체적이고 전문성이 강화된 정보 제공이 요구된다.

조절회귀분석을 통해 디지털 기반 영양교육 이용의사와 관련된 요인을 분석한 결과, 주효과를 확인한 Model 1에 상호작용항을 추가한 Model 2의 설명력은 45.8%로 Model 1 대비 약 0.3% 증가하는 데 그쳤다. 또한, Model 2에 투입된 모든 상호작용 변수(관심도 × 성별, 필요도 × 성별, 디지털능력 × 성별, 건강증진행위 × 성별)가 통계적으로 유의미 하지 않은 것으로 나타났다. 특히, Model 2에서는 Model 1에서 유의미하게 나타났던 ‘영양관리 관심도’와의 관련성이 사라진 반면, ‘성별’과 ‘디지털 영양교육 필요성’은 여전히 독립적인 주효과를 유지하고 있었다. 이러한 결과로 성별은 주요 변수(영양관리 관심도, 디지털 영양교육 필요도, 주관적 디지털 이용능력, 건강증진행위)들이 디지털 기반 영양교육 이용의사와의 관련성을 강화하거나 약화시키는 조절효과를 나타내지 않음을 확인하였다. Lee 등[43]은 새로운 지식을 습득하려는 ‘인지욕구’가 스마트기기 활용능력과의 관련성이 남성에게서 더 강하게 나타난다고 보고했으나, 본 연구의 주요 변수인 ‘영양관리 관심도’나 ‘건강증진행위’는 노년기 삶의 질을 결정하는 필수적인 가치이다. 따라서 일반적인 인지욕구와 달리, 건강과 직결된 교육 콘텐츠에 대한 수용 의사는 성별에 따른 조절 기제가 작동하지 않을 만큼 보편적인 욕구인 것으로 판단된다. 또한, Chung 등[44]은 디지털 역량의 심리적 안녕이 성별에 따라 조절되는지 확인한 결과 여성 노인에게서 두드러짐을 보고하였다. 반면, 본 연구에서 성별의 조절효과가 통계적으로 유의하지 않은 것은 영양교육 프로그램이 성별보다는 개인이 인지하는 교육의 필요도 혹은 영양교육에 대한 관심이 결정적인 요인으로 작용할 수 있음을 의미한다. 더불어 Park & Jo [45]의 연구에서 건강에 대한 관심 정도와 건강관심도 × 쿡방 정보수용이 건강관리와 관련성을 보인 것으로 보고하였다. 본 연구에서도 영양관리관심도가 디지털 기반 영양교육 이용의사와의 관련성을 보였으며, 디지털화된 영양교육에 대한 필요도에서도 종속변수와 유의한 관련성이 있는 것으로 나타났다. 또 다른 선행연구에서 연령이 증가할수록 자가관리 정도가 낮아지며, 노인 대상의 건강증진을 위한 프로그램 설계에 있어 실천 향상을 위한 핵심요소로 지속가능성과 접근성이 도출된 바 있다[37]. 이에 디지털 이용이 가능한 노인세대에게 시간적, 공간적 제한이 적은 디지털 기반의 영양교육 프로그램 개발에의 중요성을 확인하였다. 반면에 주관적 디지털 이용능력은 디지털 기반 영양교육 이용의사와 유의미한 관련성을 보이지 않는 것으로 나타났다. 그러나, 선행연구에서 디지털 기반의 비대면 프로그램이 돌봄 필요 노인의 신체적인 한계를 보완하고, 영양결핍 해소에 도움이 되었음을 확인하였다[46]. 또 다른 연구에서 노인의 디지털 기기 활용이 건강한 노화와 밀접한 연관성을 가지며, 노화로 인한 신체적, 정서적 기능 쇠퇴에서 비롯되는 문제를 완화시키는 데 기여함을 보고하였다[47]. 이에 본 연구에서 주관적 디지털 이용능력 회귀계수 방향성은 디지털 영양교육 이용의사에 정(+)방향이었으며, 관련 선행연구들을 고려할 때 주관적 디지털 이용능력과 종속변수 간의 관련성을 완전히 배제하기 어렵다. 또한, 건강증진행위가 통계적 유의성에는 미치지 못했으나, 건강증진행위 점수가 높을수록 디지털 기반 영양교육 이용의사가 높아지는 경향을 보인 것은 건강에 대한 능동적인 태도가 디지털 학습으로 이어질 수 있는 잠재적 요인임을 보여준다. Lim 등[48]의 연구에서 건강증진행위가 높을수록 건강 관련 삶의 질이 높아질 수 있음을 보고한 바와 같이 건강증진행위는 노인의 삶에 있어 건강 및 영양 관련 활동에 촉진제로 작용할 수 있고 이는 활동성을 가진 노인세대를 양성하는 데 도움이 될 수 있을 것이다. 따라서 디지털 활용, 영양정보의 진위 판별 및 비판적 평가, 건강 실천 기록과 같은 교육 활동이 디지털 기반 자가영양관리 교육에 대한 흥미도와 참여도를 높일 수 있으리라 생각된다.

Limitations

본 연구는 설문조사 전문기업에 속한 패널 중 연구의 대상과 일치하는 노인에게 온라인 설문조사를 통해 실시되어, 이미 디지털 기반에 익숙한 대상자일 여지가 있다. 또한, 전체 대상자의 10% 이상이 대학원 이상의 교육수준을 보유하고 있었다. 이는 2022년 기준 우리나라 만 25–64세 인구의 대학원 이상 학력 비율(11%)과 비슷한 수준으로, 노인 집단임에도 불구하고 생산가능연령층과 대등한 교육수준을 보였다. 이러한 점을 고려할 때, 본 연구의 표본은 대학원 이상의 교육수준을 가진 고학력자로 과대표집(oversampling) 되었을 가능성이 있다. 이는 표본집단이 디지털 기반 환경에 상대적으로 익숙한 특성을 가질 수 있음을 시사하며, 이에 본 연구의 결과만으로 우리나라 만 65세 이

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상 85세 미만 디지털 기기 이용이 가능한 노인 인구 전체를 대표하여 일반화하는 데는 한계가 있다. 또한, 본 연구에서는 확인적 요인분석을 통한 구성타당성 검증을 실시하지 못한 한계가 있으나, 요구도 항목 간의 상관관계를 바탕으로 유사한 항목들을 그룹화하고 요인을 축소하여 분석의 효율성을 높이고자 탐색적 수준에서 요인 구조를 파악하였으며, 척도의 내적 일관성을 검토하였다. 디지털 기반 영양교육 이용의사와 주관적 디지털 이용능력 간의 관련성이 통계적으로 유의하지 않았다. 이는 주관적 평가 특성상 실제 역량과는 차이가 있을 수 있고, 접근성과 환경 등의 변수를 충분히 반영하지 못한 제한점이 있다. 따라서 후속 연구에서는 다음과 같은 방향으로 연구를 확장할 필요가 있다. 첫째, 주관적 건강상태, 객관적 디지털 이용능력 등의 추가적인 관련 변수를 포함하여 설명력을 높이는 연구가 필요하다. 둘째, 새로운 변수들 간의 조절효과를 분석하여 교육 필요도 및 이용의사와의 복합적인 관련성을 확인한다면 연구 결과의 타당성을 높일 수 있을 것이다.

Conclusion

본 연구는 전국 만 65–84세 디지털 기기 이용이 가능한 노인을 대상으로 한 설문조사를 통해 디지털 기반 영양교육 프로그램 개발 방안을 도출하고자 하였다. 본 연구의 결과를 통해 노인의 높은 영양관리 관심도를 실제 행동 변화로 연결시키기 위해서는 디지털 접근성을 개선하고 성별 특성에 적합한 콘텐츠를 제공, 디지털 활용 교육의 선행과 건강 및 영양 관련 교육 활동을 포함하는 것이 중요하다. 이에 본 연구는 노인 대상 디지털 기반 영양교육 프로그램 개발에 있어 성별 맞춤형 접근과 개인의 디지털 역량 및 주체적 건강관리 수준을 고려한 교육 설계의 중요성을 제시하였으며, 향후 지역사회 중심의 실용적 교육모델 구축을 위한 기초자료로 활용될 수 있을 것이라 기대된다.

CONFLICT OF INTEREST

The authors declare 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

서울·경기 지역 장애인복지관의 발달장애인 대상 급식관리 및 영양교육 현황과 요구도 분석

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Foodservice management and nutrition education status and needs for individuals with developmental disabilities in welfare facilities in Seoul and Gyeonggi, Korea: a cross-sectional study

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Objectives: This study aimed to examine the current status of foodservice management and nutrition education practices, and the needs for individuals with developmental disabilities in welfare centers in Seoul and Gyeonggi, South Korea, and to compare the differences according to dietitians' level of understanding of developmental disabilities.
Methods: A cross-sectional survey was conducted among dietitians working at 65 welfare centers, and data from 45 centers were analyzed. The questionnaire assessed general characteristics, foodservice operations, nutrition education practices, perceived needs, and the understanding of developmental disabilities. Participants were classified into high- (n = 17) and low-understanding (n = 28) groups based on their self-rated understanding of developmental disabilities. Data were analyzed using IBM SPSS Statistics 29.0 (IBM Corp.).
Results: All centers provided one daily meal (lunch), with one cook serving an average of 116 individuals. Only 11.1% of centers implemented nutrition education, primarily limited due to insufficient time and low expectations regarding the effectiveness of nutrition education. Overall, no significant differences were observed between the two groups in most aspects of foodservice management and nutrition education practices, although some specific items showed significant differences. The high-understanding group reported a significantly greater perceived need for nutrition education and placed higher importance on rapport-building and situational response skills. These findings suggest that structural constraints, including staffing, budget, and limited resources, may play a greater role than individual-level understanding in shaping foodservice and nutrition education practices.
Conclusion: Welfare centers showed limited capacity to provide tailored foodservice and systematic nutrition education for adults with developmental disabilities. Strengthening staffing standards, improving foodservice environments, and developing standardized educational materials that consider communication levels are necessary. Moreover, expanding

professional training opportunities for dietitians and establishing institutional support systems are essential to enhance sustainable nutrition education practices.

Keywords: intellectual disability; autism spectrum disorder; food services; dietitians; education

INTRODUCTION

발달장애(developmental disability)란 정신발육이 항구적으로 지체되어 지적 능력 발달이 불충분하거나 불완전한 상태로, 자기관리 및 사회적 적응에 상당한 어려움이 있는 지적장애와 자폐스펙트럼장애를 포함한다[1]. 2024년 기준, 우리나라의 장애인 인구는 약 264만 명 수준이다[2]. 보험연구원 자료에 따르면 최근 10년 동안 총인구 대비 전체 장애인의 비율은 약 5% 수준을 유지해 왔으나, 발달장애인의 비중은 꾸준히 증가하고 있다. 발달장애 중 지적장애는 2015년 7.6%에서 2023년 8.7%로 증가한 반면, 자폐스펙트럼장애는 같은 기간 0.8%에서 1.6%로 두 배 이상 증가하였다[3].

장애인은 식생활 환경의 제약과 신체·생리적 특성으로 인해 식품 섭취의 제한, 약물과 영양소 간 상호작용, 대사 장애 등의 문제를 경험하기 쉬우며, 그 결과 비만, 심혈관질환, 골다공증 등의 만성질환 발생 위험이 증가할 수 있음이 지적되고 있다[4]. 이러한 경향은 발달장애인에서도 유사하게 나타난다. 발달장애인은 의사소통 및 자기관리의 어려움으로 인해 건강관리 취약성이 높으며[5], 이는 섭식행동과 영양섭취 문제로 이어질 수 있다[6]. 이러한 문제는 감각 민감성, 제한적·반복적 행동 특성, 인지 기능 제한 등 발달장애의 특성과 밀접하게 관련되며, 특히 자폐스펙트럼장애에서 이러한 경향이 두드러지게 나타난다. 즉, 감각 자극에 대한 과민 또는 둔감 반응, 반복적 행동 경향, 그리고 새로운 음식에 대한 수용의 어려움은 특정 음식에 대한 선호 및 거부를 강화하고 식품 선택의 폭을 제한하는 것으로 알려져 있다[6, 7]. 이러한 특성은 이식증, 폭식 등 다양한 섭식행동 문제[8, 9], 편식 및 고열량 식품 선호[10] 등으로 이어지며, 이는 발달장애인의 영양불균형과 비만 위험을 증가시키는 요인으로 작용한다[11].

이와 같은 특성으로 인해 발달장애인의 식생활 관리는 개인의 선택을 넘어 체계적인 지원이 요구되는 영역이다. 우리나라의 「발달장애인 권리보장 및 지원에 관한 법률」은 발달장애인의 생애주기별 특성에 맞춘 의료·영양·교육·복지 서비스의 통합적 제공 필요성을 강조하고 있으며[1], 이는 장애인의 영양관리가 개인의 영역을 넘어 이들의 건강증진을 위한 공적 책무임을 의미한다. 따라서 발달장애인의 개별 특성을 고려한 영양관리 및 이해 수준 등을 반영한 체계적인 영양교육과 식행동 중재, 보호자 및 시설 종사자와의 연계 지원 체계 구축이 중요하다. 선행연구에서도 발달장애인을 대상으로 한 영양교육의 효과가 보고되었으며[12-15], 발달장애인 보호자 및 사회복지시설 종사자를 대상으로 한 영양교육 필요성도 제기되고 있다[16, 17].

한편, 보건복지부의 「2023년 장애인실태조사」[18]에 따르면 발달장애인은 장애인복지시설 이용 비율이 높으며, 특히 여러 시설 유형 중 장애인복지관 이용이 가장 빈번하였다. 장애인복지관은 급식과 건강증진 프로그램을 동시에 운영하는 지역사회 핵심 기반 시설임에도 불구하고, 발달장애인을 대상으로 한 급식관리 실태와 영양교육 운영 현황을 체계적으로 분석한 연구는 부족한 실정이다. 또한 장애인복지관 종사자의 발달장애에 대한 이해 수준은 급식관리 및 영양교육 인식에 영향을 미칠 수 있는 요인으로 고려될 수 있다. 그러나 실제 현장에서 이해도 수준에 따른 인식과 요구도의 차이에 대해서는 충분히 검토되지 않았다. 따라서 본 연구에서는 서울 및 경기도 소재 장애인복지관의 발달장애인 대상 급식관리 현황을 파악하고, 영양사의 발달장애 이해도 수준에 따른 영양교육 운영 실태 및 관련 요구도 차이를 함께 분석함으로써 향후 발달장애인을 위한 정책적 급식 지원체계 구축과 영양교육 프로그램 개발을 위한 기초자료를 제공하고자 하였다.

METHODS

Ethics statement

Informed consent was obtained electronically from all participants prior to the online survey. The survey procedures and protocols were approved by the Institutional Review Board of Myongji University (approval number: MJU IRB 2025-05-002). The requirement for written informed consent was waived by the institutional review board.

1. 연구설계

본 연구는 횡단적 설문조사 연구(cross-sectional survey study)

로 STROBE statement (https://www.strobe-statement.org/) 지침에 따라 기술하였다.

2. 연구대상 시설 및 연구대상자

본 연구에서는 2025년 보건복지부에서 발행한 「장애인복지시설 일람표」 [19]를 근거로 서울 및 경기 지역에 소재하는 장애인복지관 전체를 연구대상 시설로 선정하였다. 일람표에 등재된 서울 소재 52개소, 경기 소재 39개소의 총 91개 장애인복지관 중 시각·청각장애인 등 특화시설 15개소, 영양사 미배치 시설 9개소, 노인복지관 연계 시설 2개소 등 26개 시설을 제외하여 총 65개 시설을 연구대상 시설로 포함하였다.

설문조사는 각 시설에 근무하는 영양사를 대상으로 2025년 8월 11일부터 8월 31일까지 실시하였으며, 연구 목적, 익명성 보장 및 연구 참여자의 권리를 설명한 후 시설 이메일을 통해 설문 URL을 발송하였다. 전체 65개 연구대상 시설 중 48개 시설에서 설문에 응답하였으며(응답률 74%), 이 중 응답이 불완전한 3개 시설을 제외하여 최종적으로 45개 시설에서 수집된 자료를 분석에 활용하였다(최종 분석률 69%).

3. 연구내용 및 방법

1) 설문지 구성

설문지는 연구대상 시설 및 연구대상자의 일반적 특성(11문항), 발달장애 이해도(6문항), 급식 운영 및 식단 관리(7문항), 급식 시설 환경(2문항), 영양교육 현황 및 요구도(9문항), 영양교육 인식(9문항)을 포함한 총 44문항으로 구성하였다.

발달장애 이해도 문항은 Choi [20]의 연구를 참고하여 구성하였고, '나는 지적장애의 일반적 특성을 설명할 수 있다', '나는 지적장애인의 식행동 특성을 설명할 수 있다' 등의 항목을 포함하였다. 급식 운영 및 식단 관리 문항은 Park & Jung [21], Oh 등[22]을 참고하여 구성하였으며, 이 중 식단 작성 시 중요 요인에 대한 인식은 '음식 기호도 및 선호도', '식사의 시각적 구성' 등을 포함한 6개 요인을 측정하였다. 급식 시설 환경 문항은 Ko [23]와 Park & Jeon [24]을 참고하여 구성하였으며, 영양교육 현황 및 요구도, 영양교육 인식 문항은 Lee [25]와 Oh 등[22]을 참고하여 구성하였다. 이 중 영양교육 필요성은 발달장애인의 영양개선 필요성, 발달장애인 대상 영양교육 필요성, 영양교육을 통한 영양개선 가능성에 대한 인식에 대한 문항으로 구성하였으며, 영양교육 직무역량 인식은 '의사소통 역량', '라포 형성 능력', '상황 대응력' 등 6개 요인에 대해 조사하였다.

이해도, 중요도 및 인식과 관련한 문항은 5점 리커트 척도(1점 = 전혀 그렇지 않다, 5점 = 매우 그렇다)로 응답하도록 하였다. 발달장애 이해도 6개 문항의 내적 일관성을 검토한 결과 Cronbach's α값은 0.96으로 나타나 높은 신뢰도를 보였다.

설문 문항은 내용 타당도 확보를 위해 장애인복지관 근무 경력 10년 이상 영양사 1인, 급식 및 영양교육 분야의 식품영양학 전공 교수 1인에게 자문을 받아 문항의 적절성 및 표현의 명확성을 검토한 후 일부 문항을 수정·보완하였다. 예를 들어, 영양교육 관련 문항에서는 교육 필요성에 대한 단일 문항을 세분화하여 응답의 구체성을 높였고, 급식 환경에서는 조사가 누락된 설비 항목을 추가하였다.

2) 분석 방법

모든 자료는 IBM SPSS Statistics 29.0 프로그램(IBM SPSS Statistics for Windows, Version 29.0; IBM Corp.)을 이용하여 분석하였다. 발달장애 이해도는 6개 문항의 평균값으로 산출한 연속형 변수로 정의하였다. 연구대상자 45명을 대상으로 해당 점수의 중앙값(median, 3.0점)을 기준으로 중앙값 초과(> 3.0점)를 '고이해도군' (n = 17), 중앙값 이하(≤ 3.0점)를 '저이해도군' (n = 28)으로 구분하여 군간 비교 분석을 실시하였다. 본 연구에서는 선행연구[26, 27]를 참고하여 표본 수와 분석 목적을 고려해 중앙값을 기준으로 집단을 구분하였다.

범주형 변수는 카이제곱 검정 또는 Fisher의 정확 검정을 이용하여 군 간 차이를 검증하였으며, 결과는 빈도와 백분율로 제시하였다. 연속형 변수는 Kolmogorov–Smirnov 및 Shapiro–Wilk 검정을 통해 정규성을 확인한 후, 정규성이 충족된 경우에는 독립표본 t-검정을, 충족되지 않은 경우에는 Mann–Whitney U 검정을 이용하여 군 간 차이를 검증하였다. 결과는 평균과 표준편차로 제시하였다. 통계적 유의수준은 $P < 0.05$로 설정하였다.

RESULTS

1. 연구대상자 일반사항

연구대상자의 일반사항은 Table 1에 제시한 것과 같이 연령, 근무지, 근무경력, 고용 형태, 근무 시간 등에서 고이해도군과 저이해도군 간 유의한 차이는 나타나지 않았다. 전체 대상자 45명(서울 20명, 경기도 25명)은 모두 여성으로, 평균 연령은 42.8세였다. 장애인복지관 총 근무경력은 평균 6.6년이었으며, 현 시설에서의 근무경력은 5.5년으로 5년 미만 근무자가 절반 이상(53.4%)이었다. 정규직 비율은 68.9%였으며, 1일 8시간 이상 근무자가 82.2%로 대다수를 차지하였다.

2. 연구대상자의 발달장애 이해도

지적장애 및 자폐스펙트럼장애의 일반적 특성과 식행동 특성에 대한 이해 수준을 산출하여 대상자를 고이해도군(17명)과 저이해도군(28명)으로 구분하였을 때 두 군의 발달장애 이해도에 대한 비교 결과는 Table 2와 같다. 발달장애 이해도 총 평균은 5점 만점에 2.8점으로 보통 이하 수준이었다. 지적장애 및 자폐스펙트럼장애에 대한 모든 세부 항목에서 고이해도군의 점수가 저

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Table 1. General characteristics of participants

Variables	Low-understanding (n = 28)	High-understanding (n = 17)	Total (n = 45)	*P*-value
Age (year)				
20–39	9 (32.1)	3 (17.6)	12 (26.7)	0.484[1)]
40–49	12 (42.9)	10 (58.8)	22 (48.9)	
≥ 50	7 (25.0)	4 (23.6)	11 (24.4)	
Mean	41.50 ± 8.46	45.00 ± 5.99	42.82 ± 7.74	0.143[2)]
Workplace location				
Seoul	11 (39.3)	9 (52.9)	20 (44.4)	0.537
Gyeonggi	17 (60.7)	8 (47.1)	25 (55.6)	
Total work experience in welfare facilities (year)				
< 1	4 (14.3)	0 (0.0)	4 (8.9)	0.369
1–4	9 (32.1)	7 (41.2)	16 (35.6)	
5–9	9 (32.1)	4 (23.5)	13 (28.9)	
≥ 10	6 (21.5)	6 (35.3)	12 (26.6)	
Mean	5.81 ± 3.87	7.86 ± 5.24	6.58 ± 4.49	0.141
Current job tenure (year)				
< 1	7 (25.0)	1 (5.9)	8 (17.8)	0.303
1–4	8 (28.6)	8 (47.1)	16 (35.6)	
5–9	10 (35.7)	5 (29.4)	15 (33.3)	
≥ 10	3 (10.7)	3 (17.6)	6 (13.3)	
Mean	5.03 ± 3.86	6.24 ± 4.98	5.49 ± 4.30	0.368
Employment status				
Permanent	18 (64.3)	13 (76.5)	31 (68.9)	0.513
Temporary	10 (35.7)	4 (23.5)	14 (31.1)	
Working hours per day (hr)				
< 8	4 (14.3)	4 (23.5)	8 (17.8)	0.452
≥ 8	24 (85.7)	13 (76.5)	37 (82.2)	
Mean	7.71 ± 1.10	7.26 ± 1.43	7.54 ± 1.24	0.234

n (%) or Mean ± SD.
Low- and high-understanding groups were classified based on the median score of the developmental disability understanding scale (mean score of 6 items; median = 3.0).
[1)]*P*-values by chi-square test or Fisher's exact test.
[2)]*P*-values by independent t-test or Mann–Whitney U test.

Table 2. Participants' understanding of developmental disability characteristics

Variables[1)]	Low-understanding (n = 28)	High-understanding (n = 17)	Total (n = 45)	*P*-value[2)]
Definition of intellectual disability	2.46 ± 0.74	4.00 ± 0.36	3.04 ± 0.97	< 0.001
General characteristics of intellectual disability	2.46 ± 0.69	3.59 ± 0.50	2.89 ± 0.83	< 0.001
Eating behavior characteristics of intellectual disability	2.43 ± 0.69	3.29 ± 0.47	2.76 ± 0.74	< 0.001
Definition of autism spectrum disorder	2.39 ± 0.73	3.65 ± 0.49	2.87 ± 0.89	< 0.001
General characteristics of autism spectrum disorder	2.39 ± 0.73	3.47 ± 0.51	2.80 ± 0.84	< 0.001
Eating behavior characteristics of autism spectrum disorder	2.36 ± 0.67	3.29 ± 0.58	2.71 ± 0.78	< 0.001
Mean	2.41 ± 0.64	3.54 ± 0.32	2.84 ± 0.77	< 0.001

Mean ± SD.
Low- and high-understanding groups were classified based on the median score of the developmental disability understanding scale (mean score of 6 items; median = 3.0).
[1)]Measured using a 5-point Likert scale based on self-reported ability to explain each item (1 = strongly disagree, 5 = strongly agree).
[2)]*P*-values by Mann–Whitney U test.

이해도군에 비해 유의적으로 높았다(P < 0.001 for all).

세부 항목별로는 지적장애 식행동(2.8점)과 자폐스펙트럼장애 식행동(2.7점)에 대한 점수가 다른 항목에 비해 상대적으로 낮게 나타났다. 저이해도군은 모든 항목에서 2.5점 미만의 낮은 점수를 보였으며 항목 간 점수 차이가 크지 않았던 반면, 고이해도군에서는 지적장애 및 자폐스펙트럼장애 식행동 항목에 대한 점수가 다른 항목에 비해 상대적으로 낮게 나타났다.

3. 연구대상 시설 특성

1) 시설 이용 장애인 유형

시설을 이용하는 장애인 유형을 조사한 결과는 Table 3에 제시하였다. 해당 장애 유형의 이용자가 한 명이라도 있는 경우 응답하도록 조사한 결과, 모든 시설에서 지적장애인의 이용이 확인되었으며, 자폐스펙트럼장애인은 88.9%의 시설에서 이용하는 것으로 나타났다. 그 외에도 지체장애인, 뇌병변장애인, 정신장애인 등이 시설을 이용하고 있었다. 또한, 지적장애 및 자폐스펙트럼장애를 포함한 발달장애인이 주요 이용자인 시설은 전체의 62.2%였다.

시설을 이용하는 발달장애인의 주요 연령대를 조사한 결과, 62.2%의 시설에서 19–39세 성인이 가장 많은 것으로 나타났다. 또한, 발달장애인의 60%–79%가 원활한 의사소통이 가능하다고 응답한 시설이 53.3%로 가장 많았다. 그러나 주 이용 장애인의 유형 및 연령대, 의사소통 수준 등 시설 이용 발달장애인 특성에서는 두 군 간 유의한 차이를 보이지 않았다.

2) 급식 운영 현황

연구대상 시설의 급식 운영 현황은 Table 4에 제시하였다. 장애인과 종사자를 모두 포함한 1일 총 급식 인원은 평균 175.0명이었으며, 이중 장애인 급식 인원은 평균 106.6명이었다. 고이해도군이 근무하는 시설의 1일 장애인 급식 인원은 124.7명으로, 저이해도군 소속 시설(95.6명)보다 유의적으로 많았다(P = 0.049). 모든 시설에서 중식을 제공하고 있었으며, 석식을 제공하는 시설은 1개소에 불과하였다. 간식을 제공하는 시설은 없었다. 1식당 평균 식재료비는 3,402원이었고, 45개소 중 10개소(22.2%)의 식재료비가 3,000원 미만인 것으로 나타났다.

Table 3. Characteristics of service users in the surveyed facilities

Variables	Low-understanding (n = 28)	High-understanding (n = 17)	Total (n = 45)	P-value[1)]
Types of disabilities among service users[2)]				
Intellectual disability	28 (100.0)	17 (100.0)	45 (100.0)	-
Autism spectrum disorder	25 (89.3)	15 (88.2)	40 (88.9)	> 0.999
Physical disability	26 (92.9)	13 (76.5)	39 (86.7)	0.179
Neurological disability	22 (78.6)	12 (70.6)	34 (75.6)	0.722
Mental disorder	22 (78.6)	11 (64.7)	33 (73.3)	0.325
Language disorder	18 (64.3)	12 (70.6)	30 (66.7)	0.752
Hearing impairment	19 (67.9)	10 (58.8)	29 (64.4)	0.539
Primary disability type[3)]				
Developmental disability[4)]	15 (53.6)	13 (76.5)	28 (62.2)	0.215
Others	13 (46.4)	4 (23.5)	17 (37.8)	
Primary age group of service users (year)				
6–18	2 (7.1)	0 (0.0)	2 (4.4)	0.740
19–39	18 (64.3)	10 (58.8)	28 (62.2)	
40–64	7 (25.0)	6 (35.3)	13 (28.9)	
≥ 65	1 (3.6)	1 (5.9)	2 (4.4)	
Communication ability level in developmental disabilities (%)				
10–39	5 (17.9)	1 (5.9)	6 (13.3)	0.665
40–59	7 (25.0)	6 (35.3)	13 (28.9)	
60–79	15 (53.6)	9 (52.9)	24 (53.3)	
80–100	1 (3.6)	1 (5.9)	2 (4.4)	

n (%).
Low- and high-understanding groups were classified based on the median score of the developmental disability understanding scale (mean score of 6 items; median = 3.0).
1)P-values by chi-square test or Fisher's exact test.
2)Multiple responses allowed; categories indicate facilities with at least one service user with the respective disability.
3)Respondents were asked to select one primary disability type representing the largest proportion of service users.
4)Includes intellectual disability and autism spectrum disorder.

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Table 4. Food service operational characteristics of the surveyed facilities

Variables	Low-understanding (n = 28)	High-understanding (n = 17)	Total (n = 45)	*P*-value
Daily number of meals served[1)]	162.61 ± 84.46	195.29 ± 72.10	174.96 ± 80.77	0.101[5)]
Daily number of meals served to service users[2)]				
< 100	19 (67.9)	6 (35.3)	25 (55.6)	0.062[6)]
≥ 100	9 (32.1)	11 (64.7)	20 (44.4)	
Mean	95.61 ± 76.76	124.71 ± 54.55	106.60 ± 70.01	0.049
Type of meals served[3)]				
Lunch	28 (100.0)	17 (100.0)	45 (100.0)	-
Dinner	1 (3.6)	0 (0.0)	1 (2.2)	> 0.999
Food cost per meal (KRW)				
< 3,000	6 (21.4)	4 (23.5)	10 (22.2)	> 0.999
≥ 3,000	22 (78.6)	13 (76.5)	35 (77.8)	
Mean	3,517 ± 665.72	3,211 ± 1,027.06	3,402 ± 823.44	0.231
Number of cooks				
1	16 (57.1)	8 (47.1)	24 (53.3)	0.590
2	8 (28.6)	8 (47.1)	16 (35.6)	
3	2 (7.1)	1 (5.9)	3 (6.7)	
≥ 4	2 (7.1)	0 (0.0)	2 (4.4)	
Mean	1.68 ± 1.02	1.59 ± 0.61	1.64 ± 0.80	0.774
Meals served per cook[4)]	104.51 ± 35.52	135.05 ± 68.45	116.04 ± 52.02	0.055
Number of food service support staff (excluding cooks)				
1–2	7 (25.0)	1 (5.9)	8 (17.8)	0.083
3–4	9 (32.1)	3 (17.6)	12 (26.7)	
≥ 5	12 (42.9)	13 (76.5)	25 (55.6)	
Mean	4.86 ± 3.56	6.53 ± 2.52	5.49 ± 3.29	0.020

n (%) or Mean ± SD.
Low- and high-understanding groups were classified based on the median score of the developmental disability understanding scale (mean score of 6 items; median = 3.0).
[1)]Daily number of meals served includes all meal recipients (e.g., service users, staff, and others).
[2)]Daily number of meals served to service users refers to meals provided to individuals with disabilities only.
[3)]Multiple responses allowed.
[4)]Calculated as the total number of meals served divided by the number of cooks.
[5)]*P*-values by independent t-test or Mann–Whitney U test.
[6)]*P*-values by chi-square test or Fisher's exact test.

평균 조리원 수는 1.6명이었으며, 조리원이 1명인 시설이 53.3%로 절반 이상을 차지하였다. 조리원 1인당 총 급식 인원은 평균 116.0명이었고, 통계적으로 유의한 수준에는 도달하지 않았으나, 고이해도 소속 시설(135.1명)이 저이해도군 소속 시설(104.5명)보다 많은 경향을 보였다(*P* = 0.055). 조리원 외 급식소 지원 인력은 평균 5.5명으로, 고이해도군 소속 시설(6.5명)이 저이해도군 소속 시설(4.9명)보다 유의하게 많았다(*P* = 0.020).

발달장애인을 위한 급식 환경 현황은 Fig. 1과 같다. 휠체어 이용을 위한 전용 식사 공간(60.0%)과 보조기구 이동 공간(57.8%)은 절반 이상의 시설에 설치되어 있는 반면, 발달장애인용 식사 도구(11.1%), 배식 공간 내 시각적 안내선(15.7%) 등의 설치율은 낮은 수준이었다.

4. 식단 작성 시 고려사항 및 중요 요인

발달장애인을 위한 식단 작성 시 고려사항 및 중요 요인에 대한 인식은 Table 5에 제시하였다. 식단 작성 시 가장 중요하게 고려하는 요인은 '이용자의 기호도' (44.4%)였으며, 다음으로 '예산' (31.1%), '영양 필요량' (11.1%) 순이었다.

식단 작성 시 중요 요인에 대한 인식을 5점 만점으로 조사한 결과, '기호도 및 선호도'의 평균 점수가 4.2점으로 가장 높았고, 다음으로 '식사의 시각적 구성(색감, 모양 등)' (4.1점), '음식의 온도 조절' (3.9점), '스스로 식사 가능한 음식 크기 및 형태 조정' (3.8점), '알레르기 및 특수식 제공' (3.4점) 순이었다. 고이해도군(4.5점)의 '기호도 및 선호도'에 대한 중요도 인식은 저이해도군(4.1점)보다 유의적으로 높았다(*P* = 0.048).

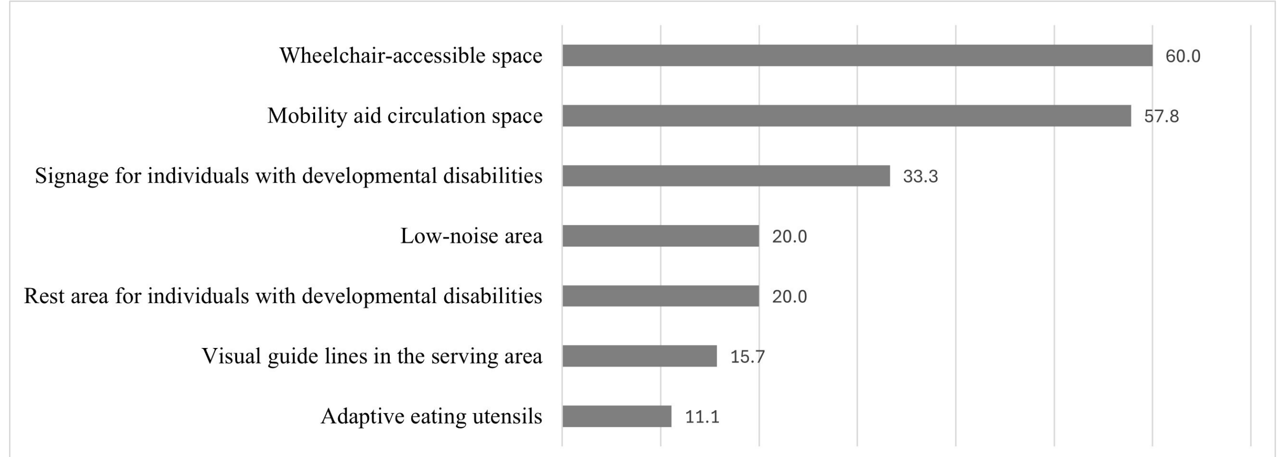

Fig. 1. Proportion of facilities equipped with foodservice-related environmental supports for individuals with developmental disabilities (n = 45; unit: %).

Table 5. Primary considerations in menu planning and perceived importance of menu-planning factors for individuals with developmental disabilities

Variables	Low-understanding (n = 28)	High-understanding (n = 17)	Total (n = 45)	*P*-value[1)]
Primary consideration in menu planning[2)]				
User preferences	12 (42.9)	8 (47.1)	20 (44.4)	0.858
Budget	10 (35.7)	4 (23.5)	14 (31.1)	
Nutritional requirements	3 (10.7)	2 (11.8)	5 (11.1)	
Seasonal factors	2 (7.1)	1 (5.9)	3 (6.7)	
Ease of food preparation	1 (3.6)	2 (11.8)	3 (6.7)	
Importance in menu planning for developmental disabilities[3)]				
Food preferences and acceptability	4.07 ± 0.76	4.53 ± 0.51	4.24 ± 0.71	0.048
Appropriate food size	3.75 ± 0.92	4.00 ± 0.79	3.84 ± 0.87	0.466
Appropriate food temperature	3.82 ± 0.77	4.00 ± 0.61	3.89 ± 0.71	0.528
Dietary restrictions	3.29 ± 1.04	3.71 ± 0.92	3.44 ± 1.01	0.180
Visual presentation of meals	4.04 ± 0.79	4.29 ± 0.68	4.13 ± 0.75	0.296

n (%) or Mean ± SD.
Low- and high-understanding groups were classified based on the median score of the developmental disability understanding scale (mean score of 6 items; median = 3.0).
[1)] *P*-values by Fisher's exact test or Mann–Whitney U test.
[2)] Participants were asked to select the single most important consideration in menu planning.
[3)] Importance of each factor in menu planning for individuals with developmental disabilities was assessed using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).

5. 영양교육 현황 및 요구도

1) 영양교육 실시 현황

발달장애인을 대상으로 영양교육을 실시하고 있는 시설은 고이해도군 3개소(17.6%), 저이해도군 2개소(7.1%)에 불과하였으며, 군에 따른 유의적 차이는 나타나지 않았다. 영양교육을 실시하는 5개소의 운영 현황은 Table 6에 제시하였다. 연간 교육 횟수는 4개소가 연 1회, 1개소가 연 12회를 운영하고 있었다. 교육 시간은 4개소는 30–60분이었고, 60분 이상 실시한 시설은 1개소였다.

교육 방법은 5개소 모두 대면 집합교육을 운영하고 있었으며, 요리실습 등 체험형 교육(3개소)과 동영상 시청(2개소) 등을 병행하고 있었다. 최근 1년간 교육 주제를 조사한 결과, '편식 개선' (3개소)이 가장 많았고, '음식 집착 및 비만' (2개소), '음식 거부 및 영양결핍' (1개소) 등이었다. 발달장애인을 대상으로 영양교육을 실시할 때의 가장 큰 어려움은 '교육자료 부족' (2개

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Table 6. Current status of nutrition education practices in facilities implementing nutrition education

Variables	Low-understanding (n = 2)	High-understanding (n = 3)	Total (n = 5)	*P*-value[1)]
Frequency of nutrition education (per year)				
Once	2 (100.0)	2 (66.7)	4 (80.0)	> 0.999
12 times	0 (0.0)	1 (33.3)	1 (20.0)	
Duration of nutrition education (min)				
10–29.9	1 (50.0)	0 (0.0)	1 (20.0)	> 0.999
30–59.9	1 (50.0)	2 (66.7)	3 (60.0)	
≥ 60	0 (0.0)	1 (33.3)	1 (20.0)	
Type of nutrition education[2)]				
Lecture-based education	2 (100.0)	3 (100.0)	5 (100.0)	-
Experiential education	0 (0.0)	3 (100.0)	3 (60.0)	0.100
Video-based education	0 (0.0)	2 (66.7)	2 (40.0)	0.400
Education using visual materials	1 (50.0)	1 (33.3)	2 (40.0)	> 0.999
Regular provision of nutrition information	1 (50.0)	0 (0.0)	1 (20.0)	0.400
Others	1 (50.0)	0 (0.0)	1 (20.0)	> 0.999
Topics of nutrition education[2)]				
Diet-related diseases and obesity	0 (0.0)	2 (66.7)	2 (40.0)	0.400
Food refusal and nutritional deficiencies	0 (0.0)	1 (33.3)	1 (20.0)	> 0.999
Picky eating	0 (0.0)	3 (100.0)	3 (60.0)	0.100
Others	2 (100.0)	0 (0.0)	2 (40.0)	> 0.999
Difficulties in providing nutrition education[3)]				
Lack of appropriate teaching methods	0 (0.0)	1 (33.3)	1 (20.0)	> 0.999
Communication difficulties	1 (50.0)	0 (0.0)	1 (20.0)	
Challenging behaviors	0 (0.0)	1 (33.3)	1 (20.0)	
Lack of education materials	1 (50.0)	1 (33.3)	2 (40.0)	

n (%) or Mean ± SD.
Low- and high-understanding groups were classified based on the median score of the developmental disability understanding scale (mean score of 6 items; median = 3.0).
[1)]*P*-values by Fisher's exact test.
[2)]Multiple responses allowed.
[3)]Participants were asked to select the single largest difficulty.

소), '지도방법의 어려움' (1개소), '의사소통의 어려움' (1개소), '돌발행동 관리' (1개소)인 것으로 나타났다.

2) 영양교육 미실시 이유 및 요구도

발달장애인 대상 영양교육을 실시하지 않고 있는 40개소를 대상으로 미실시 이유와 관련 요구도를 조사한 결과는 Table 7에 제시하였다. 영양교육을 실시하지 않는 가장 큰 이유는 '근무시간 부족' (32.5%)이었으며, 그 외 '교육 효과에 대한 낮은 기대' (22.5%)와 '발달장애 관련 지식 부족' (20.0%)이 주요 이유인 것으로 나타났다.

향후 영양교육 실시를 위한 교육 주제로는 '편식' (47.5%)과 '음식 집착 및 비만' (37.5%)에 대한 요구도가 가장 높았다. 향후 영양교육 운영을 위해 필요한 사항으로는 '교육자료 제공' (62.5%)에 대한 요구도가 가장 높았으며, 다음으로 '영양교육 관련 연수 기회' (20.0%), '교육 인력 지원' (15.0%) 순으로 나타났다. 미실시 이유와 관련 요구도 모두 두 군 간 유의적인 차이는 보이지 않았다.

3) 영양교육 필요성 및 직무역량 인식

발달장애인 대상 영양교육 필요성 및 관련 직무역량에 대한 인식은 Table 8에 제시하였다. 발달장애인의 영양개선 필요성, 영양교육을 통한 영양개선 가능성에 대한 인식은 각각 3.9점, 3.2점으로 보통 이상 수준이었으며, 두 군 간 유의한 차이가 나타나지 않았다. 반면, 영양교육의 필요성에 대한 인식의 경우 고이해도군(4.0점)이 저이해도군(3.5점)보다 유의하게 높게 나타났다($P = 0.032$).

발달장애인 대상 영양교육 수행을 위해 필요한 직무역량에 대해 조사한 결과, '장애별 특성 이해'의 중요도가 4.2점으로 가장 높았으며, 다음으로 '의사소통 역량' (4.1점), '라포 형성 능력' (4.1점) 순이었다. '라포 형성 능력'과 '상황 대응력'에 대한 중요도에서는 두 군 간 유의한 차이가 나타났다. '라포 형성 능력'에 대한 중요도는 고이해도군(4.4점)이 저이해도군(4.0점)

Table 7. Reasons for not implementing nutrition education and related educational needs for individuals with developmental disabilities

Variables[1)]	Low-understanding (n = 26)	High-understanding (n = 14)	Total (n = 40)	*P*-value[2)]
Reasons for not implementing nutrition education[1)]				
Lack of knowledge about developmental disabilities	6 (23.1)	2 (14.3)	8 (20.0)	0.852
Lack of educational materials	3 (11.5)	1 (7.1)	4 (10.0)	
Insufficient time	8 (30.8)	5 (35.7)	13 (32.5)	
Low awareness of the importance of nutrition education	1 (3.8)	2 (14.3)	3 (7.5)	
Perceived low effectiveness of nutrition education	6 (23.1)	3 (21.4)	9 (22.5)	
Others	2 (7.7)	1 (7.2)	3 (7.5)	
Educational topic needs				
Food preoccupation and obesity	7 (26.9)	8 (57.1)	15 (37.5)	0.333
Food refusal and nutritional imbalance	4 (15.4)	1 (7.1)	5 (12.5)	
Picky eating	14 (53.8)	5 (35.8)	19 (47.5)	
Others	1 (3.9)	0 (0.0)	1 (2.5)	
Support needs for nutrition education implementation				
Provision of educational materials	17 (65.4)	8 (57.1)	25 (62.5)	0.581
Training programs for nutrition education	5 (19.2)	3 (21.4)	8 (20.0)	
Development of educational guidelines	4 (15.4)	2 (14.3)	6 (15.0)	
Improving awareness among facility managers	0 (0.0)	1 (7.2)	1 (2.5)	

n (%).
Low- and high-understanding groups were classified based on the median score of the developmental disability understanding scale (mean score of 6 items; median = 3.0).
[1)]For each domain, participants were asked to select the single most important item.
[2)]*P*-values by Fisher's exact test or Mann–Whitney U test.

Table 8. Perceptions of the need for nutrition education and importance of job competencies for individuals with developmental disabilities

Variables[1)]	Low-understanding (n = 28)	High-understanding (n = 17)	Total (n = 45)	*P*-value[2)]
Perceived need for nutrition education				
Need for nutritional improvement	3.82 ± 0.72	4.12 ± 0.69	3.93 ± 0.72	0.198
Need for nutrition education	3.50 ± 0.63	4.00 ± 0.70	3.69 ± 0.70	0.032
Effectiveness of nutrition education	3.11 ± 0.78	3.35 ± 0.93	3.20 ± 0.84	0.387
Perceived importance of job competencies				
Nutrition counseling skills	3.82 ± 0.81	4.12 ± 0.60	3.93 ± 0.75	0.242
Understanding of characteristics of developmental disabilities	4.25 ± 0.79	4.24 ± 0.56	4.24 ± 0.71	0.687
Communication skills	4.07 ± 0.76	4.24 ± 0.66	4.13 ± 0.72	0.526
Rapport-building skills	3.96 ± 0.74	4.41 ± 0.61	4.13 ± 0.72	0.039
Situational response skills	3.89 ± 0.62	4.35 ± 0.60	4.07 ± 0.65	0.018
Ability to develop nutrition education materials	3.93 ± 0.66	4.12 ± 0.60	4.00 ± 0.64	0.377
Mean	3.98 ± 0.63	4.24 ± 0.50	4.08 ± 0.59	0.164

Mean ± SD.
Low- and high-understanding groups were classified based on the median score of the developmental disability understanding scale (mean score of 6 items; median = 3.0).
[1)]5-point Likert scale (1 = strongly disagree, 5 = strongly agree).
[2)]*P*-values by Mann–Whitney U test.

보다 높았으며(P = 0.039), '상황 대응력'에 대한 중요도 역시 고이해도군(4.4점)이 저이해도군(3.9점)보다 유의하게 높았다 (P = 0.018). 다른 영역에 대한 중요도에서는 두 군 간 유의한 차이가 나타나지 않았다.

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DISCUSSION

본 연구는 서울·경기 지역 장애인복지관을 대상으로 발달장애인을 위한 급식관리 및 영양교육 현황을 분석하여 향후 급식 및 영양교육 지원체계의 개선과 정책적 기반 마련을 위한 기초자료를 제공하고자 하였다. 연구대상 시설의 하루 평균 장애인 급식 인원은 107명으로 높은 수준이었으며, 선행연구 결과와도 유사하였다[22]. 그러나 조리원이 1명만 근무하는 시설이 절반 이상이었고, 조리원 1명이 평균 116명의 급식을 담당하는 것으로 나타나 조리 인력의 업무 부담이 큰 것을 알 수 있었다. 조리 인력의 부족은 장애인복지관의 효율적인 급식관리를 어렵게 하는 주요 장애요인 중 하나이다[28]. 「장애인복지시설의 종류별 사업 및 설치·운영기준」에는 장애인거주시설에 대해 조리원을 시설당 1명 배치하도록 되어 있고, 시설거주자가 50명 이상인 경우에는 50명을 초과할 때마다 1명을 추가하도록 하고 있다[29]. 이러한 장애인거주시설의 인력 배치 기준과 달리, 비거주시설인 장애인복지관은 조리 인력 배치에 대한 명확한 법적 기준이 마련되어 있지 않다. 이로 인해 장애인복지관의 경우 이용자 수에 비해 조리 인력 부족으로 급식 관리의 효율성 확보에 어려움이 있을 수 있다. 따라서 장애인복지관의 안정적인 급식 제공과 위생관리 체계 확보를 위해서는 급식 인원 규모에 적정한 조리 인력 지원이 필요하며, 이를 위해서는 관련 기준 마련이 우선되어야 한다.

연구대상 시설 중 석식을 제공하는 시설은 1개소에 불과하였고, 간식을 제공하는 시설은 없었다. 그러나 복지관 이용자가 다양한 프로그램에 참여함에 따라 에너지 요구량이 증가할 수 있음을 고려할 때, 이용자의 특성을 반영한 보완적 식사 지원 또는 간식 프로그램의 도입도 고려될 필요가 있다.

한편, 1식당 평균 식재료비는 선행연구[22, 28] 대비 상승한 것으로 나타났으나 3,402원에 불과하였으며, 5개소 중 1개소(22.2%)는 3,000원에도 미치지 못하였다. 이는 학교급식의 식재료비보다도 현저히 낮은 수준이다. 예를 들어, 경기도의 경우 2025년 기준 급식 인원이 101–200명일 때 1식당 식재료비가 학교급에 따라 4,100–5,190원으로 책정되었다[30]. 이러한 점을 고려할 때, 감각 특성 및 섭식행동을 반영한 맞춤형 식단 구성이나 대체 식품 제공이 필요한 발달장애인을 대상으로 하는 장애인복지관 급식에서는 현재의 식재료비 수준이 충분하지 않을 가능성이 있다. 따라서 장애인복지관 급식의 적정 식재료비 수준을 산정하기 위한 추가 연구가 필요하며, 이를 근거로 1인당 식재료비의 현실화 방안을 마련할 필요가 있다.

연구 결과 식단 작성 시 가장 우선적으로 고려되는 요인은 이용자의 기호도와 예산이었으며, 영양 필요량에 대한 고려는 상대적으로 낮았다. 이는 선행연구[24]의 결과와도 일치한다. 그러나 발달장애인은 과식, 편식, 특정 식품 선호 등으로 인해 영양소 섭취 부족, 식품군 섭취의 불균형, 낮은 식사의 질 등이 보고되고 있으며[31–33], 이에 따라 맞춤형 영양관리의 중요성이 강조된다. 따라서 발달장애인의 감각 특성, 인지 수준, 의사소통 능력, 식행동 문제를 반영한 개별화된 식단 관리와 영양교육이 병행되어야 하며, 장애인복지관에서 활용할 수 있는 맞춤형 가이드라인 개발이 필요하다.

급식소의 물리적 환경에 있어서는 절반 이상 시설에서 이동편의성에 대한 고려가 확인되었으나, 발달장애인의 식사를 직접 지원하는 세부 시설의 설치율은 전반적으로 낮았다. 특히 발달장애인용 식사도구 준비율이 10% 대에 불과하고, 배식 공간 내 시각적 안내선 설치율 또한 낮은 수준으로 나타났다. 이러한 환경적 제약은 발달장애인의 자율적인 식사 수행을 어렵게 하고, 식사 과정에서의 혼란과 의존도를 증가시킬 가능성이 있다. 높은 감각 민감성을 가진 발달장애인은 식사 환경이 심리적 스트레스 요인으로 작용하여 식사 거부나 불안 반응으로 이어질 수 있다[34, 35]. 지적장애인을 대상으로 한 건강증진 중재는 물리적 환경을 포함한 개입이 영양 개선에 보다 효과적인 것으로 나타나[36], 발달장애인의 적절한 영양관리를 위해서는 식사환경 개선이 우선되어야 할 것이다. 다만 소규모 시설의 공간적·재정적 제약을 고려할 때 개인 특성에 맞춘 식사 보조 도구, 시각적 안내자료 등 비교적 적용 가능성이 높은 환경 개선 전략을 우선적으로 검토하고, 조용한 시간대 배치 등 운영 조정을 병행하는 방안을 고려할 수 있다.

한편, 발달장애인을 대상으로 영양교육을 실시하는 시설은 11.1%에 불과하였고, 대부분 연 1회 수준의 단발성·강의 중심 교육에 머물러 있었다. 이러한 결과는 Jang 등[37]의 연구 결과와도 일치한다. 영양교육의 주요 어려움으로는 적절한 교육자료의 부족이 제시되었고, 영양교육을 실시하지 않은 가장 큰 이유는 시간 부족, 교육 효과에 대한 낮은 기대, 발달장애 관련 지식 부족 등이었다. 이는 Kim & Jeon [16]의 결과와 유사하며, 발달장애인 대상 영양교육이 영양사의 개별적인 역량이나 발달장애 이해도 수준보다 인력, 예산, 교육 자료 및 근무 시간 부족 등 시설 운영과 관련된 현실적인 제약 요인에 의해 좌우될 수 있음을 시사한다.

따라서 이러한 제약 요인을 완화하기 위해 교육 수행을 지원할 보조 인력 확보가 필요하며, 영양사의 역량 강화를 위한 연수 기회 확대, 표준화된 교육자료의 개발·보급 등이 병행되어야 한다. 또한 장애인복지관 시설장이 영양교육을 영양사의 공식 업무로 인식하고 지원하는 환경이 마련될 때 영양교육 수행 기반이 강화될 수 있을 것이다.

분석 결과, 고이해도군은 영양교육의 필요성과 라포 형성 및 상황 대응력의 중요도를 더 높게 평가하였다. 그러나 지적장애 및 자폐스펙트럼장애의 식행동 특성에 대한 이해도는 고이해도군과 저이해도군 모두에서 상대적으로 낮은 수준으로 나타났다. 이러한 결과는 장애인복지관의 영양사들이 영양교육의 중요성은 인식하고 있으나, 실제 식행동 문제에 대한 구체적인 이

해와 현장 적용 역량은 충분하지 않을 수 있음을 시사한다. 특히 발달장애인의 식행동 문제는 감각 처리 특성, 제한적이고 반복적인 행동 양상, 의사소통의 어려움 등과 복합적으로 연관되어 있어[36] 개별화된 접근이 요구된다. 따라서 향후 장애인복지관 영양사를 대상으로 한 직무역량 교육은 발달장애인의 식행동 문제에 대한 이론적 이해와 함께 실제 사례 기반의 교육과 상황별 대응 전략을 포함하여 현장 적용 역량을 강화하는 방향으로 이루어져야 한다. 또한 발달장애인의 개별 특성을 반영한 맞춤형 영양관리 및 영양교육 프로그램 개발과 이를 현장에서 활용할 수 있는 실무 중심 가이드라인 마련이 병행되어야 한다.

본 연구를 종합해 볼 때, 장애인복지관에서의 발달장애인 맞춤형 급식 관리 및 영양교육은 충분히 체계화되지 않은 수준이라고 할 수 있다. 국내외 다양한 연구에서 발달장애인 대상 영양교육의 효과가 일관되게 확인되고 있으므로[12-15], 장애인복지시설의 영양사는 체계적인 급식 제공뿐 아니라 영양교육과 식습관 개선의 실행 주체로서의 역할을 강화할 필요가 있다. 그러나 발달장애인은 정보 처리 속도, 이해력, 표현 능력의 제약으로 인해 일반적인 강의식 교육이 효과적으로 전달되는 데 한계가 있으며[38, 39], 일회성 교육만으로는 행동 변화를 기대하기 어렵다[13, 15, 16]. 따라서 정기적이고 반복적인 교육체계 구축과 함께 감각 친화적·체험형 학습의 도입, 인지 및 의사소통 수준을 고려한 난이도 차별화, 부모·보호자 참여 연계가 필요하다. 아울러 표준화된 교육자료 및 가이드라인 개발과 영양사 대상의 실무 지침 및 연수 프로그램이 병행될 때, 장애인복지관 영양교육의 효과성을 더욱 제고할 수 있을 것이다.

Limitations

본 연구의 제한점은 다음과 같다. 첫째, 서울·경기 지역 45개 기관을 대상으로 한 횡단 연구로서 표본 규모와 지역적 범위의 한계로 인해 연구 결과를 전국 장애인복지관으로 일반화하는 데 제약이 있다. 둘째, 수집된 자료가 영양사의 자기보고식 설문에 기반하고 있어 회상 편향의 가능성이 있으며, 현장 관찰 등을 포함하지 않아 실제 급식 운영 현황을 객관적으로 확인하는 데 한계가 있었다. 셋째, 단면 자료를 활용하여 발달장애 이해도와 급식관리 및 영양교육 실행 간의 인과관계를 규명하기 어렵고, 이해도 평가에 표준화된 도구를 사용하지 못해 실제 수준을 충분히 반영하지 못했을 가능성이 있다. 또한, 이해도 점수를 중앙값을 기준으로 이분화하여 분석하였는데, 이는 정보 손실 및 통계적 검정력 감소를 초래할 수 있다[40]. 이러한 제한점을 고려하여 결과 해석에 주의가 필요하며, 향후 연구에서는 전국 단위로 표본을 확대하고 면담, 현장 관찰, 문서 분석 등을 포함한 혼합 연구 설계를 적용할 필요가 있다.

Conclusion

본 연구는 서울 및 경기 지역 장애인복지관을 대상으로 발달장애인 대상 급식관리 실태와 영양교육 수행 현황 및 요구도를 분석한 연구이다. 장애인복지관의 급식 운영은 중식 집중 구조와 인력·예산 제약 속에서 이루어지고 있는 것으로 나타났으며, 발달장애인의 섭식 특성을 충분히 반영한 급식 관리와 체계적인 영양교육 수행 기반은 전반적으로 충분하지 않은 수준으로 파악되었다. 따라서 장애인복지관의 운영 특성을 반영한 조리 인력 배치기준 마련, 성인 발달장애인의 영양 요구와 섭식 특성을 반영한 식단 지침 구축 및 급식 환경 개선 등이 필요하다. 또한, 효과적인 영양교육 운영을 위해서는 영양사 대상 전문교육 강화, 표준화된 교육자료의 개발 및 보급, 근무시간 및 인력 지원을 포함한 근무환경 개선이 이루어져야 할 것이다.

CONFLICT OF INTEREST

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

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DATA AVAILABILITY

Data are available upon request to the corresponding author.

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Research Article

노인의 점심 식사 장소에 따른 영양 섭취 실태 및 적정성 비교: 제7–8기(2018–2021) 국민건강영양조사 자료를 이용하여

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Differences in lunch nutrient intake and nutritional adequacy among Korean older adults by meal site: a cross-sectional analysis of the 2018–2021 Korea National Health and Nutrition Examination Survey data

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Objectives: This study aimed to examine whether the dietary quality of congregate lunches differs according to meal location among older adults and to identify meal settings that may represent gaps in nutritional oversight. Specifically, this study compared lunchtime nutrient intake and adequacy among older adults eating at workplaces, welfare centers, and religious institutions.
Methods: Data were obtained from the 2018–2021 Korea National Health and Nutrition Examination Survey. The participants included 487 adults aged ≥ 65 years who reported consuming lunch at institutional meal sites, including workplaces (n = 187), welfare centers (n = 145), and religious institutions (n = 155). Nutrient intakes, nutrient adequacy ratio (NARs), and the mean adequacy ratio were compared using complex-sample general linear models with Bonferroni post-hoc tests, adjusting for sex, age, and total energy intake.
Results: Socioeconomic characteristics were broadly comparable across groups, but nutrient intake and dietary quality differed according to meal location. In food-group analyses, meat intake was lowest among participants eating at religious institutions, and dairy intake also differed significantly across settings. In nutrient adequacy analyses, NAR for carbohydrate, thiamin, and niacin differed significantly by meal location. However, except for carbohydrate, most nutrient-specific NAR remained below 1.0 across all groups, indicating insufficient adequacy relative to one-third of the recommended intake from lunch alone.
Conclusion: The dietary quality of congregate lunches among older adults differed according to meal location. Although nutrient inadequacy was common across settings, older adults eating at religious institutions showed relatively lower adequacy for some nutrients,

particularly thiamin and niacin. These findings suggest that nutritional support should be strengthened across congregate meal services, with particular attention to less structured community-based settings such as religious institutions.

Keywords: aged; nutrition assessment; nutritional status; food services; food assistance

INTRODUCTION

우리나라는 2025년 만 65세 이상 인구가 전체 인구의 20.3%를 차지하면서 본격적인 초고령사회에 진입하였다[1]. 인구구조의 급격한 변화는 노인의 영양 불균형과 사회적 고립 문제를 심화시키고 있으며, 이에 대응하는 지역사회 급식 서비스는 단순한 식사 제공을 넘어 영양 안전망이자 심리적 기반 지원체계로서 그 역할과 중요성이 더욱 강조되고 있다[2, 3]. 특히, 서울특별시에 만 65세 이상 수급자 수가 최근 10년 사이에 약 188% 급증한 사례는[4] 취약계층 노인을 위한 급식 지원 수요가 폭발적으로 확대되고 있음을 실증적으로 보여준다. 이러한 급증하는 수요에 대응하기 위해 2025년 5월 기준 전국적으로 1,253개의 무료급식시설이 운영되고 있으나 공공영역인 노인복지관(13%)과 종합사회복지관(20%)의 비중만으로 수요를 감당하기에 역부족인 실정이다[5]. 이 과정에서 종교시설(32%)을 포함한 민간지원체계는 전체 급식 공급의 상당 부분을 분담하며 지역사회 영양지원의 핵심적인 역할을 수행하고 있다[5]. 그러나 이러한 종교시설을 포함한 민간 급식 지원 체계는 공공 시설 급식에 비해 제도적 관리의 사각지대에 놓일 가능성이 크다는 점에서 급식의 양적 확대를 넘어 질적 수준과 운영 실태에 대한 심도 있는 논의가 시급한 시점이다.

기관급식은 노인복지관, 종교시설, 직장 등 가정 외의 구조화된 환경에서 제공되는 점심식사를 포괄하며, 행정적 지원 및 영양사 배치와 표준화된 식단 운영과 같은 전문 영양관리 여부에 따라 식사의 질이 달라질 수 있다[6-8]. 그럼에도 불구하고 국내에서 수행된 기관급식 관련 연구와 정책적 논의는 주로 노인복지관이나 요양시설 등 정부 지원이나 규제를 받는 시설을 중심으로 축적되어 왔다[9-11]. 예를 들어, 노인복지시설의 급식·영양서비스 필요성[12, 13]이나, 의료복지시설, 요양시설, 주간보호센터와 같이 시설 거주 및 이용 노인을 대상으로 한 연구[14-16], 노인 여가복지시설을 이용한 노인의 급식 이용 여부를 비교한 연구[17]와 성인 근로자를 대상으로 한 직장 급식 연구[18]가 대부분이었다. 그러나, 최근 지역사회에서 중요성이 커진 종교시설 급식에 대해서는 이용실태나 영양적 평가와 관련된 연구는 상대적으로 부족하다. 종교시설 급식은 기부와 자원봉사에 의존하는 운영 특성상 공식적인 영양관리 체계 밖에서 이루어질 가능성이 있어, 식재료 구성의 일관성이나 필수 영양소 제공 측면에서 취약해질 위험이 있다[19]. 따라서, 직장, 노인복지관, 종교시설 등 기관급식 제공 장소에 따른 영양 적정성을 체계적으로 비교 및 평가하는 연구는 지역사회 노인 영양정책과 현장 중재의 우선순위를 설정하는 데 중요한 근거가 될 수 있다.

한국의 급속한 인구 고령화와 그에 따른 기관급식 의존도 증가는 지역사회 노인 영양관리의 패러다임 전환을 요구하고 있다. 특히 급식 제공 장소의 다변화는 각 시설의 운영 주체와 자원 수준에 따라 노인이 섭취하는 식사의 질에 큰 차이가 있음을 의미한다. 따라서 급식 장소의 유형별로 영양 적정성을 파악하는 것은 취약한 부분을 찾아내어 표준화된 영양지원 안전망을 구축하기 위해 필요하다. 이에 본 연구는 2018–2021 국민건강영양조사(Korean National Health and Nutrition Examination Survey, KNHANES) 자료를 활용하여, 직장, 노인복지관, 종교시설에서 점심을 섭취한 노인을 대상으로 에너지 및 영양소 섭취량과 식사의 질을 비교·분석하고자 한다.

METHODS

Ethics statement

The KNHANES was conducted with approval from the Institutional Review Board of the Korea Disease Control and Prevention Agency, and all participants provided written informed consent. This study was a secondary analysis of anonymized public data and was exempted from review by the Institutional Review Board of Ewha Womans University (IRB No. ewha-202508-0024-01).

1. 연구설계

본 연구는 단면 연구로, STROBE statement (https://www.strobe-statement.org/) 보고지침을 따라 기술하였다.

2. 자료출처 및 표본설계

본 연구는 2018년부터 2021년까지의 KNHANES 원시자료를 통합하여 분석하였다. 해당 기간 동안 건강설문조사와 영양조사에 모두 참여한 대상자는 총 60,022명이었다. 연구 대상자 선정과정은 Fig. 1에 제시하였다.

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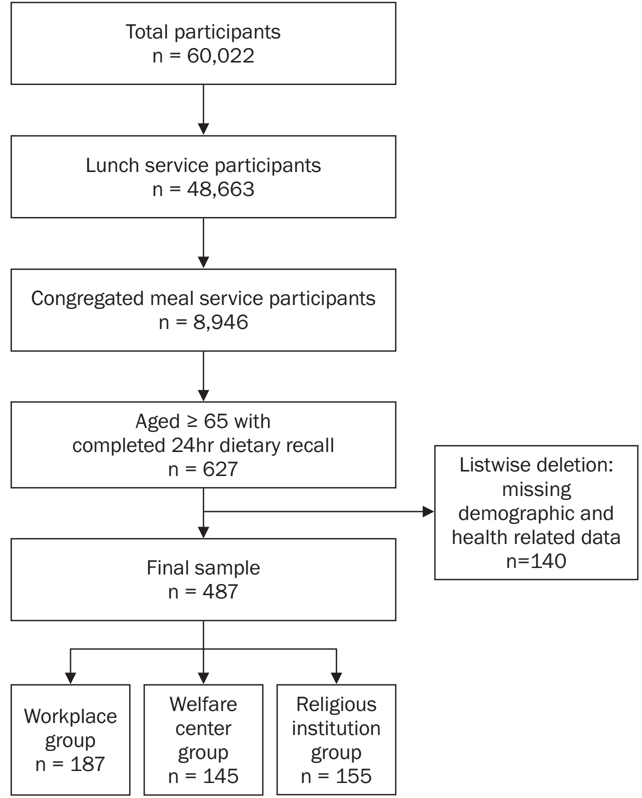

Fig. 1. Flow diagram of participant selection.

대상자 선정 과정은 다음과 같이 수행하였다. 먼저 점심식사를 섭취하였다고 응답한 48,663명 중, 점심 식사 장소로 '단체급식'을 이용하였다고 응답한 8,946명을 추출하였다. 이 중 65세 이상이면서 영양조사(24시간 회상법) 항목에 모두 응답한 627명을 1차로 선별하였다. 이후 성별, 연령, 가구소득, 거주지역, 교육수준 등 인구사회학적 변수와 건강 관련 주요 변수[저작곤란, 주관적 건강상태, 체질량지수(body mass index, BMI) 등]에 결측치가 있는 대상자를 목록별 삭제(listwise deletion) 방식으로 제외하여, 총 487명을 최종 분석 대상자로 선정하였다.

점심 섭취 장소에 따라 최종 대상자 487명은 직장군(n = 187), 복지시설 점심급식군(n = 145), 종교시설군(n = 155)으로 분류하였다. 본 연구에서 직장군은 KNHANES 항목 중 점심 섭취 장소를 '직장'으로 응답한 대상자이다. 복지시설군은 노인대학, 노인복지관, 경로당 등 지역사회 노인여가복지시설에서 제공하는 급식을 이용한 집단이며(장기요양시설 등 입소 및 거주시설 이용자 제외), 종교시설군은 교회나 성당, 사찰 등에서 제공하는 급식을 이용한 집단으로 정의하였다(Fig. 1).

3. 연구 변수

1) 일반적 특성

연구대상자의 사회인구학적 특성은 성별, 연령, 거주지역, 교육수준, 결혼상태, 기초생활수급 여부, 가구소득 분위로 구성하였다. 거주지역은 등록 주소의 행정구역 기준에 따라 '읍·면'은 농촌, '동(시)'은 도시로 분류하였다. 건강 관련 특성에는 저작 곤란, 주관적 건강상태, BMI를 포함하였다. 저작 곤란과 주관적 건강상태는 1점(매우 어렵다/매우 나쁘다)에서 5점(전혀 어렵지 않다/매우 좋다)까지의 5점 리커트 척도(Likert scale)로 평가하였으며 점수가 높을수록 좋은 것을 의미한다.

2) 식사의 질 평가

본 연구는 2025 한국인 영양소 섭취기준에 근거하여 식사의 질을 평가하였다. 식품군 분석은 KNHANES의 분류체계를 토대로 곡류, 감자 및 전분류, 당류, 두류, 견과류 및 종실류, 채소류, 버섯류, 과일류, 해조류, 육류, 난류, 어패류, 우유 및 유제품류, 음료류의 총 14개 군으로 세분화하였다. 점심 1회 섭취량을 대상으로 분석을 수행하였기에 영양소 섭취 적정성은 2025 한국인 영양소 섭취기준[20]에 제시된 연령별 권장섭취량의 1/3을 기준값으로 설정하여 평가하였다. 지표 산출을 위해 탄수화물을 포함한 11개 주요 영양소의 영양소 적정섭취비율(nutrient adequacy ratio, NAR)을 산출하였으며, 평균영양소 적정섭취비율(mean adequacy ratio, MAR)은 탄수화물을 제외한 10개 영양소의 NAR 값을 산술평균하여 도출하였다[21, 22].

4. 통계 분석

모든 통계 분석은 IBM SPSS Statistics 25.0 (IBM Co.)을 이용하였다. KNHANES의 복합표본설계를 반영하기 위해 층화(strata), 집락(cluster), 가중치(weight) 변수를 할당한 복합표본 분석(complex sample analysis)을 실시하였다. 대상자의 일반적 특성과 같은 범주형 변수는 복합표본 카이제곱 검정(complex-sample Chi-square test)을 통해 집단 간 분포 차이를 평가하였고, 빈도와 백분율(n, %)로 제시하였다. 식품군 및 영양소 섭취량, NAR, MAR 등 연속형 변수는 복합표본 일반선형모형(complex-sample general linear model)을 이용하여 평균과 표준오차(mean ± standard error)로 산출하였다. 이 때 집단 간 평균 비교를 위해 총 에너지 섭취량, 성별, 연령을 공변량으로 보정하였으며, 사후 검정은 Bonferroni 방법을 적용하였다. 모든 통계적 유의수준은 $P < 0.05$로 설정하였다.

RESULTS

1. 일반적 특성

급식 장소에 따른 연구대상자의 일반적 특성은 Table 1에 제시

Table 1. General characteristics of participants according to meal location

Category	WP (n = 187)	WC (n = 145)	RI (n = 155)	Total (n = 487)	*P*-value[1)]
Sex					< 0.001
Male	101 (57.0)	69 (46.3)	36 (22.5)	206 (42.9)	
Female	86 (43.0)	76 (53.7)	119 (77.5)	281 (57.1)	
Age (year)					< 0.001
< 75	169 (91.9)	53 (37.8)	75 (46.8)	297 (61.9)	
≥ 75	18 (8.1)	92 (62.2)	80 (53.2)	190 (38.1)	
Area of residence					0.788
Urban	143 (76.6)	118 (80.4)	119 (77.8)	380 (78.1)	
Rural area	44 (23.4)	27 (19.6)	36 (22.2)	107 (21.9)	
Education level (n = 469)					0.941
≤ Elementary school	58 (24.1)	44 (22.7)	51 (23.6)	153 (23.6)	
Middle school	21 (8.7)	21 (10.7)	12 (10.4)	54 (9.9)	
High school	55 (34.9)	31 (29.9)	36 (29.3)	122 (31.7)	
≥ College	49 (32.2)	43 (36.7)	48 (36.7)	140 (34.9)	
Marital status					0.244
Married	130 (67.9)	95 (60.2)	99 (58.2)	324 (62.6)	
Single	57 (32.1)	50 (39.8)	56 (41.8)	163 (37.4)	
National basic livelihood security recipient					0.743
Yes	9 (4.1)	6 (2.9)	8 (4.4)	23 (3.9)	
No	178 (95.9)	139 (97.1)	147 (95.6)	464 (96.1)	
Personal income quartile					0.497
Low	40 (20.3)	37 (22.7)	36 (19.8)	113 (20.8)	
Middle-low	60 (33.8)	29 (21.8)	42 (29.1)	131 (28.8)	
Middle-high	41 (19.8)	40 (28.0)	40 (26.4)	121 (24.3)	
High	46 (26.1)	39 (27.5)	37 (24.7)	122 (26.1)	
Monthly household income (1,000 KRW)	508.79 ± 31.11	532.00 ± 36.50	513.84 ± 37.01	518.21 ± 19.48	0.891

n (%) or Mean ± SE.
WP, workplace group; WC, welfare center group; RI, religious institution group.
[1)]*P*-value was determined by chi-square test and complex-sample general linear model.

하였다. 거주지역, 교육 수준, 결혼상태, 기초생활수급 여부, 개인소득 분위, 월평균 가구소득은 세 집단 간 유의한 차이가 없었다(모두 $P > 0.05$). 전체 대상자의 78.1%가 도시 지역에 거주하였고, 교육 수준은 고등학교 졸업(31.7%)과 대학 이상(34.9%)이 높은 비중을 차지하였다. 결혼상태는 유배우자가 62.6%로 가장 많았으며, 기초생활수급자 비율은 3.9%였다. 따라서, 세 집단은 전반적으로 사회경제적 배경이 유사한 것으로 확인되었다.

반면, 성별과 연령 분포는 급식 장소에 따라 유의한 차이를 보였다(모두 $P < 0.001$). 전체 대상자 중 여성의 비율은 57.1%였으나, 집단별로 종교시설군이 77.5%로 가장 높았고, 복지시설군 53.7%, 직장군이 43.0% 순으로 나타났다. 연령의 경우, 직장군은 75세 미만이 91.9%로 대부분을 차지한 반면, 복지시설군과 종교시설군의 75세 미만 비율은 각각 37.8%, 46.8%로 나타나 직장군이 타 집단에 비해 상대적으로 젊은 연령층으로 구성됨을 확인하였다.

2. 체질량지수와 주관적 건강상태

연구대상자의 BMI와 주관적 건강상태는 Table 2에 제시하였다. BMI, 주관적 건강상태의 분포와 평균 점수, 저작곤란의 분포와 평균 점수는 모두 세 집단 간 유의한 차이가 없었다(모두 $P > 0.05$). BMI는 직장군 23.65 ± 0.43 kg/m^2, 복지시설군 22.91 ± 0.47 kg/m^2, 종교시설군 23.02 ± 0.40 kg/m^{2}로 세 집단 간 유의한 차이가 없었다. 주관적 건강상태는 '나쁨' (50.1%)이 가장 높은 비율을 보였고, '매우 나쁨' (26.4%)이 뒤를 이었다. 저작곤란은 '전혀 불편하지 않음'이 43.7%로 가장 높았고, '별로 불편하지 않음' 25.4%, '불편함' 14.8% 순으로 나타났다.

3. 급식 장소에 따른 점심식사 주요 식품군 섭취량 비교

급식 장소에 따른 주요 식품군 섭취량 비교 결과는 Table 3에 제

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Table 2. Body mass index, self-rated health status, and chewing problems according to meal location

Category	WP (n = 187)	WC (n = 145)	RI (n = 155)	Total (n = 487)	*P*-value[1)]
BMI (kg/m^2)	23.65 ± 0.43	22.91 ± 0.47	23.02 ± 0.40	23.19 ± 0.25	0.553
Self-rated health status (n = 470)					0.695
Very good	4 (2.4)	5 (3.6)	8 (5.8)	17 (3.8)	
Good	7 (2.8)	4 (2.5)	3 (2.0)	14 (2.4)	
Moderate	20 (9.8)	13 (6.9)	17 (11.0)	50 (9.3)	
Poor	90 (46.9)	74 (55.1)	76 (49.7)	240 (50.1)	
Very poor	48 (27.2)	36 (24.3)	43 (26.8)	127 (26.4)	
Average[2)]	3.34 ± 0.08	3.29 ± 0.06	3.23 ± 0.07	3.29 ± 0.04	0.565
Chewing problems (n = 390)					0.173
Very uncomfortable	4 (1.1)	5 (3.1)	4 (2.3)	13 (2.1)	
Uncomfortable	27 (14.8)	24 (17.1)	19 (12.8)	70 (14.8)	
Moderate	25 (18.5)	13 (12.6)	13 (9.6)	51 (14.0)	
Not uncomfortable	42 (29.5)	25 (23.8)	34 (21.7)	101 (25.4)	
Not uncomfortable at all	53 (36.0)	48 (43.3)	54 (53.7)	155 (43.7)	
Average[2)]	3.85 ± 0.09	3.87 ± 0.12	4.12 ± 0.11	3.95 ± 0.06	0.116

n (%) or Mean ± SE.
WP, workplace group; WC, welfare center group; RI, religious institution group; BMI, body mass index.
[1)] *P*-values were determined by chi-square test for categorical variables and by complex-sample general linear model for continuous variables.
[2)] 5-point Likert scale. Higher scores indicate better self-rated health or less chewing difficulty.

Table 3. Comparison of food group intake at lunch according to meal location

Food groups	WP (n = 187)	WC (n = 145)	RI (n = 155)	Total (n = 487)	*P*-value[1)]
Grains (g)	80.55 ± 12.27	72.13 ± 3.80	96.04 ± 22.97	82.91 ± 5.72	0.156
Potatoes and starch (g)	12.33 ± 1.39[a]	1.70 ± 1.00[ab]	6.85 ± 1.71[b]	6.96 ± 0.25	< 0.001
Sugars (g)	2.97 ± 0.46[a]	0.79 ± 0.73[ab]	0.69 ± 0.54[b]	1.82 ± 0.26	0.016
Beans (g)	12.61 ± 1.50	11.71 ± 2.97	13.68 ± 6.51	12.67 ± 3.31	0.703
Seeds and nuts (g)	0.76 ± 0.16	0.51 ± 0.14	0.40 ± 0.16	0.55 ± 0.08	0.163
Vegetables (g)	125.80 ± 16.54	111.54 ± 12.49	117.99 ± 18.05	118.44 ± 7.43	0.829
Mushrooms (g)	9.72 ± 4.02	13.14 ± 0.54	8.21 ± 5.74	10.36 ± 3.08	0.415
Fruits (g)	27.50 ± 2.52	24.56 ± 2.53	18.78 ± 2.95	24.64 ± 1.60	0.201
Meats (g)	59.28 ± 7.56[a]	31.68 ± 1.28[b]	13.78 ± 4.62[c]	34.91 ± 2.19	0.003
Eggs (g)	4.51 ± 2.08	4.61 ± 0.00	79.31 ± 23.69	29.48 ± 7.76	0.105
Seafoods (g)	5.45 ± 6.33[a]	29.93 ± 6.58[a]	7.07 ± 6.58[b]	14.15 ± 2.88	0.023
Seaweeds (g)	19.56 ± 8.21	33.40 ± 2.16	25.52 ± 1.70	26.16 ± 4.02	0.412
Dairy products (g)	24.96 ± 2.57[ab]	31.52 ± 2.59[a]	21.51 ± 3.04[b]	26.10 ± 1.72	< 0.001
Drinks (g)	82.97 ± 9.99[a]	79.55 ± 10.01[a]	52.53 ± 11.77[b]	73.02 ± 6.61	< 0.001

Adjusted Mean ± SE
WP, workplace group; WC, welfare center group; RI, religious institution group.
[1)] *P*-values were obtained using a complex-sample adjusted for total energy intake, sex, and age.
[a–c] Different letters indicate statistically significant differences according to the Bonferroni test.

시하였다. 보정 후 분석에서는 곡류, 두류, 견과류 및 종실류, 채소류, 버섯류, 과일류, 난류, 해조류 섭취량에서 급식 장소에 따른 유의한 차이가 없었다(모두 $P > 0.05$). 반면, 감자 및 전분류, 당류, 육류, 어패류, 우유 및 유제품류, 음료류 섭취량은 급식 장소에 따라 유의한 차이를 보였다(모두 $P < 0.05$). 육류 섭취량은 직장군이 59.28 ± 7.56 g으로 가장 높았고, 복지시설군 31.68 ± 1.28 g, 종교시설군 13.78 ± 4.62 g 순으로 나타났다($P = 0.003$). 감자 및 전분류 섭취량은 직장군(12.33 ± 1.39 g)이 종교시설군(6.85 ± 1.71 g)보다 유의하게 높았으며($P < 0.001$), 당류 섭취량도 직장군(2.97 ± 0.46 g)이 종교시설군(0.69 ±

0.54 g)보다 유의적으로 높았다(P = 0.016). 어패류 섭취량은 복지시설군(29.93 ± 6.58 g)이 종교시설군(7.07 ± 6.58 g)보다 유의하게 높았고(P = 0.023), 우유 및 유제품류 섭취량은 복지시설군(31.52 ± 2.59 g)이 종교시설군(21.51 ± 3.04 g)보다 유의하게 높았다(P < 0.001). 직장군(24.96 ± 2.57 g)은 두 군과 유의한 차이가 없었다. 음료류 섭취량은 직장군(82.97 ± 9.99 g)과 복지시설군(79.55 ± 10.01 g)이 종교시설군(52.53 ± 11.77 g)보다 유의하게 높았다(P < 0.001).

4. 급식 장소에 따른 점심식사 에너지 및 영양소 섭취량 비교

급식 장소에 따른 점심 에너지 및 영양소 섭취량 비교 결과는 Table 4에 제시하였다. 에너지 섭취량, 성별, 연령을 보정한 후 탄수화물, 지방, 식이섬유, 당류, 칼슘, 철, 나트륨, 칼륨, 마그네슘, 비타민 A, 리보플라빈, 비타민 C, 비타민 D, 비타민 E 섭취량은 급식 장소에 따른 유의한 차이가 없었다(모두 P > 0.05). 반면, 단백질, 인, 티아민, 나이아신 섭취량과 단백질 에너지 기여율은 급식 장소에 따라 유의한 차이를 보였다. 단백질 섭취량은 직장군이 25.52 ± 1.08 g으로 복지시설군(23.30 ± 0.63 g) 및 종교시설군(21.17 ± 0.99 g)보다 유의하게 높았고(P = 0.008), 단백질의 에너지 기여율도 직장군이 16.29% ± 0.55%로 가장 높았으며, 종교시설군(13.87% ± 0.55%)과 유의한 차이를 보였다(P = 0.007). 미량 영양소의 경우, 인 섭취량은 직장군(340.26 ± 11.17 mg)이 종교시설군(300.55 ± 12.19 mg)보다 유의적으로 높았고(P = 0.049). 티아민 섭취량은 직장군(0.49 ± 0.03 mg)이 복지시설군(0.39 ± 0.02 mg) 및 종교시설군(0.34 ± 0.03 mg)보다 유의적으로 높았다(P = 0.001). 나이아신 섭취량도 직장군(4.15 ± 0.26 mg)이 종교시설군(3.14 ± 0.22 mg)보다 유의적으로 높았다(P = 0.012).

5. 급식 장소에 따른 점심식사 영양소 적정섭취비율 및 평균 영양소 적정섭취비율 비교

급식 장소에 따른 NAR 및 MAR 비교 결과는 Table 5와 같다.

Table 4. Energy and nutrient intake of participants at lunch according to meal location

Nutrient intakes	WP (n = 187)	WC (n = 145)	RI (n = 155)	Total (n = 487)	P-value[1)]
Energy (kcal)	599.82 ± 41.23	595.85 ± 32.02	607.63 ± 53.53	601.10 ± 23.39	> 0.999
Water (g)	252.11 ± 13.22	251.74 ± 13.26	219.04 ± 14.03	240.96 ± 6.91	0.128
Carbohydrates (g)	88.40 ± 2.83	92.48 ± 1.89	96.89 ± 3.93	92.59 ± 1.73	0.163
Protein (g)	25.52 ± 1.08[a]	23.30 ± 0.63[b]	21.17 ± 0.99[b]	23.33 ± 0.53	0.008
Fat (g)	15.81 ± 1.05	14.77 ± 0.77	13.75 ± 1.50	14.77 ± 0.66	0.507
Energy contribution (%)					
Carbohydrate	62.05 ± 1.35	63.28 ± 1.25	66.69 ± 1.55	64.01 ± 0.79	0.069
Protein	16.29 ± 0.55[a]	15.07 ± 0.43[ab]	13.87 ± 0.55[b]	15.08 ± 0.28	0.007
Fat	20.05 ± 1.14	20.24 ± 1.06	18.16 ± 1.36	19.48 ± 0.65	0.458
Dietary fiber (g)	7.12 ± 0.40	7.41 ± 0.33	6.95 ± 0.35	7.16 ± 0.21	0.635
Sugar (g)	11.61 ± 1.37	11.08 ± 1.16	10.54 ± 1.45	11.08 ± 0.75	> 0.999
Calcium (mg)	135.00 ± 11.25	152.16 ± 12.56	135.68 ± 12.75	140.95 ± 6.62	0.744
Iron (mg)	3.72 ± 0.23	3.72 ± 0.28	3.03 ± 0.19	3.49 ± 0.11	0.061
Phosphorus (mg)	340.26 ± 11.17[a]	333.77 ± 9.49[ab]	300.55 ± 12.19[b]	324.86 ± 5.72	0.049
Sodium (mg)	1,196.26 ± 65.72	1,210.45 ± 55.60	1,160.69 ± 81.03	1,189.13 ± 39.88	> 0.999
Potassium (mg)	774.76 ± 35.99	796.11 ± 32.37	704.86 ± 41.62	758.58 ± 18.47	0.122
Magnesium (mg)	95.41 ± 4.03	98.03 ± 4.21	88.38 ± 4.15	93.94 ± 2.22	0.204
Vitamin A (μg RAE)	127.46 ± 14.73	121.72 ± 12.08	93.71 ± 11.57	114.30 ± 8.11	0.131
Thiamine (mg)	0.49 ± 0.03[a]	0.39 ± 0.02[b]	0.34 ± 0.03[b]	0.41 ± 0.02	0.001
Riboflavin (mg)	0.48 ± 0.03	0.47 ± 0.03	0.41 ± 0.03	0.45 ± 0.02	0.149
Niacin (mg)	4.15 ± 0.26[a]	3.64 ± 0.18[ab]	3.14 ± 0.22[b]	3.65 ± 0.12	0.012
Vitamin C (mg)	14.35 ± 1.84	15.94 ± 2.36	14.87 ± 2.62	15.05 ± 1.21	> 0.999
Vitamin D (μg)	1.06 ± 0.24	1.09 ± 0.20	0.88 ± 0.29	1.01 ± 0.13	> 0.999
Vitamin E (mg)	2.23 ± 0.18	2.11 ± 0.09	1.89 ± 0.13	2.08 ± 0.07	0.251

Adjusted Mean ± SE.
WP, workplace group; WC, welfare center group; RI, religious institution group.
[1)]P-values were obtained using a complex-sample adjusted for total energy intake, sex, and age.
[a,b]Different letters indicate statistically significant differences according to the Bonferroni test.

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Table 5. NAR and MAR at lunch according to meal location

Category	WP (n = 187)	WC (n = 145)	RI (n = 155)	Total (n = 487)	*P*-value[1)]
NAR					
Carbohydrates	1.77 ± 0.09[a]	2.17 ± 0.15[ab]	2.15 ± 0.13[b]	2.03 ± 0.06	0.039
Protein	0.80 ± 0.03	0.85 ± 0.02	0.81 ± 0.03	0.82 ± 0.01	0.240
Calcium	0.43 ± 0.03	0.48 ± 0.04	0.45 ± 0.03	0.45 ± 0.02	0.505
Iron	0.72 ± 0.03	0.83 ± 0.03	0.79 ± 0.03	0.78 ± 0.02	0.075
Phosphorus	0.87 ± 0.02	0.91 ± 0.02	0.84 ± 0.03	0.87 ± 0.01	0.095
Vitamin A	0.39 ± 0.05	0.42 ± 0.04	0.49 ± 0.05	0.43 ± 0.03	0.296
Thiamine	0.78 ± 0.03[ab]	0.86 ± 0.02[a]	0.75 ± 0.03[b]	0.80 ± 0.02	0.012
Riboflavin	0.66 ± 0.04	0.73 ± 0.03	0.70 ± 0.04	0.70 ± 0.02	0.367
Niacin	0.60 ± 0.03[a]	0.69 ± 0.03[b]	0.57 ± 0.03[a]	0.62 ± 0.02	0.009
Folate	0.59 ± 0.03	0.63 ± 0.04	0.70 ± 0.04	0.64 ± 0.02	0.060
Vitamin C	0.32 ± 0.04	0.40 ± 0.04	0.44 ± 0.04	0.38 ± 0.02	0.050
MAR	0.77 ± 0.03	0.87 ± 0.04	0.85 ± 0.04	0.83 ± 0.02	0.100

Adjusted Mean ± SE.
NAR, nutrient adequacy ratio; MAR, mean adequacy ratio; WP, workplace group; WC, welfare center group; RI, religious institution group.
[1)]*P*-values were obtained using a complex-sample adjusted for total energy intake, sex, and age.
[a,b]Different letters indicate statistically significant differences according to the Bonferroni test.

공변량(총 에너지 섭취량, 성별, 연령)을 보정한 NAR은 1.0 기준으로 절삭하지 않고 산출하였으며, 1.0을 초과하는 값은 점심 1끼 기준 권장섭취량의 1/3 이상을 충족하였음을 의미한다. 분석 결과, 탄수화물의 NAR은 복지시설군(2.17 ± 0.15), 종교시설군(2.15 ± 0.13), 직장군(1.77 ± 0.09) 순으로 모든 군에서 1.0 이상이었으며, 급식 장소 간 유의한 차이를 나타냈다(*P* = 0.039). 그러나, 탄수화물을 제외한 모든 영양소의 NAR은 세 군 모두에서 1.0 미만으로 나타났고, 특히 칼슘, 비타민 A, 비타민 C의 섭취 적정성이 전반적으로 낮은 수준에 머물렀다.

영양소별 분석에서는 티아민과 나이아신에서 급식 장소에 따른 유의한 차이가 확인되었다. 티아민 NAR은 복지시설군(0.86 ± 0.02)이 종교시설군(0.75 ± 0.03)보다 유의하게 높았고(*P* = 0.012), 나이아신 NAR도 복지시설군(0.69 ± 0.03)이 직장군(0.60 ± 0.03) 및 종교시설군(0.57 ± 0.03)보다 유의하게 높았다(*P* = 0.009). 그 외 단백질, 칼슘, 철, 인, 비타민 A, 리보플라빈, 엽산, 비타민 C의 NAR과 MAR은 군 간 유의한 차이를 보이지 않았다(모두 *P* > 0.05).

DISCUSSION

본 연구는 KNHANES 2018–2021 자료를 활용하여, 점심 급식을 이용하는 65세 이상 노인의 급식 장소 유형(직장, 노인복지관, 종교시설)에 따른 영양소 섭취 상태 및 식사의 질을 비교·분석하였다. 분석 결과, 연구대상자의 사회경제적 배경이 유사함에도 불구하고 급식 장소에 따라 일부 영양소의 섭취량과 영양 적정성에서 유의한 차이가 나타났다. 특히 NAR 분석 결과, 탄수화물, 티아민, 나이아신에서 군 간 차이가 나타났으나, 탄수화물을 제외한 대부분의 영양소 NAR은 세 군 모두에서 1.0 미만으로 나타났다. 이는 노인 대상 기관급식 전반에서 점심 1끼 기준 권장섭취량의 1/3을 충족하지 못하는 영양소가 있음을 의미하며, 특히 종교시설 급식이 지역사회 영양관리 측면에서 상대적으로 취약할 수 있음을 보여준다.

본 연구의 NAR 결과는 통계적 유의성뿐 아니라 수치의 절대적 수준을 함께 고려하여 해석할 필요가 있다. 탄수화물 NAR은 세 군 모두 1.0 이상으로 유의한 차이를 보였으나, 이는 기준치를 이미 초과한 상태에서의 차이이므로 식사의 질이 우수하다고 단정하기에는 한계가 있다. 반면, 탄수화물을 제외한 대부분 영양소의 NAR은 공통적으로 1.0 미만이었다. 특히, 칼슘, 비타민 A, 비타민 C는 급식 장소와 관계없이 모든 군에서 낮은 수준을 보여, 노인 급식 전반에서 공통으로 부족한 영양소임을 확인하였다. 또한, 복지시설군에서 티아민과 나이아신의 NAR이 상대적으로 높게 나타났으나, 두 영양소 모두 1.0 미만이었고 MAR 역시 군 간 유의한 차이를 보이지 않았다. 따라서, 본 연구 결과는 급식 장소 간의 단편적인 질적 차이보다 노인 급식에서 나타나는 공통적인 영양소 결핍과 특정 영양소의 취약성에 초점을 맞추어 해석해야 한다.

이러한 영양 섭취의 차이는 집단간 사회경제적 배경 차이만으로는 충분히 설명되기 어렵다. 본 연구에서 경제적 수준이나 교육 정도는 세 군 간 유의한 차이가 없었으나, 성별과 연령을 보정한 후에도 급식 장소에 따른 영양 적정성의 차이는 유지되었다. 이는 급식 장소별 운영체계, 식재료 조달의 안정성, 영양사 등 전문 인력의 개입 여부와 같은 구조적 요인이 영양 상태

에 영향을 미쳤을 가능성을 시사한다. 특히 종교시설 급식은 자원봉사 중심의 운영과 기부 식재료에 대한 의존도가 높아 메뉴의 다양성과 영양 균형을 지속적으로 유지하기 어려운 구조적 한계가 영양소 부족으로 이어진 것으로 보인다[19, 23]. 이는 체계적인 급식 서비스를 이용하는 노인이 그렇지 않은 노인보다 식사의 질이 높았다는 선행연구 결과와도 유사한 경향을 보였다[17].

식품군별 섭취 결과는 이러한 해석을 뒷받침한다. 종교시설군은 직장군 및 복지시설군에 비해 육류 섭취량이 낮았고, 우유 및 유제품류 섭취량도 복지시설군보다 적었다. 즉, 단백질과 칼슘 급원 식품의 제공 수준 차이가 NAR 결과에 영향을 미쳤을 가능성을 시사한다. 반면, 직장군의 결과는 유료급식의 특성과 기관 차원의 체계적인 관리가 이루어지는 구조적 장점을 고려하여 결과를 해석할 필요가 있다[18, 24].

결론적으로, 노인의 영양 상태는 개인의 사회경제적 특성만이 아니라 이용하는 급식 서비스의 유형과 운영 특성에 따라 달라질 수 있다. 본 연구는 노인 대상 기관급식 전반에서 칼슘, 비타민 A, 비타민 C, 단백질 섭취의 적정성이 낮음을 확인하였으며 이는 노년기 근감소 예방과 건강 유지를 위한 개선이 시급함을 보여준다[25].

정책적 측면에서, 운영의 비공식성이 높은 종교시설 급식에 대한 우선적인 지원이 필요하다. 구체적으로는 단백질 급원 식품과 유제품을 포함한 '노인 맞춤형 표준 식단 가이드'를 보급하고, 지역 보건소 및 공공급식지원센터와 연계하여 순회 자문과 모니터링 시스템을 구축할 필요가 있다. 또한, 종교 기반 영양중재 사례[26, 27]를 참고하여 접근성이 높은 종교시설을 영양교육의 거점으로 활용하고, 식재료 단가 보전과 같은 실질적인 재정 지원을 통해 영양 불균형 문제를 구조적으로 해결해야 한다.

Limitations

본 연구는 단면 연구로서 급식 장소와 영양 상태 간의 인과관계를 명확히 규명하는 데 한계가 있다. 또한 24시간 회상법 자료를 이용하였기 때문에 개인의 평소 섭취량을 충분히 반영하지 못했을 가능성이 있다. 본 연구는 점심 1끼 섭취를 기준으로 식사의 질을 평가하였으므로, 평균필요량이나 상한섭취량을 기준으로 한 부족 및 과잉 섭취 우려 비율을 산출하여 집단의 영양 상태를 평가하는 데에는 제한이 있다. 아울러 KNHANES 원시 자료의 특성상 급식기관의 영양사 배치 여부, 실제 제공 식단, 조리 및 배식 환경, 운영방식 등 세부적인 급식 운영 특성을 파악할 수 없어 장소별 차이의 구체적인 원인을 분석하는 데 한계가 있었다. 그럼에도 불구하고 본 연구는 전국 규모의 대표성 있는 자료를 활용하여 종교시설을 포함한 다양한 기관급식 장소에 따른 노인의 영양섭취 상태와 식사의 질을 비교·분석하였다는 점에서 의의가 있다. 향후 연구에서는 1일 총섭취량 또는 반복 섭취자료를 활용한 영양평가와 함께, 급식기관의 운영 특성 및 실제 제공 메뉴를 함께 고려한 분석이 필요하다.

Conclusion

본 연구는 노인 대상 기관급식의 영양 관리가 급식이 제공되는 환경과 운영 특성에 따라 달라질 수 있음을 보여준다. 특히, 지역사회 기반의 비공식적 급식 환경은 영양관리의 사각지대가 될 가능성을 고려할 필요가 있다. 따라서, 상대적 취약성이 확인된 종교시설 급식을 중심으로 단백질 급원식품 강화, 간편 식단 가이드 보급, 지역사회 전문 인력을 활용한 교육 및 모니터링 체계 구축 등의 맞춤형 지원책이 마련되어야 한다. 본 연구 결과는 지역사회 노인 급식 서비스의 질적 개선과 영양 격차 해소를 위한 정책적 기초자료로 활용될 수 있을 것이다.

CONFLICT OF INTEREST

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

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None.

DATA AVAILABILITY

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

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Revised in October 15, 2024

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<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¤tPageNo=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.

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

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

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

I. GENERAL RULES

1. Title

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

2. Purpose

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

II. ETHICS CODE FOR A RESEARCHER

3. Integrity of Researcher

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

4. Inclusion of Scientific Misconduct

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

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

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

6. Authorship

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

7. Record of Published Work

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

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

8. Citation and Reference

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

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

9. Role and Ethics for a Journal Editor

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

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

10. Role and Ethics for a Reviewer

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

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

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

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

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

III. ESTABLISHEMENT AND OPERATION OF THE COMMITTEE

11. Function of the Committee

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

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

12. Organizing Principles of the Committee

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

13. Report and Receipt of the Scientific Misconduct

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

14. Authority for Verification and Recommendation of the Committee

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

15. Verification Process of the Committee

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

16. Assurance of Opportunity to Be Heard

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

17. Confidentiality Duty for a Member of the Committee

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

18. Disciplinary Procedures and Content

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

19. Revision of the Code of Research Ethics

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

Author's checklist

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	
	3. Submission	- The title page, the copyright transfer agreement, and IRB approval are all included when submitting your paper to the submission site by uploading them to the 'Attachment' section. - Remove the cover page including author information from the submitted paper before submitting	
	4. ORCID	- ORCID should be stated for all authors e.g., Gildong Hong: https://orcid.org/https://orcid.org/0000-0000-0000-0000	
	5. Funding	e.g., This research was supported by a grant from the National Research Foundation of Korea (Grant No. 000). - When there is no funding associated with the manuscript, 'None.' should be stated.	
Abstract	1. Structure	- Objectives-Methods-Results-Conclusion	
	2. Keywords	- Three to five keywords are recommended with one or two words except for technical terms. - The terminology should be listed, in principle, in MeSH (www.nlm.nih.gov/mesh/MBrowser.html). - Keywords are written in lowercase letters except for proper nouns, and keywords are separated by a semicolon (;).	
	3. Abbreviations	- Abbreviations should only be used if they are repeatedly used throughout the abstract. If an abbreviation is not used after it has been defined, use the full name instead - Define an abbreviation the first time it appears in the abstract	
Main body	1. Structure	- Title page, Abstract, Introduction, Methods (including ethics statement), Results, Discussion, Conflict of Interest, Acknowledgments, Data Availability References, Tables, and Figures - Include 'Study Design' in Method, subheadings in Results, and 'Limitations' and 'Conclusion' in Discussion - Upload tables and figures as a single file and do not separate them	
	2. Statistical software	- Enter the correct type and version of statistical software e.g., IBM SPSS Statistics 25 (IBM Corp.) e.g., SAS 9.4 (SAS Institute)	
	3. Ethics Statement	- Authors should present an "Ethics Statement" immediately after the heading "Methods". In case of reviews, research notes and educational materials, "Ethics statement" should be presented after introduction section e.g., The informed written consent was obtained from each participant. The study protocol was approved by the Institutional Review Board of *** (approval number: ***). *IRB approval statement will be included in the final version, but do not include specific IRB information (e.g., institution name) when submitting. e.g., Obtainment of informed consent was exempted by the institutional review board.	

(continued to the next page)

(Continued)

Category		Items to review	Check
	4. Conflict of Interest	- Conflict of interest must be stated. e.g., There are no financial or other issues that might lead to conflict of interest. e.g., Gildong Hong has been an editor since 2021. However, he was not involved in the review process of this manuscript. Otherwise, there was no conflict of interest. *Author information will be included in the final version but do not include it when submitting.	
	5. Acknowledgments	- List individuals who contributed to the writing or research, but do not meet the criteria for authorship. e.g., We thank the physicians who performed the sample collection. *This information will be included in the final version, but do not include it when submitting.	
	6. Data Availability	- Authors should provide a data availability statement. Providing access to research data is optional. e.g., The data that support the findings of this study are openly available in [repository name e.g "KNHANES"] at http://doi.org/[doi].	
	7. References	- Notation method: [1], [2, 5], [15-20], etc. without spaces before square brackets, when adding commas between references, add a space after commas. e.g., research on something [1] or Kim & Lee's research [2, 5] - References in the text should be listed in numerical order - The number of citations for the type of dissertation should not exceed 3. - Verify that the reference adheres to the KJCN guidelines	
	8. Other indications such as units	- Write numbers and units with a space (50 kg, 600 kcal), but attach % and °C. - g/dl (X), g/dL (O) - When indicating P-value, use capital, italic P: e.g., *P*-value - Use a en-dash "–" to indicate a range of numbers: e.g., 20–25 - Use comma notation to separate thousands (this also applies to text and tables): For example, 65,450,000.	
	9. Tables, figures	- Capitalize only the first letter of table and figure titles - Capitalize only the first letter of variables in the table - Use lowercase 'n' in tables and figures. - Additional checklists for tables and figures can be found in the section below.	

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

GUIDELINE FOR TABLES AND FIGURES

Please adhere the following guidelines for tables and figures.

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

Copyright transfer agreement

Manuscript Title: ____

Author(s): ____

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투고규정

(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 마지막 날이다. 생애주기영양, 영양판정, 영양교육, 영양역학, 식행동, 임상영양, 국제영양, 영양정책, 급식 및 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 투고할 수 있으며, 비회원의 경우 편집위원회에서 위촉 또는 국외 기관에 소속된 저자가 투고할 시 가능하다.

3. 원고의 종류

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

4. 연구 및 출판윤리

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

5. 성(SEX)/젠더(GENDER)에 대한 고려

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

- 성별 기술에서 성(sex)과 젠더(gender)를 구분하여 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 포함된 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.

8. 원고 작성법

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

2) **표지:** 다음의 내용을 포함한다.

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

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

〈예〉

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

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

〈예〉

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- 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.

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

- 연구윤리(Ethics Statement)

저자는 "방법(Method)" 연구윤리에 관해 영문으로 기술해야 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.

〈예〉

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

4) **영문초록:** 영문초록은 목적(Objectives), 연구방법(Methods), 결과(Results), 결론(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 띄어 쓴다.
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.

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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 후속조치에 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