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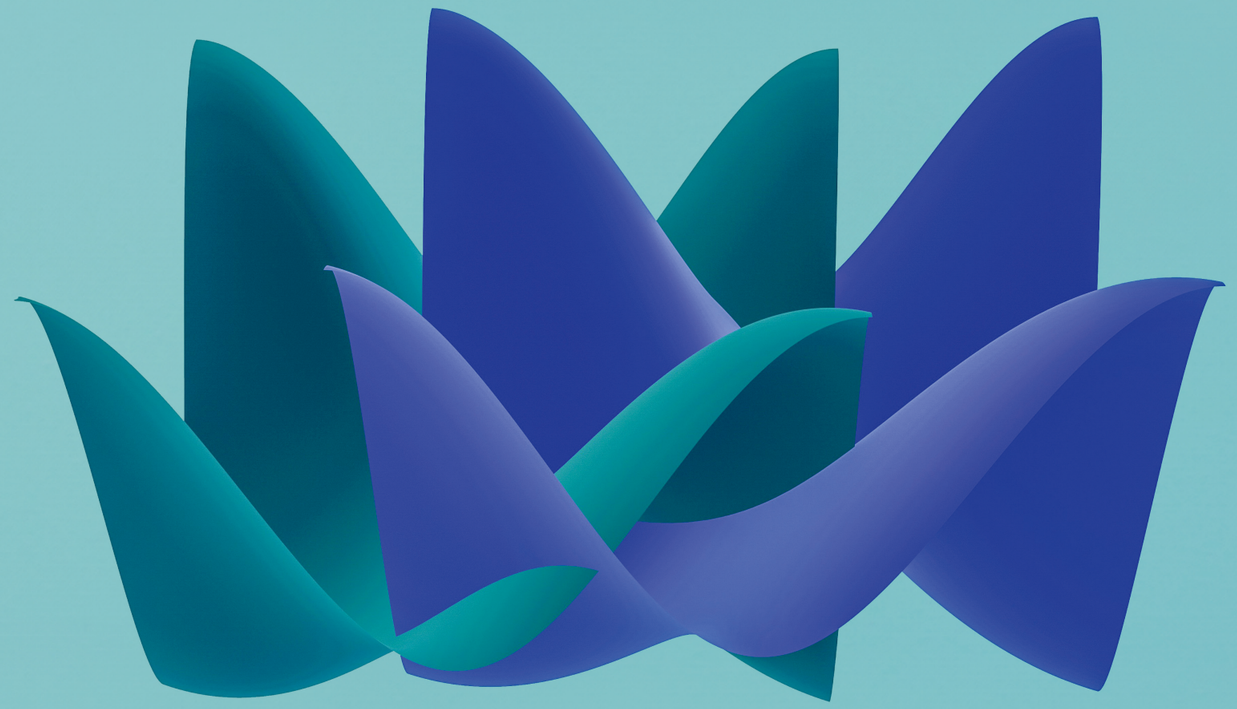

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AIMS AND SCOPE

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

BACKGROUND

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

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ABSTRACTING AND INDEXING

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Review

노인 대상의 영양교육 매체 현황 및 맞춤형 영양정보 제공을 위한 활용방안: 범이론적 모델과 먹거리 이해력 기반의 주제범위 문헌고찰을 중심으로

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Current status of nutrition education media and its utilization in providing customized nutrition information for older adults in Korea: a scoping review based on the transtheoretical model and food literacy

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Objectives: This study analyzes the status of nutrition education media among Korean older adults based on the transtheoretical model (TTM) and their food literacy to propose effective strategies for the development and utilization of educational media.
Methods: A literature review was conducted using The Joanna Briggs Institute protocol. The literature search was performed using government and local government agency websites, as well as those of affiliated institutions, health and nutrition-related academic societies, and academic search engines. A total of 144 studies were identified, and after a cross-evaluation by two reviewers based on the literature selection criteria, 73 studies were included in the final analysis.
Results: Among the types of nutrition education media, card news had the highest proportion, followed by video media. The development and distribution of nutrition education media for older adults were primarily carried out by government and local government agencies, as well as related affiliated institutions, accounting for 80.8% (n = 59) of the total. When nutrition education topics in the media were categorized according to the stages of behavior change in the TTM, the largest proportion, 64.6% (n = 61), was applicable to the precontemplation and contemplation stages. When categorized by food literacy domains, all topics fell under the categories of nutrition and safety.
Conclusion: Nutrition education media for older adults were found to be primarily focused on knowledge acquisition and information delivery, making them mostly applicable to the precontemplation and contemplation stages of behavior change. The concept of food literacy addressed in the different types of media was limited to the domains of nutrition and safety, with no content covering the cultural and relational domains or the social and ecological domains. For tailored nutrition education, it is necessary to develop diverse educational materials that comprehensively reflect each stage of the TTM and all aspects of food literacy.

Keywords: aged; food; literacy; transtheoretical model; food literacy

INTRODUCTION

의료기술 발달로 노년기가 연장됨에 따라 건강 유지에 대한 관심이 증가하고 있다. 또한 돌봄의 문제와 의료비 등 사회적 및 경제적 비용의 부담도 증가하고 있어 개인적인 수준과 함께 사회적으로 노인의 건강 관리에 대한 교육의 필요성이 요구되고 있다[1]. 이러한 배경 속에서 보건복지 분야에서는 노인에게서 발생하는 건강 문제를 해결하고 삶의 질을 높이기 위해 여러 영양교육 프로그램을 개발하여 노화를 대비하고 건강을 관리할 수 있도록 하고 있다[2]. 최근의 영양교육 프로그램의 내용은 건강과 관련된 지식을 제공하는 측면에서 벗어나 사회환경의 지속가능성에 기여하는 식생활을 제시하는 방향으로 변화하고 있다[3]. 또한 다양한 교육 프로그램이 개발되면서 교육대상의 연령에 맞는 매체와 종류를 활용하는 영양교육이 중요시되고 있다[4].

노인 대상의 매체들은 고령인 대상자의 특성을 고려하여 글자의 크기가 비교적 크고 알기 쉽게 글보다는 그림이 많은 것이 큰 특징인데, 현재 노인 대상의 기존 매체들은 일반 성인을 대상으로 하는 매체와 도구를 주로 활용하는 편이다. 신체가 건강한 성인을 대상으로 만들어진 매체자료를 그대로 노인 대상 영양교육 프로그램에 활용하기에는 한계점이 있기에 고령층 대상만을 위한 매체와 도구의 개발이 중요하다[5].

대상자 맞춤형 교육 매체를 효율적으로 활용하기 위해서는 대상자의 인지 또는 동기 부여 수준의 파악이 중요하다[6]. 따라서 건강행동이론을 기반으로 대상자를 진단하고 진단에 따른 매체의 활용은 대상자의 내적 동기를 유발하고 유지하는 데 도움이 될 수 있다. 건강행동이론 중 범이론적 모델(transtheoretical model)은 개인의 건강행위 변화를 단계적으로 설명하는 이론으로, 각 단계에 맞는 맞춤형 증진 전략을 적용하여 건강행위 실천을 유도할 수 있는 이론적 기반을 제시한 도구이다[7]. 특히 노인들은 신체적, 인지적 변화로 인해 일반적인 교육 방식으로는 충분한 효과를 보기 어려운 경우가 많아 범이론적 모델은 노인 대상의 영양교육에서도 효과적으로 활용될 수 있다[8].

영양교육의 효과를 위해서 이론적 모형의 적용을 통한 교육도 중요하지만 건강한 식품을 선택할 수 있는 능력을 높이기 위한 교육 주제도 중요하다. 최근 지속가능한 식생활 개선을 위하여 먹거리 이해력(food literacy)의 중요성이 대두되었고[9], 이는 노인의 영양 상태를 개선하는 데 도움이 될 수 있는 중요한 요소로 보고되고 있다[10]. 먹거리 이해력은 개인이 식품 선택, 준비, 소비 및 관리에 대해 지식과 기술을 갖추고, 이를 통해 지속 가능한 식습관을 유지할 수 있는 능력을 의미한다[9]. 노령층은 신체적, 인지적 변화로 인해 정보 접근 및 이해 능력이 저하될 수 있어 먹거리 이해력이 낮아지기 쉽다[11]. 먹거리 이해력을 향상시키기 위한 교육 매체의 개발과 활용을 통해 노인과 같은 취약 계층이 식단을 스스로 관리할 수 있는 능력을 향상시키고, 건강한 생활 방식을 유지하는 데 대한 자신감을 높이는 것은 중요할 것이다.

현재 국내 노인을 위한 영양교육 프로그램을 위한 매체의 종류들이 개발되고 있으나 이러한 매체들이 범이론적 모델의 어떤 단계에서 주로 활용될 수 있고, 먹거리 이해력의 어떤 영역을 주로 다루고 있는지에 대한 구체적인 연구가 되고 있지 않다. 따라서 본 연구에서는 주제범위 문헌고찰을 활용하여 노인 대상으로 개발된 영양교육의 매체들을 범이론적 모델과 먹거리 이해력을 기반으로 현황을 분석하여 향후 이들의 맞춤형 영양교육을 위한 방안을 제시하고자 하였다.

METHODS

Ethics statement

This study used data from previously published papers and systematically reviewed. Therefore, institutional review board approval was not deemed necessary.

1. 연구설계

본 연구는 주제범위 문헌고찰(scoping review)로, 연구의 기술은 PRISMA-ScR (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) 지침(https://www.prisma-statement.org/scoping)에 따라 기술되었다.

2. 연구대상 및 자료수집

노인을 위한 맞춤형 영양정보 제공을 위해, 국내 연구를 대상으로 영양교육 매체의 현황과 활용 방안을 주제범위 문헌고찰로 파악하였다. Arksey와 O'Malley [12]가 제시하고, Levac 등[13]이 구체화하여 보완한 주제범위 문헌고찰 방법 틀을 기반으로 개발된 국제 연구기관인 The Joanna Briggs Institute (JBI)에서 제시한 주제범위 문헌고찰 프로토콜에 맞춰 진행되었다[14, 15].

주제범위 문헌 고찰은 주제에 대해 사용할 수 있는 문헌을 체계적으로 지도화(mapping)하여 핵심 개념, 이론, 근거 출처 및 유형을 식별하는 탐색적 연구방법으로 사전 프로토콜(protocol)에 따라 계획되고 추진되어야 한다[16, 17]. JBI에서 제시한 연구 단계는 다음과 같다. (1) 연구 질문 도출, (2) 관련 문헌 조사, (3) 문헌 검색, (4) 문헌 추출, (5)자료 수집 • 요약 • 결과 보고[18], (1)–(4)까지는 본 연구의 연구방법 부분에 기술하였고, (5)는 연구결과 부분에 서술하였다.

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1) 1단계: 연구 제목 및 연구 질문 도출

주제범위 문헌고찰을 위해서 첫번째로 JBI 주제범위 문헌고찰 매뉴얼에 따라 연구 질문을 도출해냈다. 메뉴얼로는 대상(population), 맥락(context), 개념(concept)을 구체화하여 설정하였다. 대상은 국내 노인, 맥락은 국내 노인을 위한 영양교육 매체의 종류 및 개발 현황 파악으로, 본 문헌고찰의 연구 질문은 "노인 대상 교육을 위해 개발 및 활용되고 있는 교육 매체를 범이론적 모델과 먹거리 이해력 영역에 적용 시, 구성 요인 및 영역별 매체 유형의 분포 현황은 어떻게 되는가?"이다.

2) 2단계: 관련 문헌 조사

(1) 검색전략

연구의 문헌검색은 국내 노인을 대상으로 개발된 영양교육 매체 관련 주제로 학술지에 게재된 논문, 정부기관 보고서 등을 대상으로 2008년부터 2023년까지의 15년 기간 동안 보고된 문헌을 검색하였다. 이때 사용된 국내 검색 데이터베이스는 다음과 같다; 서울시 식생활 종합지원센터, 질병관리청, 식품의약품안전처(식품안전나라 포함), 한국건강증진개발원, 농림축산식품부 등의 정부 및 지자체 기관 및 관련 산하기관, 대한영양사협회, 한국지질 및 동맥경화학회, 대한신장학회, 한국영양학회, 대한고혈압학회 등의 학회, 국내저널 검색엔진(Korean Medical Database, KMbase, RISS), 국외 검색엔진(PubMed)을 활용하였다. 이때 사용한 국문 색인은 '노인', '영양교육', '매체', '국내', 영문 색인은 'older adults' 또는 'elderly', 'nutrition education', 'material', 'media'의 검색어를 조합하여 사용하였다.

(2) 문헌 선정기준 및 제외기준

문헌고찰에 포함된 자료의 선정 기준 다음과 같다; ① 대상자를 만 65세 이상의 노인으로 하였는가? ② 국내를 배경으로 연구가 진행된 논문인가? ③ 영양교육을 위한 매체 활용과의 관련성이 있는가? 제외기준은 매체가 노인 외에 다른 대상자를 위한 자료가 포함된 경우, 식생활이나 영양과 관련된 내용이 없는 경우, 자료의 공개(접근성)가 되지 않아 관련성 확인이 불가한 경우는 배제하였다.

3) 3단계: 문헌 검색

고찰할 문헌을 선정하기 위한 구체적인 과정은 Fig. 1과 같다. 우선, 관련 기관 홈페이지와 국내외 검색엔진에 관련 키워드를

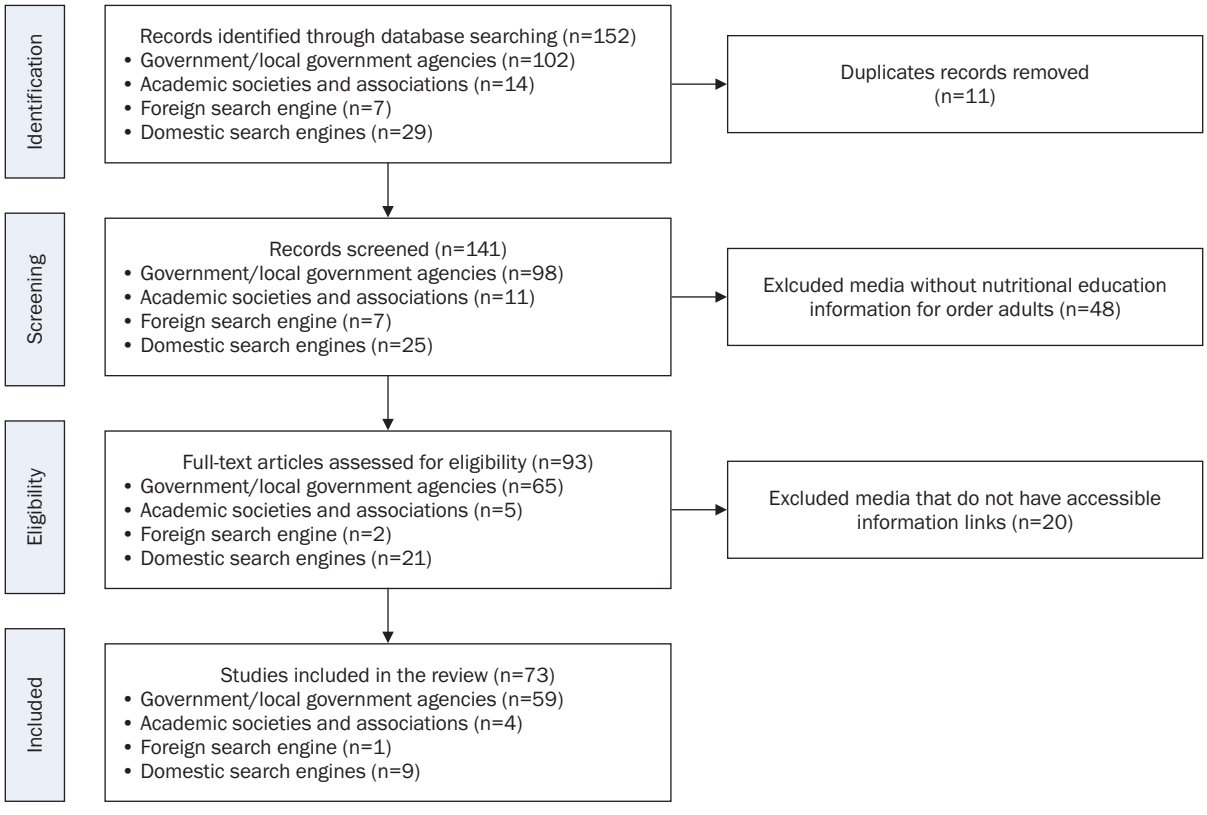

Fig. 1. PRISMA-ScR flow diagram of study selection for scoping review on nutrition education media for older adults in Korea.

넣어 총 152편의 관련 문헌을 찾았고 중복 문헌을 제외한 141편의 문헌을 일차적으로 선별하였다. 144편 중에서 93편의 문헌이 "국내, 노인, 영양교육, 매체"와 관련성이 있었고, 최종적으로 접근성이 유효한 문헌만을 추출한 결과 총 73편이 모든 조건에 부합하였다. 주제범위 문헌고찰의 가이드라인에 선정된 키워드를 기반으로 2명의 연구자(SY, JA)가 독립적으로 초기 문헌 검색 및 자료 검토를 진행하였다. 독립적 검토 후 연구자 간 선정된 문헌의 포함 여부에 대한 일치도를 확인하였다. 문헌 포함 여부에서 연구자 간에 의견이 일치하지 않은 경우, 좀 더 해당 분야 경험이 풍부한 제3의 연구자(KK)가 참여하여 논의된 내용을 기반으로 최종 합의에 도달할 때까지 회의를 반복적으로 수행하면서 합의 과정을 거쳤다. 최종 포함된 문헌들의 출처는 정부기관이 문헌의 80.8% (n = 59)로 가장 높았고, 다음으로는 국내외저널 검색엔진에서 13.7% (n = 10), 학회 및 협회에서 5.5% (n = 4) 순으로 나타났다.

4) 4단계: 문헌 추출

선정된 문헌은 노인 영양교육 매체의 현황 분석을 위해 4개의 특성에 따라 매체를 구분하였다. 첫번째, 영양교육 매체 유형을 구분하고, 오프라인 영양교육 매체와 온라인 영양교육 매체로 분류하였다. 두번째, 매체를 개발 및 배포한 기관에 따라 구분하였다. 세번째, 범이론적 모델의 단계에 따라 구분하였다. 범이론적 모델에서의 다섯 단계 중 단계별로 중복하여 활용할 수도 있는 점을 고려하여 이 연구에서는 고려전단계 및 고려단계, 준비단계, 행동 및 유지단계인 총 3단계로 분류하였다. 마지막으로 먹거리 이해력 구성 영역별(영양 및 안전 영역, 관계 및 문화 영역, 사회-생태 영역)로 분류하였다(Supplementary Table 1).

RESULTS

1. 영양교육 매체 유형과 활용범위 비율

영양교육 매체 유형과 활용범위의 비율은 Table 1과 같다. 매체 유형 중 비율이 가장 높은 것은 카드뉴스로 24건(30.4%)이었다. 그 다음으로는 동영상 21건(26.6%), Power Point 강의 자료 12건(15.2%), 리플렛 8건(10.1%)으로 높은 비율을 차지하였다. 매체의 활용범위에서 오프라인이 30건(38.0%)으로 비율이 가장 높고, 온/오프라인(병행) 26건(32.9%), 온라인 23건(29.1%) 순으로 나타났다.

2. 기관별 영양교육 매체 개발 및 배포 현황

기관별 영양교육 매체 개발 및 배포 현황은 Table 2와 같다. 교육 매체 자료 수가 가장 많은 기관은 정부 • 지자체 기관 및 관련 산하기관으로 59건(80.8%)을 차지하였다. 다음으로 국내외 저널 검색엔진에서 10건(13.7%), 학회 및 협회가 4건(5.5%)이었다. 정부 • 지자체 기관 및 관련 산하기관 중에서 매체 자료 수가 가장 많은 기관은 서울시 식생활 종합지원센터 31건(52.5%)

Table 1. Type of nutrition education material

Education material	Value
Media type	
Card news	24 (30.4)
Video	21 (26.6)
Power Point lecture material	12 (15.2)
Leaflet	8 (10.1)
Poster	3 (3.8)
Booklet	3 (3.8)
Manual/guidebook	3 (3.8)
Mobile APP, website	2 (2.5)
Infographic	2 (2.5)
Educational charts	1 (1.3)
Scope of use (online/offline application)	
Offline	30 (38.0)
Online	23 (29.1)
Both	26 (32.9)
Total	79 (100)[1)]

n (%).
[1)]Out of a total of 73 types of media, six were counted more than once when classified by media type.

Table 2. Source of nutrition education material

Source	Value
Government/local government agencies	59 (80.8)
Seoul Food Life Support Center	31 (52.5)
Korea Health Promotion Institute	11 (18.6)
Ministry of Food and Drug Safety/Food Safety Korea	10 (16.9)
Ministry of Agriculture, Food and Rural Affairs	4 (6.8)
Korea Disease Control and Prevention Agency	3 (5.1)
Media search engines	10 (13.7)
Academic thesis from RISS	7 (70.0)
Article from Korean Medical Database and KMbase	2 (20.0)
Article from PubMed	1 (10.0)
Academic societies and associations	4 (5.5)
The Korean Dietetic Association	3 (75.0)
The Korean Society of Lipid and Atherosclerosis	1 (25.0)
Total	73 (100)

n (%).

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으로, 한국건강증진개발원 11건(18.6%), 식품의약품안전처(식품안전나라 포함) 10건(16.9%), 농림축산식품부 4건(6.8%), 질병관리청 3건(5.1%) 순이었다. 국내 저널 검색엔진인 RISS로부터의 학위논문 7건(70.0%), KMbase로부터의 논문 2건(20.0%), 국외저널 검색엔진인 PubMed로부터의 논문 1건(10.0%)의 분포를 보였고, 학회 및 협회에서는 대한영양사협회 3건(75.0%), 한국지질·동맥경화학회 1건(25.0%)의 비율 분포를 보였다.

3. 범이론적 모델과 먹거리 이해력 영역에 따른 매체 현황

Table 3은 범이론적 모델의 행동단계에 따라 매체를 구분하고, 각 행동단계 내에서의 영양교육 주제에 해당할 수 있는 먹거리 이해력 영역에 따라 매체를 분류한 결과이다. 고려 전 단계 및 고려 단계는 51건(64.6%)으로 가장 높은 비중을 차지하였고, 준비 단계가 22건(27.8%), 행동 및 유지 단계는 6건(7.6%)으로 나타났다. 행동 단계별 먹거리 이해력을 분류한 결과, '영양 및 안전' 영역에 한정되었으며, 그 외에 '문화 및 관계' 및 '사회 및 생태적' 영역은 포함되지 않았다. 먹거리 이해력의 영양 및 안전 영역에 해당하는 교육 주제를 행동변화 단계별로 세분화한 결과, 고려 전 단계 및 고려 단계에서의 영양교육 매체 내용은 건강한 식생활 31건(60.8%), 만성질환 관리 12건(23.5%), 연하곤란 6건(11.8%), 여름철 노인 건강관리 2건(3.9%)이었다. 준비단계에서의 영양교육 매체 내용은 연하곤란 환자를 위한 식사 방법 실습 교육 10건(45.5%), 건강한 식사를 실천할 수 있는 방법 7건(31.8%), 만성 질환 관리를 위한 장기적인 식사 계획 5건(22.7%)이었고, 행동 및 유지단계에서는 만성 질환 관리를 위한 음식 선택 기술 4건(66.7%), 당뇨병 환자를 위한 모바일 앱을 통한 식이 모니터링 2건(33.3%)이었다.

Table 3. Distribution of materials by transtheoretical stages and food literacy

Materials	Value
Precontemplation and contemplation	51 (64.6)
Nutrition and safety domain	51 (100)
Information on healthy eating habits	31 (60.8)
Dietary information for chronic disease management	12 (23.5)
Dietary information for dysphagia	6 (11.8)
Methods for elderly health management in summer	2 (3.9)
Cultural and relationship	0 (0.0)
Social and ecological	0 (0.0)
Preparation	22 (27.8)
Nutrition and safety domain	22 (100)
Practical training on meal methods for patients with dysphagia	10 (45.5)
Methods of healthy dietary practices	7 (31.8)
Long-term dietary plan for chronic disease management	5 (22.7)
Cultural and relationship	0 (0.0)
Social and ecological	0 (0.0)
Action and maintenance	6 (7.6)
Nutrition and safety domain	6 (100)
Food selection skills for managing chronic diseases	4 (66.7)
Dietary monitoring by a mobile app for diabetic patients	2 (33.3)
Cultural and relationship	0 (0.0)
Social and ecological	0 (0.0)
Total	79 (100)[1)]

n (%).
[1)]Out of a total of 73 types of media, six media were counted more than once when classified by transtheoretical stages and food literacy.

DISCUSSION

본 연구는 주제범위 문헌고찰 방법을 사용하여 국내 노인을 대상으로 한 영양교육 매체를 범이론적 모델과 먹거리 이해력 영역을 기반으로 현황을 파악하여 활용 방안을 제안하고자 하였다. 노인을 대상으로 한 영양교육과 관련하여 활용가능한 매체를 중심으로 분석한 결과, 총 73개의 문헌이 포함되었다. 배포기관별로 매체를 분류하였을 시 정부/지자체 기관 및 관련 산하 기관에서 관련된 매체가 가장 많았다. 범이론적 모델에 따라 교육 매체를 분류하였을 때 고려 전 단계 및 고려 단계에서 사용 가능한 매체가 대부분이었고, 행동단계별 먹거리 이해력 영역을 적용했을 때에는 대부분 영양 및 안전 영역에 해당하였다. 영양 및 안전 영역에서 다룬 영양교육주제로는 건강한 식생활을 위한 정보가 가장 많이 차지하였다.

주제범위 문헌고찰은 특정 연구에 대해 심층적으로 분석하기보다는 연구의 진행 현황, 규모 등을 포괄적으로 살펴보는 방법이다[9, 19]. 주로 해당분야의 이용가능한 근거의 유형을 조사하고자 할 때, 특정 주제와 분야에 대해 연구가 얼마나 수행되었는지를 조사하고자 할 때 및 체계적 문헌고찰의 선행 연구로서 수행하고자 할 때 등과 같은 연구 목적을 위해 수행되는 방법이다[18, 20]. 본 연구에서는 노인을 대상으로 한 영양교육 매체의 개발 주제와 현황 및 분포 특성을 분석하였으며, 맞춤형 노인 대상 영양교육을 위해 범이론적 모델과 먹거리 이해력 영역을 기반으로 필요한 교육 주제나 방법에 대한 향후 방향을 제시하고자 했다.

범이론적 모델은 행동변화를 목표로 하여 프로그램 및 교육 전략을 개발하는데 적합한 이론으로, 행동변화단계에 따라 중

재전략을 제공하는 것이 건강위험행동을 개선시키는데 효과적이다[21]. 모바일을 통해 개인 맞춤형으로 이뤄지는 상호작용은 행동 중재 효과를 높이거나 행동 강화 요인으로 작용할 수 있다[22]. 따라서 헬스케어 프로그램들이 모바일과 같은 정보통신기술(information and communications technology) 기반으로 이루어짐에 따라 노인 대상의 영양교육 매체 또한 온라인 기반의 매체 요구도는 증가할 것이다. 이 연구에서는 온라인 기반의 매체가 29.1%의 비율을 보였고, 향후 이 비율은 더 증가할 것으로 생각된다. 매체를 범이론적 모델의 행동단계별로 구분하였을 때, 대부분의 매체는 고려 전 단계 또는 고려단계에 사용가능한 내용을 포함하였는데, 식품 또는 영양소 섭취의 이점이나 위험성, 적정섭취량, 식생활 지침과 같은 식생활 정보와 지식 제공 중심의 내용이 대부분이었다. 상대적으로 준비단계와 행동 및 유지단계에서 사용 가능한 매체의 교육 내용은 매우 부족한 실정이었다. 따라서 향후 노인 대상의 영양교육 내용을 개발함에 있어서 준비단계 대상자들에게 적합한 건강한 식품 섭취 목표 설정이나 섭취 일정 계획, 건강한 식품 섭취 증진을 위한 조리기술과 같은 매체나 내용이 필요할 수 있고, 행동 및 유지 단계의 대상자에서는 지속적으로 건강한 식품을 섭취하는 지의 모니터링을 위한 체크리스트, 건강하지 않은 식품을 건강한 식품으로 대체할 수 있는 팁, 불건강한 식품 섭취를 제한할 수 있는 방법 등의 관련된 정보를 효율적으로 제공하는 매체나 건강한 식품 섭취 증진을 위해 노인이 직접 참여하고 피드백을 주고받을 수 있는 상호적인 매체(예, 모바일 앱, 디지털 영양상담 등)의 활용이 필요할 것으로 생각된다.

최근 지속가능한 식생활의 중요성이 대두됨에 따라 이러한 식생활의 이해도와 실천력을 높일 수 있는 먹거리 이해력 향상은 중요하다[9]. 먹거리 이해력은 기능적, 상호작용적, 비판적 세 가지 핵심 영역으로 구성되어 있다. 기능적 영역은 영양 및 안전 영역으로, 개인의 능력과 관련한 개념을 나타내며 식품 기술과 지식, 자아효능감 및 자신감, 식행동을 포함한다. 상호작용적 영역은 문화 및 관계 영역으로, 자신뿐만 아니라 공동체 안에서의 식품 소비와 선택, 개인과 식품과의 관계를 포함하며, 다양한 식품을 사회적인 방법으로 즐기고 건강한 관계를 발전시키는 것을 의미한다. 비판적 영역은 사회 및 생태적 영역으로, 자신과 공동체에서 더 나아가 환경까지 생각하는 다양한 사고력을 의미하고, 식품 선택이 사회 및 환경에 미치는 영향을 인식한다[23]. 또한 이는 지속 가능한 환경적 요인과 건강의 사회적 결정요인을 포함한다[23]. 이러한 먹거리 이해력 개념을 적용해 매체의 영양교육 내용을 구분하였을 때 대부분 기능적 영역인 영양 및 안전 영역에 해당했으며, 문화 및 관계 영역과 사회 및 생태적 영역에 해당하는 국내 노인 대상의 영양교육 자료가 부족한 것을 확인할 수 있었다. 문화 및 관계 영역에 해당하는 영양교육 자료는 조리 및 식사하는 과정에 집중할 수 있는 내용이나 다양한 문화권과 관련한 내용을 포함할 수 있다. 따라서 노인이 음식을 직접 조리하고, 식사하는 과정에 음식에 집중하고 오감을 느끼고 즐길 수 있는 교육내용이 포함된 매체나 주변 지인들과 음식을 나누고 즐기거나 다양한 문화권의 음식을 소개하는 내용이 포함된 교육 내용과 매체 개발을 고려할 수 있다. 사회 및 생태적 영역은 지속가능성 식단이나 동물복지 및 친환경 식품, 로컬 푸드와 관련된 영양교육과 매체를 고려할 수 있다.

이 연구에서 노인 대상의 영양교육 매체 유형을 살펴보면 기존의 오프라인 기반 중심의 매체에서 벗어나 동영상, 카드 뉴스와 같은 온라인 기반의 매체의 비율이 높았던 것을 확인할 수 있었다. 정보통신 기술이 계속해서 발전함에 따라 키오스크 이용이나 스마트폰으로 인한 결제 등 디지털화가 빠르게 진행되고 있다. 이에 따라 정보와 디지털 기기에 대한 접근 및 활용할 수 있는 능력인 디지털 리터러시(digital literacy) 역량의 강화에 많은 초점을 두고 있다[24]. 최근 온라인 환경에서 새로운 사회적 관계 활동을 형성함으로써 삶의 즐거움을 찾는 노인들이 증가함에 따라 앱이나 웹과 같은 다양한 온라인 기반의 영양교육 매체 개발은 중요할 것이다[25]. 디지털 리터러시가 높은 노인의 경우, 개인이 인지하는 주관적 정서에 긍정적인 영향을 미치고, 심리적 안정감이 높은 것으로 보고되고 있다. 이에 따라 노인을 위한 온라인 기반의 교육 매체 개발의 요구도는 점차 높아질 것으로 사료된다[24]. 그러나 노인들은 디지털 기기에 대한 접근 및 활용에서 소외되기 쉬운 집단이기 때문에 향후 디지털 리터러시가 낮은 노인들이 접근하기 쉬운 온라인 기반의 매체 개발 및 노인 친화적인 사용자 인터페이스(user interface)와 사용성 테스트를 실시하여 실효성을 검증하는 것은 중요한 과제일 것이다[26].

Limitations

본 연구의 제한점은 다음과 같다. 첫째, 이 연구는 출판된 연구를 기반으로 하고 있어 출판되지 않은 영양교육 매체 연구가 포함되지 않았을 가능성이 있다. 이로 인해 특정 영양교육 매체의 연구가 누락될 가능성이 있으며, 연구 결과의 포괄성(comprehensiveness)이 제한될 수 있다. 둘째, 일부 영양교육 매체는 개발 이후 지속적인 유지 • 관리가 이루어지지 않아, 기관의 홈페이지나 검색 엔진에서 접근이 불가능한 경우가 발생할 수 있으며, 이로 인해 특정 매체가 연구에서 제외되는 한계가 있다. 마지막으로, 문헌고찰을 통해 다양한 영양교육 매체의 종류와 내용을 분석하였으나, 이들 매체가 실제 교육 현장에서 얼마나 효과적으로 활용되고 있는지에 대한 직접적인 검증이 이루어지지 않았다. 즉, 연구에서 제시된 매체들이 노인 대상 교육에서 실

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제로 사용되고 있는지, 사용자(노인 및 교육자)의 만족도와 접근성이 어떠한 지에 대한 실증적 데이터가 부족하여, 연구 결과를 실무에 적용하는 데 한계가 있을 수 있다.

Conclusion

본 연구는 주제범위 문헌고찰을 통해 국내 노인을 대상으로 한 영양교육 매체의 현황을 분석하고 효율적인 매체 활용을 위한 방안을 제시하고자 하였다. 대부분의 교육 주제는 영양 및 안전 영역 중심의 주제로, 정보나 지식 제공 기능을 위한 매체를 활용하고 있었다. 향후, 노인 대상의 영양교육이 보다 효과적으로 이루어지기 위해서는 노인의 신체적, 인지적 특성뿐만 아니라 행동단계별 특성을 고려하여 행동 변화를 유도하고 사회적 상호작용을 증진시키고 지속 가능한 식생활의 가치를 이해할 수 있는 교육 주제를 포함하여 다양한 디지털 기반의 매체 확대 및 지역사회 기반의 참여형 교육 프로그램이 필요할 것으로 생각된다.

CONFLICT OF INTEREST

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

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DATA AVAILABILITY

Research data is available upon request to the corresponding author.

SUPPLEMENTARY MATERIALS

Supplementary Table 1. Information on nutrition education materials for the elderly.

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Research Article

The impact of flash continuous glucose monitoring and nutrition coaching on dietary self-efficacy and weight management in university students in Korea: a pre-post intervention study

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Objectives: This study aimed to evaluate the impact of a 4-week multicomponent intervention combining flash continuous glucose monitoring (flash-CGM), group nutrition education, and personalized nutrition coaching on dietary self-efficacy (DSE) and weight management in healthy university students.

Methods: A total of 27 university students participated in a pre-post intervention study. The intervention included a single 4-hour group-based nutrition education session, flash-CGM usage (FreeStyle Libre; Abbott Diabetes Care), and weekly one-on-one nutrition coaching. Participants wore the CGM device for 28 days (replaced after 14 days), and were guided in using the FoodLens app (DoingLab) for dietary tracking and a mobile app-linked digital scale for weight monitoring. Outcomes measured before and after the intervention included DSE, body mass index (BMI), nutrition quotient (NQ) and glycemic indicators. Statistical analyses included Wilcoxon signed-rank and Mann-Whitney *U*-tests with significance set at $P < 0.05$.

Results: There was a significant increase in DSE ($P < 0.05$), particularly in managing eating behavior under stress and fatigue. A modest but significant decrease in BMI was observed in the overall group ($P < 0.05$), though changes were not significant in the BMI ≥ 23 kg/m^2 subgroup. Glycemic indicators showed minimal changes. The overall NQ score improved slightly, with significant increases in fruit intake ($P < 0.01$) and nutrition label checks ($P < 0.05$). High satisfaction levels (4.52 ± 0.65 on a 5-point scale) were reported for device usability and coaching services.

Conclusion: The multicomponent intervention improved DSE, NQ scores, and supported modest weight reduction among university students. The combined effect of CGM, nutrition education, and coaching appears promising; however, further studies are needed to isolate the effects of each component and evaluate long-term outcomes.

Trial Registration: Clinical Research Information Service Identifier: KCT0010255.

Keywords: flash continuous glucose monitoring; dietary self-efficacy; nutrition coaching; body mass index; university students

INTRODUCTION

The transition from adolescence to early adulthood represents a critical phase for establishing lifelong dietary habits [1]. Addressing this phase with targeted dietary interventions is crucial for preventing the onset of chronic conditions and promoting long-term well-being. University students, in particular, face unique challenges such as increased social engagements, diverse living arrangements (e.g., dormitories or shared apartments), and irregular eating patterns [1, 2]. The 2021 Korea National Health and Nutrition Examination Survey highlighted these issues, reporting that adults in their 20s have the highest breakfast skipping rates (53.0%) and lowest rates of healthy dietary practices (38.0%) [3]. This age group is also characterized by frequent consumption of convenience store meals, delivery food, and processed foods, prioritizing taste and convenience over health [2, 4]. Despite recognizing the importance of health management, only 4.0% of individuals in this age group have experienced formal nutrition education, significantly lower than other age groups [5].

During the COVID-19 pandemic, university students experienced a further decline in dietary quality, with reduced physical activity, increased weight gain, irregular eating patterns, and greater reliance on processed and delivery foods [6]. Although students understand the significance of health management [7], they often struggle to adopt health-promoting behaviors, emphasizing the need for targeted nutrition education programs.

Digital health tools, such as smartphone-based nutrition education [2, 8, 9] and continuous glucose monitoring (CGM), provide promising solutions for real-time dietary feedback. CGM, particularly the flash-CGM such as FreeStyle Libre (Abbott Diabetes Care), provides minimal invasiveness, ease of use, and continuous glucose tracking without finger-prick blood samples. The device measures glucose levels in interstitial fluid providing immediate visual feedback through a smartphone app. This real-time data enhances dietary awareness and supports behavioral adjustments, potentially benefiting even healthy populations. While CGM has demonstrated efficacy in managing glycemic control and promoting dietary behavior change in individuals with and without diabetes [10-14], the application of CGM outside diabetic populations remains debated [15], with emerging evidence suggesting heightened dietary awareness and behavior modification. Klonoff *et al.* [16] noted the increasing adoption of CGM for promoting healthy behaviors and metabolic awareness in non-diabetic populations. However, research exploring the practical benefits and challenges of CGM among healthy young adults remains limited.

To address this gap, the present study investigates the impact of a short-term multicomponent intervention, combining flash-CGM, structured group-based nutrition education, and tailored nutrition coaching, on dietary self-efficacy (DSE) and weight management in this population. We hypothesize that real-time feedback from CGM as part of this multicomponent approach will enhance dietary behaviors, particularly among individuals with higher body mass index (BMI).

METHODS

Ethics statement

The informed written consent was obtained from each participant. The study protocol was approved by the Institutional Review Board of Semyung University (2024-05-003-03), and the clinical research Information Service (approval number: KCT0010255).

1. Study design

This study was conducted as a pre-post intervention 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. Intervention period and participants

This study was conducted over four weeks from September to October 2024. The four-week duration was selected to balance feasibility and the potential for meaningful dietary behavior changes within a manageable time frame for university students, given their academic schedules and the study's logistical constraints. This period was also informed by prior research suggesting that short-term interventions can yield measurable improvements in DSE and related outcomes [17-19].

Participants included 27 university students enrolled

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in an extracurricular program on digital bio-healthcare using AIoT at Semyung University in Chungbuk, South Korea. Inclusion criteria included ownership of a smartphone and no diagnosis of diabetes. Initially, 40 students attended a briefing session and provided written consent; however, after excluding those with incomplete survey responses or who missed post-intervention assessments, the final sample size was 27, resulting in a 32.5% dropout rate.

Study design and the weekly research progress is presented in Fig. 1.

3. Intervention components

At baseline, participants selected one dietary improvement goal from five options: nutritional balance, regular eating habits, impulse control, weight loss, or disease prevention. Also, the readiness for dietary habit change was scored on a scale from 1 (not at all) to 10 (very much).

The intervention consisted of: (1) A 4-hour group-based nutrition education session covering healthy eating principles and interpretation of CGM data as shown in Table 1. (2) Flash-CGM device (FreeStyle Libre), worn for 14 days and replaced once to cover the full 28-day period. Data were collected via the LibreLink and LibreView platforms. And (3) Weekly individual nutrition coaching sessions (average 15–30 minutes) were conducted via a KakaoTalk (Kakao Corp.) channel, guided by the 5A's model: assess, advise, agree, assist, and arrange for self-management support provided with the *Gluet: glucose diet* textbook [20]. Table 2 outlines the weekly topics covered during the intervention. For instance, participants with frequent post-meal glucose spikes were advised to increase fiber intake and reduce simple carbohydrates. Also, participants used the FoodLens mobile app (DoingLab) for dietary tracking and a Bluetooth-linked digital scale (Atflee T9; Guangdong Welland Technology Co.) for self-weight monitoring. The study protocol is illustrated in Fig. 1, showing the sequencing of educational sessions, CGM use, mobile app integration, and pre/post assessments over the 5-week schedule.

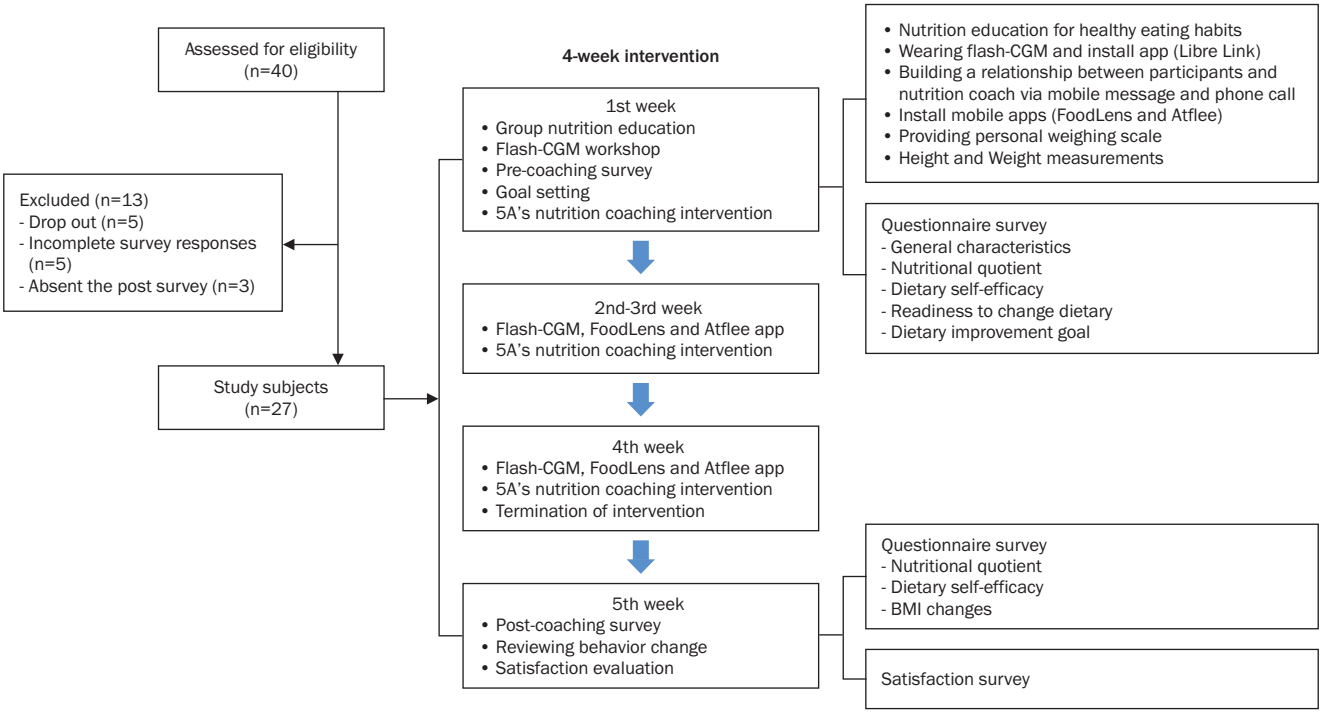

Fig. 1. Study design and flow of the 4-week multicomponent intervention. The intervention included baseline surveys, a 4-hour group nutrition education and flash-CGM workshop (week 1), weekly 5A's-based nutrition coaching, app-based dietary and weight monitoring and a post-intervention evaluation (week 5). A total of 40 participants were screened, with 27 completing the study. CGM, continuous glucose monitoring; BMI, body mass index.

Table 1. Baseline group nutrition education session

Period	Time	Lecture topics	Contents
1st	10:00–10:50	The importance of healthy eating	Diet and health problems in young adults
2nd	11:00–11:50	What constitutes a healthy diet?	Principles of balance, variety, moderation of diet
3rd	13:00–13:50	What are my nutritional problems?	General characteristics, nutrition quotient and dietary self- efficacy survey
4th	14:00–14:50	Smart healthcare tools for healthy weight management	How can I manage my body weight?

Table 2. Weekly consultation topics for 5A's nutrition coaching[1)]

Week	Nutrition coaching topic	Objective
1	Introduction to flash-CGM and nutritional basics	Educate participants on CGM functionality, glucose trends, and healthy eating guidelines
2	Meal timing and macronutrient distribution	Optimize meal schedules and balance macronutrients to minimize glucose spikes
3	Managing emotional and environmental eating triggers	Identify and implement strategies to control eating influenced by emotions or environmental cues
4	Sustaining behavioral changes and long-term goal setting	Review progress, address challenges, and set long-term goals for sustainable behavior change

CGM, continuous glucose monitoring.
[1)]Weekly nutrition coaching sessions (average 15–30 minutes) were conducted via a KakaoTalk channel, guided by the 5A's model: Assess, Advise, Agree, Assist, and Arrange for self-management support provided with the Gluet textbook.

4. Outcome measurements

The primary outcome of this study was DSE, and the secondary outcomes included BMI, nutrition quotient (NQ), and glycemic indicators. The DSE questionnaire was based on previous research [2, 21, 22]. DSE assessed using a 13-item questionnaire evaluating emotional regulation efficacy (7 items) and environmental cue control efficacy (6 items) on a 10-point scale, with higher scores indicating greater self-efficacy. Reliability coefficients were 0.874 (pre-test) and 0.896 (post-test).

The NQ questionnaire survey [23] including 20 items categorized into balance, moderation, and practice dimensions, and 7 items on general characteristics of the participants. The NQ for adults was used as a tool to evaluate dietary quality and nutritional status, based on the revised 2021 guidelines. The domain-specific scores, total scores, and grades were determined using the methodology outlined by Yook *et al.* [23].

Average glucose and estimated glycated hemoglobin (HbA1c) were derived from CGM data using the LibreView platform, based on 14-day glucose profiles. Estimated HbA1c was calculated as (mean glucose [mmol/L] + 2.59) / 1.59 [24].

BMI was used to standardize for height and for consistency with previous studies, even though body weight may be more sensitive over short durations. BMI changes were taken at baseline and week 5. BMI was calculated using the formula: weight / [height]^2, where weight was measured in kilograms (kg) using a calibrated digital scale (InBody 720; InBody Co., Ltd.) and height was measured in meters (m) using a standardized stadiometer (DS-103; Dong Sahn Jenix Co. Ltd.). FoodLens data were not analyzed due to incomplete records.

At the end of the study, the satisfaction survey included 15 items on a 5-point Likert scale assessing educational effectiveness, device usability, coaching satisfaction, and behavioral changes. All the survey was administered via online using Google Forms (Google).

5. Statistical analysis

Data were analyzed using IBM SPSS statistics (version 28; IBM Corp.). The Wilcoxon signed-rank test was chosen to evaluate pre- and post-intervention changes in DSE, BMI, NQ, and glycemic indicators. Mann-Whitney *U*-test was used to compare changes between BMI subgroups (< 23 and ≥ 23 kg/m^2). These tests were appropriate given the small sample size and potential deviations from normality. To control for type I error due to

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multiple comparisons, Bonferroni corrections were applied where applicable, ensuring the robustness of the statistical inferences. Statistical significance was set at $P < 0.05$. The sample size was calculated using G*Power (version 3.1.9.7). With an effect size of f = 0.25 (medium), a significance level of $\alpha = 0.05$, and power $(1-\beta) = 0.80$, the minimum required sample size was determined to be 27 participants. The final sample size in this study met this requirement. Effect sizes (r) were calculated for Wilcoxon signed-rank and Mann-Whitney *U*-tests using the formula $r = Z / \sqrt{N}$, where Z is the test statistic and N is the number of observations. According to Cohen's criteria, r values of 0.1, 0.3, and 0.5 represent small, medium, and large effect sizes, respectively.

RESULTS

1. Participant characteristics

Table 3 presents the general characteristics of the participants. The mean age of the participants was 20.33 ± 1.71 years, and 59.3% were female. Among the participants, 48.2% resided in dormitories, the majority were non-smokers (77.8%), and 74.1% reported infrequent alcohol consumption. More than half (55.6%) reported not using dietary supplements. None of the participants had received nutrition coaching in the past year. Based on BMI (kg/m^2) classification, 48.1% of the participants were categorized as underweight or normal weight, while 51.9% were classified as overweight or obese.

Table 4 shows that the primary dietary goals among participants were weight loss (55.6%, n = 15), notably

Table 3. General characteristics of the participants

Variable	Category	Total (n = 27)	BMI < 23 kg/m^2 (n = 13)	BMI ≥ 23 kg/m^2 (n = 14)
Age (year)		20.33 ± 1.71	19.69 ± 1.49	21.0 ± 1.57
Sex	Female	16 (59.25)	9 (33.33)	7 (25.93)
	Male	11 (40.74)	4 (14.81)	7 (25.93)
Residence	Living at home	9 (33.33)	6 (22.22)	3 (11.11)
	Dormitory	13 (48.15)	5 (18.52)	8 (29.63)
	Self-boarding	5 (18.52)	2 (7.41)	3 (11.11)
Smoking status	Current smoker	5 (18.52)	2 (7.41)	3 (11.11)
	Ex-smoker	1 (3.70)	1 (3.70)	0 (0.00)
	Non-smoker	21 (77.78)	10 (37.04)	11 (40.74)
Alcohol drinking	≥ 3 times/week	3 (11.11)	2 (7.41)	1 (3.70)
	1–2 times/week	4 (14.81)	3 (11.11)	1 (3.70)
	1–3 times/month	0 (0.00)	0 (0.00)	0 (0.00)
	Rarely	20 (74.07)	8 (29.63)	12 (44.44)
Vitamin & mineral supplements	Everyday	6 (22.22)	3 (11.11)	3 (11.11)
	3–4 times/week	2 (7.41)	1 (3.70)	1 (3.70)
	1–2 times/week	2 (7.41)	0 (0.00)	2 (7.41)
	1 time/week	2 (7.41)	2 (7.41)	0 (0.00)
	Never	15 (55.56)	7 (25.93)	8 (29.63)
Experience for nutrition coaching during the past year	Yes	0 (0.00)	0 (0.00)	0 (0.00)
	No	27 (100)	13 (48.15)	14 (51.85)
BMI (kg/m^2)		24.17 ± 5.64	19.75 ± 1.92	28.68 ± 4.69
	Underweight (BMI < 18.5)	2 (7.41)	2 (7.41)	0 (0.00)
	Normal (18.5 ≤ BMI < 23)	11 (40.74)	11 (40.74)	0 (0.00)
	Overweight (23≤ BMI < 25)	4 (14.81)	0 (0.00)	4 (14.81)
	Obese (BMI ≥ 25)	10 (37.04)	0 (0.00)	10 (37.04)

Mean ± SD or n (%).
BMI, body mass index.

higher in the BMI ≥ 23 kg/m^2 group (71.4%) compared to BMI < 23 kg/m^2 (38.5%). Other frequently reported goals included achieving a nutritionally balanced diet (22.2%, predominantly BMI < 23 kg/m^2), establishing regular eating habits (14.8%), correcting impulsive eating (3.7%), and disease prevention through diet (3.7%). Participants' overall readiness to change dietary habits, assessed on a 10-point scale before the intervention, was moderately high (7.85 ± 1.54). There were no significant differences between BMI groups (BMI ≥ 23 kg/m^2: 8.07 ± 1.49; BMI < 23 kg/m^2: 7.62 ± 1.61; P = 0.370). Data are not shown.

2. Changes in dietary self-efficacy

Table 5 shows that the intervention significantly improved participants' DSE in various dimensions, including affective factor control efficacy and environmental stimulus control efficacy. Participants demonstrated significant improvements in their ability to resist eating under various emotional conditions. Significant improvements were noted in the ability to resist eating when stressed (from 5.78 ± 2.76 to 7.52 ± 1.67, P < 0.01, r = 0.510) and tired (from 5.70 ± 2.71 to 8.74 ± 1.40, P < 0.001, r = 0.577) in total. Interestingly, the ability to control eating when tired significantly improved across both BMI categories. Notably, participants with BMI < 23 kg/m^2 exhibited the improvement to resist eating when tired (from 4.85 ± 2.67 to 9.15 ± 0.90, P < 0.01), nervous (from 8.15 ± 1.52 to 9.54 ± 0.78, P < 0.01) and when feeling unstable (from 7.85 ± 1.63 to 9.00 ± 1.15, P < 0.05). Subtotal scores for this dimension showed a significant improvement from 6.97 ± 1.81 to 8.03 ± 1.41 (P < 0.01) in total. Improvements were also observed in participants' ability to resist eating in response to external stimuli, although the changes were less pronounced compared to the affective domain. The ability to resist eating in social settings, such as with friends, increased significantly from 4.96 ± 2.67 to 6.30 ± 2.37 in total (P < 0.05). Subtotal scores for this dimension improved from 6.69 ± 1.72 to 7.30 ± 1.50, although the change was not statistically significant.

Overall, the total DSE score improved significantly from 6.84 ± 1.64 to 7.69 ± 1.26 (P < 0.05). The improvement was particularly notable among participants with BMI < 23 kg/m^2, where the total score increased from 6.49 ± 1.36 to 7.89 ± 1.06 (P < 0.01).

3. Changes in body mass index

Fig. 2 displays the outcomes of the pre- and post-intervention in BMI. A statistically significant decrease in BMI was observed among the total sample (from 24.51 ± 5.71 to 24.29 ± 5.67, P < 0.05), while subgroup analysis for BMI ≥ 23 kg/m^2 showed no significant change. BMI significantly decreased after the intervention (P = 0.045, r = 0.393), indicating a medium effect size. Among participants with BMI ≥ 23 kg/m^2, a non-significant reduction in BMI was observed (P = 0.153, r = 0.394), suggesting a moderate effect size despite statistical insignificance.

4. Changes in glycemic indicators

Table 6 presents the changes in glycemic indicators from pre- and post-intervention assessments. The intervention did not lead to statistically significant changes in glycemic indicators, including overall blood glucose variability, and estimated HbA1c. The overall blood glucose variability remained stable, with pre-intervention levels of 105.75 ± 11.47 mg/dL compared to 104.77 ± 9.40 mg/dL post-intervention (P = 0.822, r = 0.046). Similarly, the estimated HbA1c levels showed no significant change, with pre-intervention levels of 5.26% ± 0.32%

Table 4. Primary dietary goals reported by participants according to BMI group

Primary dietary goal	Total (n = 27)	BMI < 23 kg/m^2 (n = 13)	BMI ≥ 23 kg/m^2 (n = 14)
Weight loss	15 (55.60)	5 (38.50)	10 (71.40)
Correction to nutritionally balanced diet	6 (22.20)	5 (38.50)	1 (7.10)
Regular eating habits	4 (14.80)	1 (7.70)	3 (21.40)
Correction of impulsive eating habits	1 (3.70)	1 (7.70)	0 (0.00)
Disease prevention through diet	1 (3.70)	1 (7.70)	0 (0.00)

n (%).
BMI, body mass index.

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Table 5. Changes in dietary self-efficacy scores by intervention according to BMI group

Category	Variable	Total (n = 27)	BMI < 23 kg/m^2 (n = 13)	BMI ≥ 23 kg/m^2 (n = 14)
Affective factor control efficacy[1)]	I can resist eating when I am stressed			
	Pre	5.78 ± 2.76	4.85 ± 2.67	6.64 ± 2.65
	Post	7.52 ± 1.67**	7.46 ± 1.56**	7.57 ± 1.83
	I can resist eating when I am depressed			
	Pre	6.81 ± 2.84	6.46 ± 2.93	7.14 ± 2.82
	Post	7.67 ± 1.82	7.62 ± 1.89	7.71 ± 1.82
	I can resist eating when I am angry			
	Pre	6.74 ± 2.82	6.54 ± 2.93	6.93 ± 2.81
	Post	7.56 ± 1.89	7.62 ± 1.98	7.50 ± 1.87
	I can resist eating when I am bored			
	Pre	7.44 ± 2.34	7.23 ± 2.31	7.64 ± 2.44
	Post	7.33 ± 2.42	7.85 ± 2.58	6.86 ± 2.25
	I can resist eating when I feel unstable			
	Pre	7.93 ± 1.80	7.85 ± 1.63	8.00 ± 2.00
	Post	8.48 ± 1.60	9.00 ± 1.15*	8.00 ± 1.84
	I can resist eating when I am tired			
	Pre	5.70 ± 2.71	4.85 ± 2.67	6.50 ± 2.59
	Post	8.74 ± 1.40***	9.15 ± 0.90**	8.36 ± 1.69*
	I can resist eating when I am nervous			
	Pre	8.41 ± 1.80	8.15 ± 1.52	8.64 ± 2.06
	Post	8.93 ± 1.54	9.54 ± 0.78**	8.36 ± 1.86
	Subtotal			
	Pre	6.97 ± 1.81	6.56 ± 1.49	7.36 ± 2.04
	Post	8.03 ± 1.41**	8.32 ± 1.08**	7.76 ± 1.65
Environmental stimulus control efficacy	I can resist eating even when others are pressuring me to eat			
	Pre	6.44 ± 2.49	6.38 ± 2.69	6.50 ± 2.38
	Post	7.33 ± 1.80	7.46 ± 1.39	7.21 ± 2.15
	I can resist eating when I eat at even event (wedding, holiday, etc.) or at a company dinner			
	Pre	5.33 ± 2.53	5.38 ± 2.66	5.29 ± 2.49
	Post	5.96 ± 2.30	5.85 ± 2.41	6.07 ± 2.27
	I can resist eating when I eat with my friends			
	Pre	4.96 ± 2.67	4.62 ± 2.63	5.29 ± 2.76
	Post	6.30 ± 2.37*	6.23 ± 2.65	6.36 ± 2.17
	I can resist eating when I am alone			
	Pre	7.93 ± 2.22	7.54 ± 2.40	8.29 ± 2.05
	Post	8.19 ± 2.13	8.15 ± 2.67	8.21 ± 1.58
	I can resist eating when I am watching TV or smartphone			
	Pre	7.59 ± 2.36	7.46 ± 2.30	7.71 ± 2.49
	Post	7.26 ± 2.30	7.69 ± 2.39	6.86 ± 2.21
	I can resist eating when I am watching food advertisement or eating show			
	Pre	7.85 ± 2.33	7.08 ± 2.53	8.57 ± 1.95
	Post	8.74 ± 1.70	9.00 ± 1.78	8.50 ± 1.65
	Subtotal			
	Pre	6.69 ± 1.72	6.41 ± 1.61	6.94 ± 1.84
	Post	7.30 ± 1.50	7.40 ± 1.56	7.20 ± 1.50
	Pre	6.84 ± 1.64	6.49 ± 1.36	7.16 ± 1.86
	Post	7.69 ± 1.26*	7.89 ± 1.06**	7.50 ± 1.43

Mean ± SD.
BMI, body mass index.
[1)]10-point Likert scale. Higher score means higher DSE.
The *P*-value for the comparison pre-and post-intervention by Wilcoxon signed-rank test.
*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

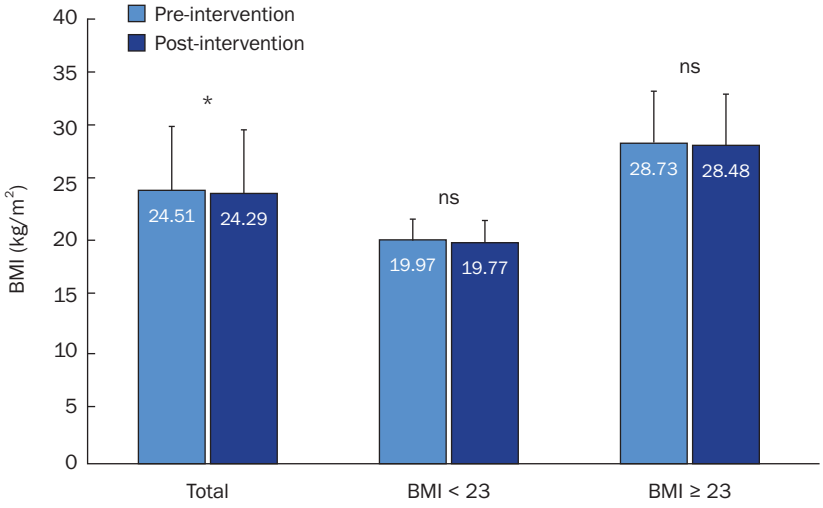

Fig. 2. Changes in BMI before and after the intervention by group. BMI significantly decreased in the total sample (*P < 0.05). No statistically significant changes were observed in the BMI < 23 kg/m^2 and BMI ≥ 23 kg/m^2 subgroups. BMI, body mass index; ns, not significant.

Table 6. Changes in glycemic indicators

Measurements	Pre-intervention (n = 27)	Post-intervention (n = 27)	*P*-value
Overall blood glucose distribution and variability (mg/dL)			
Total (n = 27)	105.75 ± 11.47	104.77 ± 9.40	0.822
BMI < 23 kg/m^2 (n = 13)	104.68 ± 9.91	102.82 ± 7.11	0.635
BMI ≥ 23 kg/m^2 (n = 14)	106.75 ± 13.05	106.59 ± 11.07	0.808
Overall estimated HbA1c (%)			
Total (n = 27)	5.26 ± 0.32	5.24 ± 0.33	0.863
BMI < 23 kg/m^2 (n = 13)	5.27 ± 0.33	5.28 ± 0.34	0.480
BMI ≥ 23 kg/m^2 (n = 14)	5.25 ± 0.33	5.21 ± 0.32	0.180

Mean ± SD.
Glycemic indicators including average blood glucose and estimated HbA1c were derived from CGM data through the LibreView platform.
BMI, body mass index; HbA1c, hemoglobin A1c (glycated hemoglobin).
The *P*-value for the comparison pre-and post-intervention by Wilcoxon signed-rank test.

compared to 5.24% ± 0.33% post-intervention (P = 0.863, r = 0.033).

5. Changes in nutrition quotient scores

Table 7 presents the results in NQ scores before and after the intervention. Although the total NQ score did not significantly improve (P = 0.485, r = 0.136), small to medium effect sizes were observed for several individual NQ items, such as fruit intake (P = 0.008, r = 0.894) and labeling check (P = 0.048, r = 0.471), suggesting meaningful behavioral changes (Table 8).

In Table 8, intake frequency of fruits showed a statistically significant increase from 1.63 ± 0.49 to 1.89 ± 0.58 (P < 0.01) in total. Participants with BMI < 23 kg/m^2 exhibited a significant rise from 1.69 ± 0.48 to 2.00 ± 0.71 (P < 0.05). Nutrition labeling check when eating out or purchasing processed foods significantly improved from 2.59 ± 1.15 to 3.22 ± 1.34 (P < 0.05) in total.

6. Satisfaction survey

Table 9 presents the satisfaction evaluation after the completion of the entire program. Participants reported high levels of satisfaction with the flash-CGM device and the accompanying nutrition coaching services. The overall satisfaction score was 4.52 ± 0.65 on a 5-point Likert scale. Participants acknowledged the effective-

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Table 7. Changes in the NQ score of respective dimension

Variable	Pre-intervention (n = 27)	Post-intervention (n = 27)	*P*-value
NQ category			
Balance	14.56 ± 3.24	15.70 ± 3.82	0.136
Moderation	16.44 ± 4.11	15.67 ± 2.95	0.265
Practice	12.74 ± 2.19	13.22 ± 2.52	0.428
Overall NQ score	43.74 ± 6.32	44.59 ± 6.24	0.485
Frequency of sweetened-beverage consumption[1)]	1.67 ± 1.09	2.78 ± 1.11	0.473
Frequency of exercise[2)]	2.44 ± 1.03	3.44 ± 0.87	0.512
Evaluation (range of overall NQ score)			
High (68.5–100)	0	0	
Medium (52.7–68.5)	2	3	
Low (0–52.7)	25	24	

Mean ± SD or n.
NQ, nutrition quotient.
[1)]5-point Likert scale (1 = rarely, 5 = everyday).
[2)]5-point Likert scale (1 = ≤ 1–2 times/week, 5 = ≥ 3 times/day).
The *P*-value for the comparison pre-and post-intervention by Wilcoxon signed-rank test.

Table 8. Changes in the NQ score of each question according to BMI group

Category	Variable	Total (n = 27)	BMI < 23 kg/m^2 (n = 13)	BMI ≥ 23 kg/m^2 (n = 14)
Balance	Number of vegetable dishes excluding Kimchi at each meal			
	Pre	2.67 ± 1.21	2.69 ± 1.11	2.64 ± 1.34
	Post	2.78 ± 0.70	2.77 ± 0.83	2.79 ± 0.58
	Intake frequency of fruits			
	Pre	1.63 ± 0.49	1.69 ± 0.48	1.57 ± 0.51
	Post	1.89 ± 0.58**	2.00 ± 0.71*	1.79 ± 0.43
	Intake frequency of milk or dairy products			
	Pre	1.78 ± 0.70	1.54 ± 0.52	2.00 ± 0.78
	Post	1.89 ± 0.85	1.62 ± 0.51	2.14 ± 1.03
	Intake frequency of fishes			
	Pre	1.41 ± 0.64	1.46 ± 0.66	1.36 ± 0.63
	Post	1.41 ± 0.64	1.38 ± 0.65	1.43 ± 0.65
	Intake frequency of beans or bean products			
	Pre	1.67 ± 0.78	1.62 ± 0.51	1.71 ± 0.99
	Post	1.81 ± 0.92	1.62 ± 0.51	2.00 ± 1.18
	Intake frequency of nuts			
	Pre	1.63 ± 0.84	1.54 ± 0.78	1.71 ± 0.91
	Post	1.89 ± 1.05	1.54 ± 0.88	2.21 ± 1.12
	Intake frequency of whole grains or mixed grains			
	Pre	2.19 ± 1.24	1.85 ± 0.90	2.50 ± 1.45
	Post	2.41 ± 0.97	2.08 ± 0.64	2.71 ± 1.14
	Intake frequency of breakfast			
	Pre	1.59 ± 1.19	1.31 ± 0.63	1.86 ± 1.51
	Post	1.63 ± 1.18	1.46 ± 0.78	1.79 ± 1.48

(Continued to the next page)

Table 8. Continued

Category	Variable	Total (n = 27)	BMI < 23 kg/m^2 (n = 13)	BMI ≥ 23 kg/m^2 (n = 14)
Moderation	Moderation Intake frequency of greasy baked products or snacks			
	Pre	3.15 ± 1.17	3.38 ± 1.19	2.93 ± 1.14
	Post	3.04 ± 0.90	3.08 ± 0.64	3.00 ± 1.11
	Intake frequency of fast foods			
	Pre	2.78 ± 0.70	2.77 ± 0.60	2.79 ± 0.80
	Post	2.67 ± 0.88	2.77 ± 0.73	2.57 ± 1.02
	Intake frequency of spicy and salty soup and stew			
	Pre	2.48 ± 0.80	2.54 ± 0.88	2.43 ± 0.76
	Post	2.41 ± 0.89	2.46 ± 0.88	2.36 ± 0.93
	Intake frequency of red meats			
	Pre	2.93 ± 1.11	2.92 ± 1.19	2.93 ± 1.07
	Post	3.26 ± 0.81	3.23 ± 0.83	3.29 ± 0.83
	Intake frequency of processed meats			
	Pre	2.56 ± 0.97	2.62 ± 0.65	2.50 ± 1.22
	Post	2.44 ± 1.01	2.46 ± 0.88	2.43 ± 1.16
	Frequency of overeating or binge eating			
	Pre	2.56 ± 1.53	2.46 ± 1.56	2.64 ± 1.55
	Post	1.85 ± 0.99	1.62 ± 0.87	2.07 ± 1.07
Practice	Efforts to have healthy eating habits			
	Pre	3.04 ± 0.71	2.77 ± 0.83	3.29 ± 0.47
	Post	3.30 ± 0.72	3.38 ± 0.87	3.21 ± 0.58
	Nutrition labeling check when eating out or purchasing processed foods			
	Pre	2.59 ± 1.15	2.54 ± 1.27	2.64 ± 1.08
	Post	3.22 ± 1.34*	3.15 ± 1.41	3.29 ± 1.33
	Washing hands practices before eating meals			
	Pre	4.00 ± 1.00	3.85 ± 1.21	4.14 ± 0.77
	Post	4.04 ± 0.94	4.15 ± 0.99	3.93 ± 0.92
	Heavy drinking frequency of alcohol			
	Pre	3.11 ± 1.31	3.15 ± 1.34	3.07 ± 1.33
	Post	2.67 ± 1.30	2.38 ± 1.19	2.93 ± 1.38

Mean ± SD.
The *P*-value for the comparison pre-and post-intervention by Wilcoxon signed-rank test.
*$P < 0.05$, **$P < 0.01$.

ness of nutrition education in helping them understand postprandial glucose changes (4.67 ± 0.55) and found the provided materials easy to understand (4.74 ± 0.45). The flash-CGM device was rated highly for its usability, with participants finding it easy to monitor blood glucose levels (4.78 ± 0.42) and understand daily glucose patterns (4.70 ± 0.47). The device also helped participants feel capable of managing their weight (4.52 ± 0.64). The nutrition coaching service was highly appreciated, particularly for its tailored approach (4.56 ± 0.51) and reliable materials (4.59 ± 0.57). Participants expressed satisfaction with the coach's attitude and behavior (4.78 ± 0.42) and indicated a willingness to recommend the service to others (4.63 ± 0.56). Participants reported moderate improvements in dietary habits (4.37 ± 0.88) and other health behaviors, such as exercise and sleep (4.44 ± 0.75). Confidence in maintaining these lifestyle changes after the intervention was also noted (4.33 ± 0.83).

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Table 9. Satisfaction evaluation of flash-CGM and nutrition coaching services

Category	Variable	Satisfaction scores[1] (n = 27)
Educational effectiveness	The nutrition education helped me learn that postprandial glucose changes can assist in weight management	4.67 ± 0.55
	The contents of Gluet textbook were easy to understand	4.74 ± 0.45
Device usability	The flash-CGM device made it easy to monitor my blood glucose levels	4.78 ± 0.42
	I was able to understand my daily blood glucose patterns using the flash-CGM device	4.70 ± 0.47
	The flash-CGM device helped me feel capable of managing my weight	4.52 ± 0.64
	Using the flash-CGM device and nutrition coaching increased my interest in blood glucose and weight control	4.52 ± 0.70
Coaching satisfaction	The nutrition coach tailored the service to my ability and needs	4.56 ± 0.51
	I believe that the materials provided by the nutrition coach are accurate and reliable	4.59 ± 0.57
	I was satisfied with the attitude and behavior of the nutrition coach	4.78 ± 0.42
	I actively utilized the nutrition coaching service	4.11 ± 1.05
	I would recommend the nutrition coaching service to family and friends	4.63 ± 0.56
	I am willing to purchase nutrition coaching service in the future	4.11 ± 0.89
Behavioral and lifestyle changes	The coaching service improved my dietary choices over 4 weeks	4.37 ± 0.88
	The coaching service helped improve other health habits such as exercise	4.44 ± 0.75
	I am confident in maintaining the improved lifestyle habits after the coaching service ends	4.33 ± 0.83
Overall		4.52 ± 0.65

Mean ± SD.
[1]5-point Likert scale (1 = not satisfied at all, 5 = very satisfied).
CGM, continuous glucose monitoring.

DISCUSSION

This study evaluated the effects of a short-term multicomponent intervention, combining flash-CGM, structured nutrition education, and personalized nutrition coaching, on DSE and weight management among healthy university students. Significant improvements in DSE were observed, particularly regarding the ability to manage eating behaviors under emotional triggers such as stress, emotional instability and fatigue.

This finding is consistent with Shah *et al.* [14], who emphasized CGM's ability to provide real-time insights into glucose trends, fostering awareness and motivating healthier dietary behaviors. Similarly, Clark *et al.* [21] highlighted self-efficacy as a critical component of successful weight management, reinforcing the role of tailored interventions in achieving meaningful behavioral change. The enhanced DSE observed in this study likely reflects the combined effect of flash-CGM feedback and supportive nutrition coaching, consistent with Kim *et al.* [2], who demonstrated the benefits of technology-assisted, personalized dietary coaching in young adults.

Although body weight could serve as a sensitive indicator for short-term change, BMI was used as the primary outcome to control for height variation across participants and ensure consistency with related literature. In this study, a modest but statistically significant reduction in BMI was noted across the total sample, although subgroup analysis revealed no significant change among participants with higher BMI (≥ 23 kg/m^2). The observed BMI reduction, albeit small, indicates the potential utility of integrated digital health tools and personalized coaching in supporting weight management efforts. This outcome aligns with Klonoff *et al.* [16], who emphasized the potential of CGMs to drive behavioral modifications that support weight loss and prevent weight gain. The personalized dietary feedback provided during this intervention appears to have encouraged participants to make meaningful adjustments to their eating habits, resulting in measurable weight reductions.

It is noteworthy that significant improvements were also observed in participants' NQ scores, particularly regarding fruit intake frequency and nutrition label checking habits, reinforcing the intervention's effectiveness in promoting better dietary practices. Additionally, Kim *et al.* [2] demonstrated that personalized goal setting and smartphone-based nutrition counseling significantly improve both the NQ scores among young adults. These findings reinforce the effectiveness of combining technology with tailored guidance to achieve health-related goals.

While the behavioral improvements were clear, minimal changes were observed in glycemic markers, such as average glucose levels and estimated HbA1c, were derived from CGM data using the LibreView platform. This finding aligns with Shah *et al.* [14], who noted that glucose variability among healthy individuals is relatively low, making significant shifts in glycemic markers less likely within short intervention periods. The results underscore the importance of longer monitoring durations to fully capture the metabolic effects of CGM-based interventions. It is also worth noting that the primary focus of this study was on behavioral outcomes rather than metabolic changes, which may explain the limited findings in glycemic markers.

This study contributes to the growing body of evidence supporting the use of CGMs in non-diabetic populations. While prior research has predominantly focused on clinical populations, such as individuals with diabetes, this study highlights the broader applicability of CGMs for preventive health. The real-time feedback provided by CGMs offers a dynamic and engaging approach to dietary management, distinguishing it from traditional nutrition education programs. As Klonoff *et al.* [16] argued, CGMs represent a timely and relevant innovation for promoting metabolic awareness and supporting healthier lifestyle choices, even among individuals without diabetes.

Critically, Shmerling [15] raised concerns about CGM's cost-effectiveness and necessity in non-diabetic populations, cautioning against its widespread adoption without clearer evidence of sustained benefits. This study addresses such skepticism by demonstrating CGM's effectiveness in enhancing DSE and supporting weight management, particularly when combined with personalized coaching and nutrition education. However, future research should explore strategies to improve affordability and adherence. Until more evidence is available, CGM use in such populations should be considered exploratory and implemented in contexts where digital literacy and engagement are high.

Limitations

Despite these promising findings, this study has several limitations. A major limitation of this study is the multicomponent nature of the intervention. While CGM likely played a motivational role by providing real-time feedback, it was implemented alongside structured education and individualized coaching, both of which are known to influence dietary behaviors. Therefore, it is difficult to isolate the independent contributions of each component, notably flash-CGM use. This limitation should be clearly acknowledged, and future studies should include control groups or factorial designs to evaluate the separate contributions of each intervention component. Although the Foodlens app was used to track dietary intake, the data were not analyzed in detail in this study. Future studies should ensure thorough dietary data collection and analysis to clarify behavior change mechanisms. Additionally, the sample was relatively small and homogeneous, limiting generalizability. Larger-scale studies are needed to validate the observed effects across more diverse populations. It is essential to investigate the applicability of flash-CGM-based interventions in other populations, such as individuals with prediabetes, older adults, or those at higher risk of metabolic disorders.

The intervention period was limited to four weeks. While significant improvements in DSE and BMI were observed, the study cannot determine whether these changes are sustained over the long term. Future studies should incorporate follow-up periods to evaluate the persistence of the intervention's effects. Also, the study relies heavily on self-reported data, which may introduce bias. Incorporating objective dietary assessments, such as digital food diaries or automated dietary tracking tools, could enhance the reliability of future studies. These limitations suggest that while flash-CGM interventions show promise, further research is necessary to confirm their broader applicability and long-term efficacy. However, our findings suggest that short-term flash-CGM use can

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be a powerful tool in promoting dietary awareness and self-efficacy. Real-time glucose monitoring appears to motivate individuals to adopt healthier eating habits by providing immediate feedback on dietary choices. While the study demonstrates the potential of flash-CGM in short-term interventions, the minimal changes in blood glucose and HbA1c levels indicate that longer-term monitoring may be necessary for significant metabolic improvements. It would also be valuable to examine the psychological mechanisms underpinning the observed improvements in DSE, as well as the role of flash-CGMs in maintaining long-term health behaviors. Qualitative studies capturing participants' experiences and challenges with CGM use could provide further insights into how these devices can be optimized for broader adoption. Addressing these concerns, this study demonstrates that CGMs can effectively enhance DSE and weight management when combined with personalized coaching. However, future research should explore strategies to optimize cost-efficiency and assess whether these benefits can be sustained over longer periods.

Conclusion

In conclusion, this study suggests that a multicomponent intervention utilizing flash-CGM, nutrition education, and personalized coaching can effectively enhance DSE and support modest weight reduction among university students. While these findings are promising, the inability to isolate the effect of CGM alone, the absence of detailed dietary intake analysis, and the short intervention period should be addressed in future research. By expanding on these initial results and addressing the identified limitations, future work can further validate the role of CGMs as an innovative tool for preventive health.

CONFLICT OF INTEREST

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

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DATA AVAILABILITY

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

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Research Article

The dietary factors associated with sleep duration in postmenopausal middle-aged women: a cross-sectional study using 2019–2023 Korea National Health and Nutrition Examination Survey data

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Objectives: This study aimed to analyze dietary factors associated with sleep duration in postmenopausal middle-aged women using data from the Korea National Health and Nutrition Examination Survey (KNHANES), with particular emphasis on the postmenopausal period.

Methods: A total of 3,040 postmenopausal women aged 40–64 years from the 2019–2023 KNHANES were included. Sleep duration was classified into four categories: "appropriate sleep duration" (ASD; 7–9 hours), "short sleep duration" (6–7 hours), "very short sleep duration" (VSSD; < 6 hours), and "long sleep duration" (LSD; > 9 hours). Nutrient and food intake were compared among groups using analysis of covariance. Multinomial logistic and polynomial regression models assessed associations, adjusting for demographic and health covariates.

Results: The VSSD group had higher body mass index and waist circumference than the ASD group, despite lower total energy intake, and also consumed more snack energy and skipped breakfast and dinner more often. This group also had lower intakes of monounsaturated fatty acids and nuts and seeds. In the late menopausal group, greater consumption of cereal grains, fish and shellfish, and beverages was associated with elevated LSD risk. Conversely, higher folate intake in the early menopausal group was inversely associated with VSSD risk. Cholesterol intake was positively associated with LSD risk in both groups. A negative nonlinear association between sleep duration and dietary intake was observed in the early menopausal group when polyunsaturated fatty acid intake exceeded 19.86 g/day and riboflavin intake exceeded 1.76 mg/day. In the late menopausal group, riboflavin intake was strongly correlated with increased LSD risk (odds ratio = 4.776, $P = 0.004$). Sugar and beverage intake showed a positive linear relationship with sleep duration at average intake levels.

Conclusion: Dietary factors associated with sleep duration differed by postmenopausal period, with specific nutrients and food groups exhibiting variable associations with sleep duration above mean intake levels.

Keywords: postmenopause; sleep duration; middle aged; dietary intake

INTRODUCTION

The recommended sleep duration for adults aged 18–64 years to promote optimal health and well-being is 7 to 9 hours per day [1]. Sleep is closely linked to the endocrine system. Therefore, insufficient sleep duration affects cortisol, insulin, ghrelin, leptin, sex hormones, and growth hormone, altering energy metabolism, glucose regulation, and appetite [2]. Impaired metabolic homeostasis due to sleep insufficiency increases the risk of chronic diseases including hypertension, cardiovascular disease, type 2 diabetes mellitus, obesity, and cancer [1, 3, 4]. Conversely, abnormal glucose metabolism caused by diabetes negatively affects sleep through inflammation and nocturia [5], elevated blood pressure deteriorates sleep quality through sympathetic nervous system activation [6], and a high body mass index (BMI) increases the risk of sleep disorders such as insomnia [7]. This indicates a bidirectional relationship between chronic diseases and sleep.

Despite the importance of adequate sleep duration for health, the average sleep duration in the Korean population has steadily decreased over the past decade. In particular, the proportion of adults aged ≥ 19 years who sleep for short durations of < 7 hours has continuously increased, with this phenomenon being more pronounced among women [3]. Sleep disorders, such as insomnia, can occur in men and women across all age groups; however, they are more prevalent in women and significantly increase during the years surrounding menopause [8].

Menopause is defined as the permanent cessation of reproductive function, characterized by the absence of menstruation for 12 consecutive months or more following the reproductive years [9]. Natural menopause, excluding pathological premature menopause, occurs on average between 49 and 52 years of age; therefore, women spend more than the final third of their lives in a postmenopausal state [10]. During the transition to menopause, complex physical and psychological changes associated with aging occur, along with alterations in the endocrine system, including decreased sex hormone levels. Consequently, up to 85% of postmenopausal women experience characteristic menopausal symptoms, including vasomotor symptoms (hot flashes and night sweats), depression, impaired concentration, reduced libido, anxiety, and sleep disturbances [11].

According to the Study of Women's Health Across the Nation, the prevalence of sleep disorders increases from 16%–42% in premenopausal women to 39%–47% during the perimenopausal period and 35%–60% in postmenopausal women [12]. Studies investigating the causes of increased sleep disorders during the menopausal transition have identified hormonal fluctuations (e.g., estrogen and progesterone), reduced melatonin levels, mood disorders, and vasomotor symptoms (e.g., night sweats and hot flashes) as major contributing factors [3, 9, 12]. In particular, the risk of sleep insufficiency due to ovarian hormone changes during the postmenopausal period is estimated to gradually increase independent of aging [13]. Menopause-related sleep disorders represent a significant public health issue, as they not only contribute to reduced quality of life through chronic fatigue caused by shortened sleep duration, but also negatively impact mental health—leading to conditions such as depression, anxiety, and dementia—and increase the risk of various chronic diseases [9].

Several studies have reported inconsistent findings regarding the relationship between sleep and dietary intake [4]. Nevertheless, irregular eating patterns and the consumption of energy-dense snacks have been consistently associated with short sleep duration [4, 14]. Severe sleep deprivation is presumed to be involved in a series of mechanisms that affect food choice by enhancing the pleasure stimulus processing of the brain, thereby increasing food reward responses [15]. An experimental study targeting young adults at risk of obesity who were chronically sleep-deprived demonstrated that sleep extension reduced overall appetite and cravings for sweet and salty foods [16].

Furthermore, consumption of foods rich in tryptophan or melatonin may improve sleep quality and increase sleep duration [17]. The intake of macronutrients and specific vitamins or minerals has been reported to be associated with the risk of very short or long sleep duration, suggesting that dietary factors and sleep have a mutual causal relationship [18]. Previous research targeting Koreans has demonstrated that habitual alcohol consumption in postmenopausal women is associated with short sleep duration and that comorbidities inter-

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act with the relationship between vitamin C and carbohydrate intake and short sleep risk [19].

Sleep insufficiency is a public health issue that imposes social and economic burdens on communities and significantly impairs quality of life by negatively affecting individual mental and physical health. Given that the postmenopausal period constitutes a substantial portion of a woman's life, identifying factors related to sleep insufficiency that commonly occur during this period is meaningful. However, research investigating the relationship between nutritional intake, dietary habits, and sleep in postmenopausal Korean women and analytical studies examining sleep-related dietary factors according to postmenopausal duration are limited.

Therefore, this study was conducted using the nationally representative Korea National Health and Nutrition Examination Survey (KNHANES) to analyze the dietary factors associated with sleep insufficiency according to postmenopausal duration in middle-aged Korean women to provide fundamental data for promoting sleep health in postmenopausal women and preventing chronic diseases through improved sleep quality.

METHODS

Ethics statement

Informed written consent was obtained from each participant. The study protocol was approved by the Institutional Review Board (IRB) of the Korea Disease Control and Prevention Agency (approval numbers: 2018-01-03-C-A, 2018-01-03-2C-A, 2018-01-03-5C-A, 2018-01-03-4C-A, 2022-11-16-R-A). According to Article 2, Item 1 of the Bioethics and Safety Act and Article 2, Paragraph 2, Item 1 of the Enforcement Decree, the study is considered research directly conducted by the government for public welfare. Therefore, it is exempt from review by a separate Research Ethics Committee.

1. Study design

This study is a cross-sectional analysis of raw KNHANES data, described according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (https://www.strobe-statement.org/).

2. Study participants

From the raw data of 35,753 participants across five survey years, including the 1st (2019, n = 8,110), 2nd (2020, n = 7,359), and 3rd (2021, n = 7,090) years of the 8th KNHANES, and the 1st (2022, n = 6,265) and 2nd (2023, n = 6,929) years of the 9th KNHANES, middle-aged postmenopausal women aged 40–64 years were extracted. To exclude analytical errors due to extreme intake, individuals reporting total daily energy intakes of ≤ 500 kcal or ≥ 5,000 kcal were excluded. Additionally, cases with missing health questionnaire data (age, education level, household income, economic activity status, alcohol consumption and smoking rates, and aerobic physical activity practice), health examinations (anthropometric measurements, blood pressure, diabetes, and dyslipidemia tests), and nutritional surveys (food intake and dietary behavior surveys) were excluded, resulting in a final study population of 3,040 participants (Fig. 1).

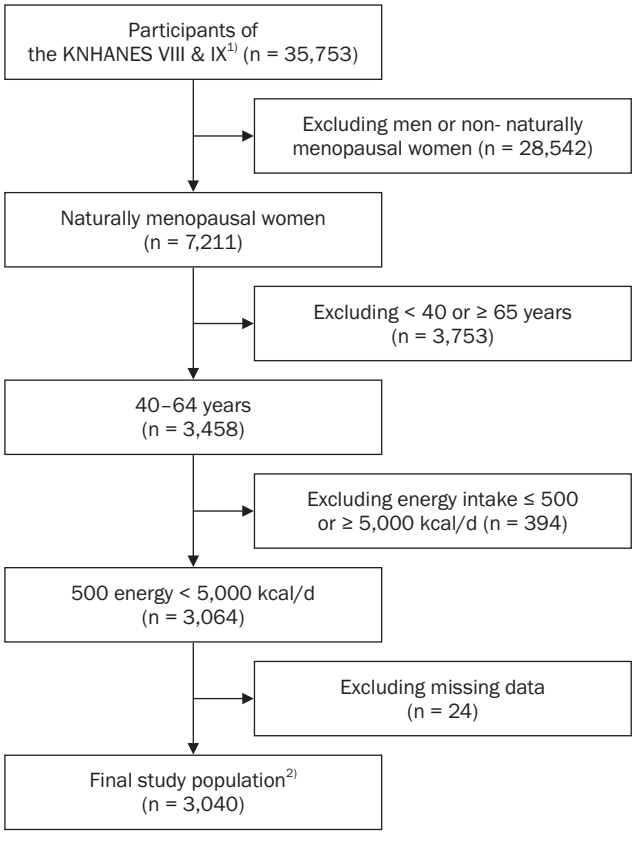

Fig. 1. Final study population derivation process.
[1]Year 1 (2022) and 2 (2023).
[2]Postmenopausal period data missing for two participants.

3. Sleep duration and general characteristics

Daily average sleep duration was calculated using weekday/weekend average sleep hours from the health questionnaire surveys of the 8th Survey 1st and 2nd years and 9th Survey 1st and 2nd years, applying the following formula: {(weekday sleep hours × 5 days) + (weekend sleep hours × 2 days)} / 7 days. For the 8th Survey 3rd year, which investigated weekday/weekend bedtime and wake-up times instead of daily average sleep duration, weekday/weekend daily average sleep hours were calculated first, and then the daily average sleep duration was computed using the same formula. Based on the recommended sleep duration criteria of the National Sleep Foundation for adults aged 26–64 years [1], participants were classified as follows: "appropriate sleep duration (ASD)" group, those sleeping 7–9 hours/day; "short sleep duration (SSD)" group, those sleeping ≥ 6 hours/day but < 7 hours/day; "very short sleep duration (VSSD)" group, those sleeping < 6 hours/day; and "long sleep duration (LSD)" group, those sleeping > 9 hours/day. General characteristics were analyzed using data collected from health questionnaire surveys including age, education level (elementary school or below, middle school, high school, college or above), household income (low, lower-middle, upper-middle, high), economic activity status (employed, unemployed or economically inactive), alcohol consumption status (drinking defined as monthly to 4 times/week consumption, non-drinking otherwise; unknown and non-response excluded), smoking status (smoking defined as daily or occasional smoking, non-smoking otherwise; unknown and non-response excluded), and aerobic physical activity practice (practice defined as moderate-intensity physical activity ≥ 2.5 hours/week or high-intensity physical activity ≥ 1.25 hours/week or equivalent combined moderate and high-intensity activity, non-practice otherwise). Health examination data included anthropometric measurements such as BMI calculated from height and weight and waist circumference (WC); blood test results including fasting blood glucose (FBG), glycated hemoglobin (HbA1c), total cholesterol, high-density lipoprotein-cholesterol (HDL-chol), low-density lipoprotein-cholesterol (LDL-chol), and triglycerides (TG); and mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) from three measurements. Postmenopausal duration was calculated using current age and menopausal age and then classified into two groups according to postmenopausal duration: "early postmenopause" for < 6 years postmenopause and "late postmenopause" for ≥ 6 years postmenopause [20].

4. Nutrient and food group intake and dietary behavior survey

Daily intake data for total energy and nutrients, including carbohydrates, dietary fiber, sugars, protein, fat, saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), n-3 fatty acids, n-6 fatty acids, cholesterol, calcium, phosphorus, sodium, potassium, iron, vitamin A, thiamin, riboflavin, niacin, folate, and vitamin C, and water from 24-hour dietary recall surveys were used. Energy intake ratios for macronutrients (carbohydrates, proteins, and fats) were calculated as 4, 4, and 9 kcal/g, respectively. Daily intake data for food groups, including cereal grains, potatoes and starchy foods, sweeteners, pulses, nuts and seeds, vegetables, mushrooms, fruits, seaweeds, meats, eggs, fish and shellfish, dairy products, fats and oils, beverages, and alcoholic beverages from food intake surveys were utilized. Meal skipping status according to meal type was obtained from the dietary behavior survey questionnaire data.

5. Statistical analysis

Because KNHANES employs a multistage stratified cluster probability sampling design to ensure sample representativeness and estimation accuracy, complex sample analyses were conducted incorporating strata, clusters, and sampling weights. Categorical variables, including age groups, education level, household income, economic activity status, alcohol consumption and smoking status, aerobic physical activity practice, and meal frequency by meal type, were presented as frequencies and percentages using the PROC SURVEYFREQ procedure, and distribution differences among the four groups were tested using the Rao-Scott chi-square test. For continuous data, including food intake survey data such as energy, nutrient, and food group intake, and health examination data such as BMI, WC, SBP, DBP, FBG, HbA1c, total cholesterol, HDL-chol, and

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TG, complex sample analysis was conducted using the PROC SURVEYMEANS and PROC SURVEYREG procedures. Analysis of variance was performed to present the least-squares means and standard errors for the four groups according to the sleep duration classification and test mean differences. In the analysis of covariance (ANCOVA), variables known to affect sleep [5-7] or showing significant differences according to sleep duration in the statistical analysis results of this study, including age, education level, household income, alcohol consumption and smoking status, BMI, SBP, TG, HDL-chol, HbA1c, and total energy intake, were adjusted, and mean differences were tested. A post hoc analysis using Tukey's method was conducted for between-group difference testing. Multinomial logistic regression was used to analyze the effects of nutrient and food group intakes on sleep duration with odds ratios. As the LSD group showed different patterns of nutrient and food group intake compared with the other three groups and J/U-shaped relationships between disease risk and sleep have been reported [1, 5], polynomial regression was applied to model nonlinear associations between sleep duration and nutrient and food group intake. For variables showing significance in polynomial regression analysis, 1st coefficients (β_1, coefficients of independent variables) showing linear relationships and 2nd coefficients (β_2, coefficients of squared independent variables) showing nonlinear relationships were presented, and inflection points with corresponding sleep durations were calculated using the formula $-\beta_1 / 2\beta_2$. Multinomial logistic and polynomial regression analyses were conducted separately for the early and late postmenopause groups, adjusting for the same variables used in the ANCOVA. Variance inflation factors were checked to diagnose multicollinearity among the independent variables. All data were analyzed using SAS statistical software (version 9.4; SAS Institute Inc.), with significance determined at $P < 0.05$ using two-tailed tests.

RESULTS

1. General characteristics and health factors of study participants

The general characteristics of the participants are listed in Table 1. Among the total 3,040 study participants, the ASD group comprised 1,570 participants (51.6%), the SSD group 829 participants (27.3%), and the VSSD group 585 participants (19.2%), with the sleep-insufficient SSD and VSSD groups accounting for 46.5% of the total. The LSD group consisted of 56 participants (1.8%). The 50–59 age group was the most prevalent, with 1,721 participants (56.6%), followed by 1,231 participants (40.5%) aged 60–64 years and 88 participants (2.9%) aged 40–49 years. No statistically significant differences were observed in the age group distribution according to sleep duration. The late postmenopausal group included more participants (1,590; 52.3%) than the early postmenopausal group (1,448; 47.7%). While no differences were observed in postmenopausal duration distribution according to sleep duration, daily average sleep duration was significantly shorter in the late postmenopausal group (6.6 ± 0.03 hours) than in the early postmenopausal group (6.8 ± 0.03 hours; $P < 0.001$, data not shown). Education level, classified as college or above, high school, middle school, and elementary school or below ($P < 0.001$), and household income, classified as high, upper-middle, lower-middle, and low ($P = 0.006$), showed statistically significant differences among the four groups according to sleep duration. In particular, the VSSD and LSD groups were characterized by lower proportions of college or above education and high household income and higher proportions of elementary school or below education and low household income. No significant differences were observed among the four groups in terms of the distribution of economic activity status, alcohol consumption and smoking status, or aerobic physical activity. The results of the health examination data analysis are presented in Table 2. The VSSD group had higher mean BMI ($P = 0.022$), WC ($P = 0.040$), and HbA1c ($P = 0.022$) levels than the ASD and SSD groups. The mean HDL-chol was higher in the VSSD and SSD groups than in the ASD group ($P = 0.030$), whereas the mean LDL-chol was significantly lower in the order of the LSD, VSSD, ASD, and SSD groups ($P = 0.014$). No significant differences were observed among the four groups in the mean SBP, DBP, FBG, total cholesterol, and TG levels.

Table 1. General characteristics according to sleep duration categories

Characteristics	Total (n = 3,040)	VSSD (n = 585)	SSD (n = 829)	ASD (n = 1,570)	LSD (n = 56)	*P*-value
Age group (year)						0.533
40–49	88 (2.9)	15 (2.6)	22 (2.7)	50 (3.2)	1 (1.8)	
50–59	1,721 (56.6)	322 (55.0)	485 (58.5)	887 (56.5)	27 (48.2)	
60–64	1,231 (40.5)	248 (42.4)	322 (38.8)	633 (40.3)	28 (50.0)	
Postmenopausal period						0.071
Early postmenopause[1)]	1,448 (47.7)	250 (42.7)	404 (48.7)	767 (48.9)	27 (48.2)	
Late postmenopause[2)]	1,590 (52.3)	335 (57.3)	425 (51.3)	801 (51.1)	29 (51.8)	
Education level						< 0.001
Up to elementary school	406 (13.4)	108 (18.5)	85 (10.3)	200 (12.7)	13 (23.2)	
Middle school graduate	465 (15.3)	106 (18.1)	132 (15.9)	215 (13.7)	12 (21.4)	
High school graduate	1,362 (44.8)	253 (43.2)	369 (44.5)	719 (45.8)	21 (37.5)	
College or above	807 (26.5)	118 (20.2)	243 (29.3)	436 (27.8)	10 (17.9)	
Household income						0.006
Low	365 (12.0)	85 (14.5)	87 (10.5)	181 (11.5)	12 (21.4)	
Lower middle	768 (25.3)	158 (27.0)	212 (25.6)	383 (24.4)	15 (26.8)	
Upper middle	845 (27.8)	171 (29.2)	212 (25.6)	447 (28.5)	15 (26.8)	
High	1,062 (34.9)	171 (29.2)	318 (38.4)	559 (35.6)	14 (25.0)	
Economic participation						0.624
Employed	1,740 (57.2)	338 (57.8)	483 (58.3)	891 (56.8)	28 (50.0)	
Unemployed or non- economically active	1,300 (42.8)	247 (42.2)	346 (41.7)	679 (43.2)	28 (50.0)	
Current drinking status						0.739
Non-drinker	1,975 (65.0)	379 (64.8)	527 (63.6)	1,031 (65.7)	38 (67.9)	
Drinker	1,065 (35.0)	206 (35.2)	302 (36.4)	539 (34.3)	18 (32.1)	
Current smoking status						0.089
Non-smoker	2,928 (96.3)	555 (94.9)	795 (95.9)	1523 (97.0)	55 (98.2)	
Smoker	112 (3.7)	30 (5.1)	34 (4.1)	47 (3.0)	1 (1.8)	
Aerobic physical activity status						0.274
Participation	1,765 (58.0)	328 (56.1)	500 (60.3)	898 (57.2)	36 (64.3)	
Non-participation	1,278 (42.0)	257 (43.9)	329 (39.7)	672 (42.8)	20 (35.7)	

n (%).
Rao-Scott chi-square test.
VSSD, very short sleep duration (< 6 hours); SSD, short sleep duration (6–7 hours); ASD, appropriate sleep duration (7–9 hours); LSD, long sleep duration (> 9 hours).
[1)]< 6 years after menopause.
[2)]≥ 6 years after menopause.

2. Meal skipping rates and energy intake comparison according to sleep duration

The distribution of meal skipping rates by meal type among the four groups according to sleep duration is presented in Table 3. The skipping of lunch meals showed no statistically significant differences among the four groups according to sleep duration, whereas skipping breakfast and dinner meals showed differences. Breakfast skipping rates were 15.5%, 16.6%, and 19.1% in the ASD, SSD, and VSSD groups, respectively, and 32.1% in the LSD group ($P = 0.006$). Dinner skipping rates were 5.2% and 5.3% in the ASD and SSD groups, respectively, and 7.9% and 10.7% in the VSSD and LSD groups, respectively ($P = 0.013$). The comparison results of energy intake through each meal and snack among the four groups are presented in Table 4. In model 1 without variable adjustment, energy intake through breakfast was lower in the VSSD group than in the ASD group ($P = 0.014$), and energy intake through dinner was lower in the VSSD group than in the ASD and SSD groups ($P =$

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Table 2. Health indicators according to sleep duration categories

Characteristics	Total (n = 3,040)	VSSD (n = 585)	SSD (n = 829)	ASD (n = 1,570)	LSD (n = 56)	*P*-value
BMI (kg/m^2)	23.8 ± 0.08	24.2 ± 0.18^a	23.6 ± 0.12^b	23.7 ± 0.10^b	23.5 ± 0.65^{ab}	0.022
WC (cm)	81.4 ± 0.21	82.7 ± 0.49^a	81.1 ± 0.34^b	81.2 ± 0.28^b	80.6 ± 1.82^{ab}	0.040
SBP (mmHg)	118.8 ± 0.34	119.4 ± 0.73	118.5 ± 0.63	118.9 ± 0.48	117.2 ± 2.78	0.769
DBP (mmHg)	75.0 ± 0.20	75.6 ± 0.43	74.7 ± 0.36	74.9 ± 0.28	76.2 ± 1.56	0.353
FBG (mg/dL)	101.2 ± 0.47	102.3 ± 0.90	100.4 ± 0.65	101.0 ± 0.72	106.6 ± 5.23	0.237
HbA1c (%)	5.8 ± 0.02	5.9 ± 0.04^a	5.8 ± 0.02^b	5.8 ± 0.03^b	6.1 ± 0.23^{ab}	0.022
Total cholesterol (mg/dL)	202.1 ± 0.88	199.9 ± 1.91	203.4 ± 1.54	202.5 ± 1.17	189.2 ± 6.63	0.093
HDL-chol (mg/dL)	58.7 ± 0.31	59.7 ± 0.71^a	59.6 ± 0.56^a	57.9 ± 0.41^b	56.8 ± 2.00^{ab}	0.030
LDL-chol (mg/dL)	122.9 ± 1.20	117.3 ± 2.54^b	125.6 ± 2.22^a	124.0 ± 1.59^a	107.6 ± 7.62^c	0.014
TG (mg/dL)	116.7 ± 1.40	116.9 ± 3.31	113.6 ± 2.49	118.2 ± 1.96	117.0 ± 12.46	0.530

Mean ± SE.
Analysis of variance.
VSSD, very short sleep duration (< 6 hours); SSD, short sleep duration (6–7 hours); ASD, appropriate sleep duration (7–9 hours); LSD, long sleep duration (> 9 hours); BMI, body mass index; WC, waist circumference; SBP, systolic blood pressure; DBP, diastolic blood pressure; FBG, fasting blood glucose; HbA1c, glycated hemoglobin; HDL-chol, high-density lipoprotein-cholesterol; LDL-chol, low-density lipoprotein-cholesterol; TG, triglyceride.
[a–c]Different letters indicate statistically significant differences according to the Tukey test.

Table 3. Meal skipping according to sleep duration categories

Meal	VSSD (n = 585)	SSD (n = 829)	ASD (n = 1,570)	LSD (n = 56)	*P*-value
Breakfast					0.006
No (skipped)	112 (19.1)	138 (16.6)	244 (15.5)	18 (32.1)	
Yes (not skipped)	473 (80.9)	691 (83.4)	1326 (84.5)	38 (67.9)	
Lunch					0.238
No (skipped)	54 (9.2)	60 (7.2)	105 (6.7)	3 (5.4)	
Yes (not skipped)	531 (90.8)	769 (92.8)	1465 (93.3)	53 (94.6)	
Dinner					0.013
No (skipped)	46 (7.9)	44 (5.3)	81 (5.2)	6 (10.7)	
Yes (not skipped)	539 (92.1)	785 (94.7)	1489 (94.8)	50 (89.3)	

n (%).
Rao-Scott chi-square test.
VSSD, very short sleep duration (< 6 hours); SSD, short sleep duration (6–7 hours); ASD, appropriate sleep duration (7–9 hours); LSD, long sleep duration (> 9 hours).

0.046). In model 2, with variable adjustment, no significant differences were observed among the four groups in energy intake through each meal (breakfast, lunch, and dinner) except snacks, while energy intake through snacks was higher in the VSSD group than in the ASD group (P = 0.033). The LSD group did not significantly differ from the other three groups in energy intake through all meals and snacks in models 1 and 2.

3. Nutrient and food group intake comparison according to sleep duration

The results of the comparison of energy and nutrient intake among the four groups according to sleep duration are presented in Table 5. In model 1, the total daily energy intake was lower in the VSSD group than in the ASD and SSD groups (P = 0.008). In model 2, the total daily energy intake remained lower in the VSSD group than in the ASD group (P = 0.037). Regarding the energy intake ratios of macronutrients (carbohydrates, protein, and fat), in model 1, the carbohydrate energy intake ratio was significantly higher in the VSSD group than in the ASD and SSD groups (P = 0.005). In contrast, the fat energy intake ratio was lower (P = 0.001). However, in model 2, no significant differences were observed. In

Table 4. Energy intake by meal according to sleep duration categories

Meal	Model 1				*P*-value	Model 2				*P*-value
	VSSD (n = 585)	SSD (n = 829)	ASD (n = 1,570)	LSD (n = 56)		VSSD (n = 585)	SSD (n = 829)	ASD (n = 1,570)	LSD (n = 56)	
Breakfast	305.2 ± 9.66[b]	320.0 ± 7.72[ab]	330.8 ± 6.03[a]	270.4 ± 30.57[ab]	0.014	303.4 ± 17.09	315.6 ± 15.96	325.0 ± 16.21	259.8 ± 46.43	0.169
Lunch	452.2 ± 12.14	474.5 ± 11.05	481.1 ± 7.58	476.2 ± 41.71	0.145	446.8 ± 20.74	442.6 ± 19.79	449.4 ± 20.21	439.8 ± 49.28	0.957
Dinner	448.4 ± 12.71[b]	477.1 ± 10.37[a]	477.8 ± 7.35[a]	462.0 ± 41.91[ab]	0.046	494.5 ± 21.23	510.8 ± 20.03	512.1 ± 19.02	526.1 ± 49.59	0.612
Snacks	319.1 ± 14.03	317.8 ± 10.80	314.3 ± 7.53	354.7 ± 64.61	0.643	343.6 ± 20.52[a]	319.2 ± 18.72[ab]	301.7 ± 18.39[b]	362.6 ± 46.71[ab]	0.033

Model 1, mean ± SE, analysis of variance; model 2, weighed mean ± SE, analysis of covariance adjusted for age, education level, household income, current drinking and smoking status, body mass index, systolic blood pressure, high-density lipoprotein-cholesterol, glycated hemoglobin, and total energy intake.
VSSD, very short sleep duration (< 6 hours); SSD, short sleep duration (6–7 hours); ASD, appropriate sleep duration (7–9 hours); LSD, long sleep duration (> 9 hours).
[ab]Different letters indicate a significant difference.

model 1, the daily intakes of protein (P = 0.017), fat (P < 0.001), SFA (P = 0.003), MUFA (P < 0.001), PUFA (P = 0.015), and n-6 fatty acids (P = 0.013) were lower in the VSSD group than in the ASD and SSD groups. In model 2, the daily MUFA intake was lower in the VSSD group than in the ASD group (P = 0.017). In contrast, the daily potassium intake was higher in the VSSD group than in the ASD group (P = 0.045). The LSD group showed no significant differences from the other three groups in terms of total daily energy and nutrient intake in models 1 and 2. The results of the food group intake comparison among the four groups according to sleep duration are presented in Table 6. In model 1, daily nut and seed intake was lower in the SSD and VSSD groups than in the ASD group (P = 0.020). Meanwhile, daily meat intake was lower in the VSSD group than in the ASD group (P = 0.044). In model 2, the intakes of nuts and seeds and meat, which showed significant differences in model 1, showed no significant differences among the four groups. Daily potato and starch intake was higher in the VSSD group than in the ASD and LSD groups (P = 0.046), and daily vegetable intake was lower in the LSD group than in the SSD and VSSD groups (P = 0.038).

4. Associations between sleep duration and nutrient and food group intake according to postmenopausal duration

The variables showing significant associations in the multinomial logistic regression analysis between nutrient and food group intake and sleep duration in the early and late postmenopausal groups are presented in Table 7. In the early postmenopausal group, higher intakes of sugars (P = 0.039), cholesterol (P < 0.001), and phosphorus (P = 0.023) were associated with a higher risk of LSD. Conversely, higher vitamin A intake was associated with a lower LSD risk (P = 0.020), and folate intake was associated with a lower VSSD risk (P = 0.010). In the late postmenopausal group, higher intakes of cholesterol (P = 0.004), vitamin A (P = 0.011), cereal grains (P < 0.001), fish and shellfish (P < 0.001), and beverages (P = 0.005) were associated with a higher LSD risk. In particular, a higher riboflavin intake was associated with a 4.776-fold higher LSD risk (P = 0.004). Conversely, higher intakes of water (P < 0.001) and eggs (P = 0.046) were associated with a lower LSD risk. The results of the polynomial

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Table 5. Energy and nutrient intake according to sleep duration categories

Nutrients	Model 1				*P*-value	Model 2				*P*-value
	VSSD (n = 585)	SSD (n = 829)	ASD (n = 1,570)	LSD (n = 56)		VSSD (n = 585)	SSD (n = 829)	ASD (n = 1,570)	LSD (n = 56)	
Total energy intake (kcal/day)[1)]	1,498.1 ± 29.08[b]	1,588.5 ± 21.46[a]	1,610.8 ± 16.22[a]	1,588.5 ± 97.49[ab]	0.008	1,497.1 ± 40.98[b]	1,569.1 ± 38.85[ab]	1,593.5 ± 36.28[a]	1,587.7 ± 104.97[ab]	0.037
Carbohydrate (%)	64.4 ± 0.51[a]	62.5 ± 0.43[b]	62.8 ± 0.30[b]	64.7 ± 1.60[ab]	0.005	64.0 ± 0.87	62.7 ± 0.82	62.8 ± 0.82	62.9 ± 1.94	0.135
Protein (%)	15.0 ± 0.19	15.3 ± 0.16	15.1 ± 0.11	14.7 ± 0.67	0.623	15.4 ± 0.32	15.5 ± 0.29	15.4 ± 0.28	15.2 ± 0.73	0.915
Fat (%)	20.6 ± 0.42[b]	22.2 ± 0.34[a]	22.0 ± 0.24[a]	20.6 ± 1.37[ab]	0.001	20.6 ± 0.67	21.7 ± 0.62	21.8 ± 0.62	21.9 ± 1.67	0.058
Carbohydrate (g/day)	237.9 ± 4.78	243.7 ± 3.75	247.7 ± 2.53	249.5 ± 16.43	0.289	238.7 ± 4.08	234.5 ± 3.81	233.4 ± 3.84	236.0 ± 8.92	0.191
Dietary Fiber (g/day)	25.2 ± 0.65	26.4 ± 0.52	26.8 ± 0.39	24.7 ± 1.85	0.125	23.9 ± 0.63	23.6 ± 0.60	23.6 ± 0.55	21.7 ± 1.73	0.617
Sugars (g/day)	56.3 ± 2.03	58.8 ± 1.80	61.8 ± 1.21	63.8 ± 6.27	0.067	54.7 ± 2.23	52.6 ± 2.13	54.8 ± 1.90	58.7 ± 6.19	0.520
Protein (g/day)	56.0 ± 1.26[b]	60.0 ± 1.04[a]	60.3 ± 0.77[a]	56.3 ± 3.65[ab]	0.017	57.9 ± 1.21	58.2 ± 1.19	57.8 ± 1.16	54.22 ± 2.57	0.453
Fat (g/day)	34.7 ± 1.09[b]	39.8 ± 0.89[a]	40.7 ± 0.73[a]	39.2 ± 4.09[ab]	< 0.001	36.6 ± 1.18	38.0 ± 1.11	38.5 ± 1.10	38.8 ± 3.47	0.152
SFA (g/day)	10.6 ± 0.40[b]	11.9 ± 0.31[a]	12.4 ± 0.26[a]	11.8 ± 1.46[ab]	0.003	11.4 ± 0.50	11.6 ± 0.44	12.0 ± 0.46	12.0 ± 1.37	0.361
MUFA (g/day)	10.8 ± 0.36[b]	12.7 ± 0.32[a]	13.1 ± 0.28[a]	13.3 ± 1.67[ab]	< 0.001	11.7 ± 0.46b	12.3 ± 0.45[ab]	12.7 ± 0.45[a]	13.5 ± 1.53[ab]	0.017
PUFA (g/day)	9.6 ± 0.36[b]	11.0 ± 0.26[a]	10.8 ± 0.20[a]	9.8 ± 0.97[ab]	0.015	9.5 ± 0.34	10.0 ± 0.29	9.6 ± 0.26	8.8 ± 0.83	0.312
n-3 Fatty acids (g/day)	1.7 ± 0.08	1.9 ± 0.07	1.8 ± 0.05	1.7 ± 0.24	0.182	1.6 ± 0.13	1.7 ± 0.13	1.6 ± 0.13	1.4 ± 0.29	0.314
n-6 Fatty acids (g/day)	7.9 ± 0.31[b]	9.1 ± 0.22[a]	8.9 ± 0.17[a]	8.1 ± 0.81[ab]	0.013	7.9 ± 0.30	8.2 ± 0.25	8.0 ± 0.23	7.4 ± 0.66	0.432
Cholesterol (mg/day)	209.8 ± 8.49	227.5 ± 6.58	225.4 ± 4.79	223.1 ± 31.66	0.359	219.4 ± 11.03	219.6 ± 10.61	218.1 ± 10.47	228.8 ± 29.58	0.982
Calcium (mg/day)	489.2 ± 14.93	491.9 ± 10.37	503.9 ± 8.04	481.1 ± 45.82	0.700	468.2 ± 16.25	439.6 ± 13.35	449.0 ± 12.80	442.4 ± 47.58	0.355
Phosphorus (mg/day)	928.1 ± 19.36	966.1 ± 14.36	975.0 ± 10.92	923.9 ± 54.40	0.163	936.0 ± 17.05	915.8 ± 16.06	914.5 ± 15.53	873.9 ± 47.52	0.238
Sodium (mg/day)	2,697.8 ± 76.80	2,809.0 ± 59.77	2,798.4 ± 44.59	2,655.3 ± 263.85	0.613	2,713.2 ± 76.14	2,676.8 ± 72.44	2,629.4 ± 63.32	2,514.9 ± 199.37	0.571
Potassium (mg/day)	2,713.8 ± 67.50	2,789.4 ± 46.64	2,787.0 ± 34.08	2,647.1 ± 162.43	0.642	2,644.0 ± 59.49[a]	2,555.6 ± 55.24[ab]	2,510.7 ± 51.18[b]	2,409.4 ± 158.86[ab]	0.045
Iron (mg/day)	9.3 ± 0.26	9.6 ± 0.22	9.7 ± 0.16	10.1 ± 1.07	0.547	9.1 ± 0.27	8.8 ± 0.27	8.8 ± 0.22	9.5 ± 1.08	0.674
Vitamin A (μgRAE/day)	394.7 ± 15.94	396.7 ± 12.08	409.8 ± 9.66	430.8 ± 95.55	0.780	378.9 ± 19.65	353.3 ± 18.02	361.3 ± 16.99	402.7 ± 103.71	0.617
Thiamin (mg/day)	1.0 ± 0.03	1.0 ± 0.02	1.1 ± 0.02	0.9 ± 0.06	0.118	1.0 ± 0.04	1.0 ± 0.04	1.0 ± 0.04	0.9 ± 0.07	0.190
Riboflavin (mg/day)	1.4 ± 0.04	1.4 ± 0.02	1.5 ± 0.02	1.5 ± 0.12	0.351	1.4 ± 0.05	1.3 ± 0.05	1.3 ± 0.05	1.5 ± 0.11	0.249
Niacin (mg/day)	10.3 ± 0.29	10.6 ± 0.21	10.9 ± 0.16	10.7 ± 0.79	0.374	10.9 ± 0.29	10.5 ± 0.26	10.6 ± 0.25	10.6 ± 0.72	0.542
Folate (μg DFE/day)	320.2 ± 8.26	331.6 ± 5.73	332.7 ± 4.80	324.1 ± 31.21	0.619	310.3 ± 8.63	303.8 ± 7.37	301.3 ± 7.17	299.2 ± 34.21	0.672
Vitamin C (mg/day)	82.2 ± 5.37	74.1 ± 2.76	75.8 ± 2.41	87.3 ± 23.48	0.569	75.1 ± 6.02	61.8 ± 3.99	61.6 ± 3.88	77.6 ± 24.48	0.117
Water (g/day)	947.3 ± 28.37	1,003.6 ± 20.03	992.8 ± 14.77	921.9 ± 80.21	0.354	911.4 ± 29.11	896.3 ± 24.56	877.2 ± 24.88	825.2 ± 61.73	0.381

Model 1, mean ± SE, analysis of variance; model 2, weighed mean ± SE, analysis of covariance adjusted for age, education level, household income, current drinking and smoking status, body mass index, systolic blood pressure, high-density lipoprotein-cholesterol, glycated hemoglobin, and total energy intake.

VSSD, very short sleep duration (< 6 hours); SSD, short sleep duration (6–7 hours); ASD, appropriate sleep duration (7–9 hours); LSD, long sleep duration (> 9 hours); SFA, saturated fatty acids; MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids.

[1)]Total energy intake excluded from adjusted variables in model 2.

[a,b]Different letters indicate a significant difference.

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Table 6. Food group intake by sleep duration category

Food Groups[1)]	Model 1				*P*-value	Model 2				*P*-value
	VSSD (n = 585)	SSD (n = 829)	ASD (n = 1,570)	LSD (n = 56)		VSSD (n = 585)	SSD (n = 829)	ASD (n = 1,570)	LSD (n = 56)	
Cereal grains	212.2 ± 5.38	222.3 ± 4.84	218.9 ± 3.03	242.2 ± 30.30	0.417	214.2 ± 6.94	219.0 ± 6.36	211.1 ± 6.19	237.3 ± 24.52	0.310
Potatoes & starchy foods	52.7 ± 5.33	46.7 ± 3.80	43.5 ± 2.52	29.0 ± 8.99	0.232	47.4 ± 5.83[a]	35.9 ± 4.52[ab]	33.4 ± 3.94[b]	19.7 ± 10.29[b]	0.046
Sweeteners	6.3 ± 0.47	6.4 ± 0.39	7.8 ± 0.42	9.2 ± 2.05	0.106	6.9 ± 0.76	5.8 ± 0.59	7.2 ± 0.64	9.2 ± 2.62	0.065
Pulses	45.5 ± 3.93	48.2 ± 3.17	44.5 ± 2.05	49.4 ± 17.29	0.805	40.5 ± 4.82	42.5 ± 4.56	38.6 ± 4.07	27.0 ± 15.22	0.642
Nuts & seeds	8.4 ± 1.03[b]	7.4 ± 0.80[b]	11.8 ± 1.04[a]	9.6 ± 3.77[ab]	0.020	5.2 ± 1.13	4.2 ± 1.19	8.4 ± 0.98	6.3 ± 3.47	0.066
Vegetables	301.1 ± 9.87	307.3 ± 7.18	306.1 ± 4.96	268.2 ± 24.10	0.087	296.8 ± 12.67[a]	292.6 ± 10.19[a]	282.8 ± 9.75[ab]	225.9 ± 25.72[b]	0.038
Mushrooms	7.5 ± 1.05	6.9 ± 0.90	6.3 ± 0.54	6.7 ± 3.74	0.823	8.1 ± 1.94	6.6 ± 1.84	6.6 ± 1.87	5.8 ± 3.37	0.732
Fruits	201.0 ± 14.25	208.4 ± 8.66	221.5 ± 6.84	236.0 ± 47.25	0.235	157.5 ± 14.62	156.7 ± 13.97	166.0 ± 11.16	162.0 ± 43.37	0.903
Seaweeds	19.2 ± 3.54	19.0 ± 2.24	17.7 ± 1.52	11.1 ± 2.80	0.674	19.3 ± 4.71	14.7 ± 2.75	13.6 ± 2.23	8.4 ± 5.98	0.521
Meats	65.2 ± 4.00[b]	73.6 ± 3.85[ab]	74.6 ± 2.51[a]	47.9 ± 8.83[ab]	0.044	71.1 ± 6.73	76.8 ± 6.56	77.3 ± 6.58	56.5 ± 13.61	0.282
Eggs	34.5 ± 1.92	36.9 ± 1.57	35.2 ± 1.14	27.1 ± 5.47	0.312	31.6 ± 2.55	33.0 ± 2.43	30.8 ± 2.25	26.9 ± 7.20	0.672
Fish & shellfish	66.3 ± 5.21	75.1 ± 4.41	73.0 ± 2.77	87.9 ± 14.95	0.806	74.4 ± 7.92	74.5 ± 6.69	69.6 ± 5.40	92.0 ± 24.67	0.667
Dairy products	90.8 ± 6.64	88.1 ± 4.84	99.1 ± 4.04	88.9 ± 17.20	0.210	89.2 ± 12.02	71.0 ± 8.93	84.6 ± 9.41	101.9 ± 32.36	0.117
Fats & oils	5.0 ± 0.27	5.9 ± 0.26	5.7 ± 0.19	5.0 ± 1.04	0.186	5.0 ± 0.33	5.2 ± 0.32	4.9 ± 0.30	4.7 ± 1.10	0.829
Beverages	152.9 ± 10.91	175.4 ± 8.81	156.3 ± 6.42	160.3 ± 31.84	0.827	168.3 ± 20.50	160.1 ± 16.40	149.3 ± 16.64	181.6 ± 45.97	0.680
Alcoholic beverages	26.0 ± 5.15	42.1 ± 6.73	33.2 ± 3.92	37.3 ± 17.61	0.112	86.8 ± 21.71	95.6 ± 21.34	97.5 ± 23.09	112.4 ± 28.30	0.207

Model 1, mean ± SE, analysis of variance; model 2, weighed mean ± SE, analysis of covariance adjusted for age, education level, household income, current drinking and smoking status, body mass index, systolic blood pressure, high-density lipoprotein-cholesterol, glycated hemoglobin, and total energy intake.

VSSD, very short sleep duration (< 6 hours); SSD, short sleep duration (6–7 hours); ASD, appropriate sleep duration (7–9 hours); LSD, long sleep duration (> 9 hours).

[1)]g/day.

[a,b]Different letters indicate a significant difference.

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Table 7. Associations of dietary intake with categories of sleep duration by postmenopausal period

Variable	VSSD		SSD		LSD	
	OR (95%CI)	*P*-value	OR (95%CI)	*P*-value	OR (95%CI)	*P*-value
Early postmenopause (n = 1,448)[1]						
Sugars (g/day)	0.997 (0.986, 1.008)	0.609	1.003 (0.992, 1.013)	0.593	1.030 (1.002, 1.060)	0.039
Cholesterol (mg/day)	1.001 (0.998, 1.004)	0.482	1.000 (0.997, 1.002)	0.721	1.009 (1.004, 1.014)	< 0.001
Phosphorus (mg/day)	1.000 (0.998, 1.002)	0.953	0.999 (0.997, 1.000)	0.118	1.006 (1.001, 1.011)	0.023
Vitamin A (μgRAE/day)	0.993 (0.961, 1.027)	0.697	1.015 (0.997, 1.034)	0.108	0.478 (0.256, 0.891)	0.020
Folate (μg DFE/day)	0.996 (0.993, 0.999)	0.010	1.000 (0.997, 1.002)	0.676	1.000 (0.993, 1.007)	0.936
Late postmenopause (n = 1,590)[2]						
Cholesterol (mg/day)	1.001 (0.998, 1.004)	0.624	0.998 (0.996, 1.001)	0.223	1.007 (1.002, 1.011)	0.004
Vitamin A (μgRAE/day)	0.997 (0.978, 1.016)	0.748	1.005 (0.989, 1.022)	0.558	1.043 (1.010, 1.078)	0.011
Riboflavin (mg/day)	0.694 (0.396, 1.214)	0.200	1.153 (0.741, 1.794)	0.527	4.776 (1.635, 3.951)	0.004
Water (g/day)	1.000 (0.998, 1.002)	0.880	1.001 (1.000, 1.003)	0.106	0.994 (0.991, 0.997)	< 0.001
Cereal grains (g/day)	1.001 (0.998, 1.005)	0.406	1.001 (0.998, 1.004)	0.505	1.015 (1.008, 1.022)	< 0.001
Eggs (g/day)	1.000 (0.991, 1.010)	0.982	1.005 (0.998, 1.013)	0.176	0.986 (0.972, 1.000)	0.046
Fish & shellfish (g/day)	1.000 (0.997, 1.002)	0.859	1.000 (0.997, 1.002)	0.936	1.009 (1.004, 1.014)	< 0.001
Beverages (g/day)	1.000 (0.998, 1.003)	0.672	0.998 (0.997, 1.000)	0.098	1.005 (1.002, 1.009)	0.005

Multinomial logistic regression relative to appropriate sleep duration (7–9 hours) adjusted for age, education level, household income, current drinking and smoking status, body mass index, systolic blood pressure, high-density lipoprotein-cholesterol, glycated hemoglobin, and total energy intake.
Only variables with significant relationships to sleep duration are shown.
OR, odds ratio; VSSD, very short sleep duration (< 6 hours); SSD, short sleep duration (6–7 hours); LSD, long sleep duration (> 9 hours); CI, confidence interval.
[1]< 6 years after menopause.
[2]≥ 6 years after menopause.

Table 8. Associations of dietary intake with sleep duration by postmenopausal period

Variable	Coefficient				Inflection point[1]	Sleep duration (hr)
	β_1	*P*-value	β_2	*P*-value		
Early postmenopause (n = 1,448)[2]						
PUFA (g/day)	0.0240942	0.113	−0.0006068	0.049	19.86	7.19
Riboflavin (mg/day)	0.3556539	0.102	−0.1009126	0.032	1.76	7.08
Water (g/day)	0.0008693	0.001	−0.0000004	< 0.001	1,086.63	7.19
Alcoholic beverages (g/day)	0.0013586	0.001	−0.0000008	0.001	849.13	7.52
Late postmenopause (n = 1,590)[3]						
Sugars (g/day)	0.0056061	< 0.001	−0.0000222	< 0.001	126.33	7.01
Sodium (mg/day)	−0.0001268	0.014	0.0000000	0.046	-	-
Fruits (g/day)	0.0003218	0.061	−0.0000002	< 0.001	804.50	6.90
Beverages (g/day)	0.0006865	0.011	−0.0000007	< 0.001	490.36	6.98

Polynomial regression analysis adjusted for age, education level, household income, current drinking and smoking status, body mass index, systolic blood pressure, high-density lipoprotein-cholesterol, glycated hemoglobin, and total energy intake.
Only variables with significant relationships to sleep duration are shown.
β_1, first-order coefficient; β_2, second-order coefficient; PUFA, polyunsaturated fatty acids.
[1]$-\beta_1/2\beta_2$.
[2]< 6 years after menopause.
[3]≥ 6 yr after menopause.

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regression analysis of the associations between nutrient and food group intakes and sleep duration in the early and late postmenopausal groups are presented in Table 8. In the early postmenopausal group, PUFA (β_2 = –0.0006068, P = 0.049) and riboflavin (β_2 = –0.1009126, P = 0.032) intake showed negative nonlinear relationships with sleep duration above 19.86 g/day and 1.76 mg/day, respectively, while linear relationships were not significant. Sleep durations at respective inflection points were 7.19 and 7.08 hours. Water (β_1 = 0.0008693, P = 0.001; β_2 = –0.0000004, P < 0.001) and alcoholic beverage (β_1 = 0.0013586, P = 0.001; β_2 = –0.0000008, P = 0.001) intake showed positive linear relationships with sleep duration below 1,086.63 and 849.13 g/day, respectively, and negative nonlinear relationships above these levels. Sleep durations at respective inflection points were 7.19 and 7.52 hours. In the late postmenopausal group, sugar (β_1 = 0.0056061, P < 0.001; β_2 = –0.0000222, P < 0.001) and beverage (β_1 = 0.0006865, P = 0.011; β_2 = –0.0000007, P < 0.001) intake showed positive linear relationships with sleep duration below 126.33 and 490.36 g/day, respectively, and negative nonlinear relationships above these levels. The sleep duration at the respective inflection points was 7.01 and 6.98 hours. Fruit intake (β_2 = –0.0000002, P < 0.001) showed a negative nonlinear relationship with sleep duration above 804.50 g/day, while the linear relationship was not significant. The sleep duration at the corresponding inflection point was 6.90 hours. Sodium showed a negative linear relationship (β_1 = –0.0001268, P = 0.014) and a positive nonlinear relationship (β_2 = 0.0000000, P = 0.046) with sleep duration. However, since the β_2 value converged to 0, the inflection point and corresponding sleep duration could not be calculated.

DISCUSSION

This study was conducted to identify the dietary factors associated with sleep duration in postmenopausal middle-aged women by integrating five years of raw data from the KNHANES. The intake of specific food groups and nutrients was associated with sleep duration, with characteristic results emerging according to the time since menopause. In addition, meal-skipping patterns and energy intake from snacks differed according to sleep duration.

The proportion of short sleepers (46.5%) was higher than in premenopausal women (31.9%) but slightly lower than in the general postmenopausal population (50.1%) [21], indicating that insufficient sleep is prevalent among Korean postmenopausal middle-aged women. The VSSD and LSD groups had low education levels and household income. Populations with low socioeconomic status characteristically exhibit poor sleep quality and quantity and SSD due to unhealthy lifestyles, high stress levels, and psychological factors [7, 22]. Furthermore, low education and household income are observed not only in short-sleep groups but also in long-sleep groups, as unemployed populations tend to have lower education levels, income, and assets and sleep longer [7, 23, 24].

Previous studies on the relationship between sleep duration and obesity have shown that SSD is associated with obesity, including increased visceral fat [25] and a higher risk of abdominal obesity [26]. In this study, the VSSD group exhibited high average BMI and WC and blood HbA1c levels, whereas energy intake levels were lower. This finding suggests that the association between sleep deprivation and obesity is due to complex interactions in the endocrine system. Experimental sleep restriction studies have reported disruptions in energy metabolism and endocrine function, including decreased physical activity [27] and reduced energy expenditure due to increased cortisol secretion [28]. The association between VSSD and high HbA1c levels observed in the Fukuoka Diabetes Registry study [29] and the Nurses' Health Study [30] also suggests that insulin resistance due to sleep deprivation leads to increased body fat mass. The VSSD group exhibited elevated snack energy intake, frequent skipping of breakfast and dinner, and greater consumption of potatoes and starchy foods, which is consistent with research showing that repeated bedtime restriction has an appetite-enhancing effect on high-carbohydrate foods, such as snacks, without significantly affecting overall energy intake [14]. Additionally, sleep-deprived individuals are more likely to deviate from traditional three-meals-a-day patterns, have more irregular eating patterns, and consume snacks more frequently, while adopting nocturnal lifestyles that replace regular meals with snacks consumed

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in the late evening and at night [4, 14]. As snacks are generally nutritionally unbalanced and have a high energy content, snack-dependent eating patterns may lead to nutritional imbalances [31].

The Mediterranean diet includes fresh vegetables, fruits, whole grains, olive oil, fish, and nuts. It is relatively high in fat, with MUFAs accounting for over 20% of total energy intake [17]. In women, who experience sleep disorders more frequently than men, the abundant PUFA and high MUFA intake from the Mediterranean diet may help improve sleep quality, and nuts, having high melatonin content among plant foods, may positively influence sleep regulation [17, 32]. The low MUFA and nut intake observed in the VSSD group indirectly support these research findings; however, well-designed intervention studies are needed to determine their independent effects on improving sleep quality.

In this study, a high potassium intake was observed in the VSSD group, which is presumed to be due to the high intake of potatoes and starchy foods that contribute significantly to potassium intake. However, previous studies on the relationship between sleep and potassium have shown opposite results. In women, potassium intake was positively correlated with sleep duration and quality improvement, while low potassium intake was associated with poor sleep quality [33]. Additionally, it was shown in patients with diabetes that magnesium and potassium supplementation affected serum cortisol and melatonin levels, which were associated with increased sleep duration [34]. To clarify the relationship between sleep duration and potassium, it is necessary to comprehensively consider the interactions with micronutrients such as magnesium, calcium, and vitamin D, which have positive effects on improving sleep quality, and components such as caffeine, sodium, and benzodiazepines, which have negative effects. Meanwhile, the low vegetable intake observed in the LSD group showed a similar trend to the low vegetable intake frequency in long-sleep groups reported in an observational study of older Chinese individuals [35].

Based on accumulated data on follicle-stimulating hormone and estrogen concentrations, women's reproductive age can be classified into a 10-stage change system [20]. Sleep patterns and characteristics vary according to the stage of reproductive change. Vasomotor symptoms such as hot flashes, a physiological change occurring during menopause, are presumed to be primarily caused by estrogen decrease and continue to impair sleep quality during the menopausal transition period and for some time thereafter [36]. During perimenopause, which includes the menopausal transition period and some early postmenopause, insomnia prevalence increases significantly owing to rapid estrogen decline [8]. However, in late postmenopause, prolonged low estrogen states in the nervous system can cause sleep disorders independently of aging through physical pain, bruxism, anxiety, and depression [13]. These changes are associated with nutrient metabolism, nervous system reactivity, and sleep-wake regulation mechanisms, as well as various factors such as chronic disease morbidity and dietary habit changes, making the relationship between sleep and dietary factors more complex according to the duration since menopause [37]. Among studies investigating the relationship between nutrient and food intake according to sleep duration using the KNHANES, some have shown no significant associations in postmenopausal women, unlike in premenopausal women [19, 21]. All these studies share the common feature of not considering the duration since menopause. As physical and physiological changes continue even after menopause, studies targeting menopausal women must consider the duration since menopause to ensure analytical accuracy. The postmenopausal period can be broadly divided into two stages: early (< 6 years) and late (thereafter) [20]. In this study, targeting postmenopausal middle-aged women, the relationship between sleep duration and nutrient and food intake appeared characteristically according to the duration since menopause. In the late postmenopausal group, cholesterol, riboflavin, and intake of cereal grains, fish and shellfish, and beverages were associated with a high LSD risk. In contrast, in the early postmenopausal group, cholesterol intake was significantly associated with a high LSD risk, and folate intake was associated with a low VSSD risk.

In a previous study of 459 postmenopausal women, cholesterol intake was found to be negatively correlated with sleep duration [38]. High cholesterol intake was also observed in studies of patients with obesity and social jetlag [39], with the relationship between choles-

terol and sleep presented multiple times. Systematic literature reviews on sleep duration have shown that short and long sleep are associated with an increased risk of mortality and chronic diseases such as cardiovascular disease, stroke, diabetes, and obesity [1, 5]. This finding suggests that dietary factors such as cholesterol interact with the correlation between long sleep and chronic diseases. The risk of hypertension is highest 5–9 years after menopause, the risk of hypertriglyceridemia increases 10–14 years after menopause, and the risk of metabolic syndrome continues to increase up to 14 years after menopause [40], making these results meaningful.

In the early postmenopausal group, when insomnia significantly increases [8], riboflavin intake of ≥ 1.76 mg/day had a significant negative nonlinear relationship with sleep duration, with the corresponding sleep duration being 7.08 hours, which is at the lower boundary level of normal sleep. Given that the riboflavin intake of women aged 50–64 years reported in the 2022 KNHANES [41] was 1.37 ± 0.03 mg/day and the recommended intake of riboflavin [42] is 1.2 mg/day, this corresponds to a level higher than typical intake. Therefore, increased riboflavin intake in the high-level range may be associated with sleep reduction to levels shorter than the normal sleep duration, suggesting a nonlinear relationship due to the action of other variables. Riboflavin acts directly on the central nervous system and functions as a precursor to the brain cell electron transport chain and as a coenzyme in energy metabolism processes. It is used clinically for the prevention and treatment of migraines and pediatric neuropathy [43]. Thus, riboflavin may be involved in sleep processes that result from complex physiological interactions in the nervous system.

The range of PUFA intake showing a significant negative nonlinear relationship with sleep duration in the early postmenopausal group was ≥ 19.86 g/day, corresponding to a higher level than the average PUFA intake (10.4 ± 0.28 g/day) for women aged 50–64 years. This finding suggests that increased PUFA intake is not significantly associated with sleep duration reduction in the typical intake range. PUFA are a component of cell membranes involved in various physiological functions such as nerve transmission, inflammatory responses, and circadian rhythm regulation, and n-3 fatty acid intake affects sleep duration through melatonin and serotonin synthesis [44]. Meanwhile, systematic literature reviews on the relationship between alcohol intake and sleep duration have shown that low alcohol intake is associated with increased sleep duration, emphasizing the importance of dosage [45]. However, in the early postmenopausal group in this study, alcohol intake was positively and linearly related to sleep duration at levels below 849.13 g/day, which is more than 20 times higher than the average alcohol intake of 32.5 g/day for women aged 50-64 years reported by the 2022 KNHANES [41].

In the late postmenopausal group, the intake levels of sugars and beverages that became inflection points for positive linear and negative nonlinear relationships with sleep duration were 126.33 g/day and 490.36 g/day, respectively. These levels are twice or more than the average intake of 58.0 ± 1.8 and 212.8 ± 17.1 g/day for women aged 50–64 years reported in the 2022 KNHANES [41]. Blood sugar increases the bioavailability of serotonin, which has important effects on sleep initiation, maintenance, and cycles, while directly affecting sleep centers. Furthermore, it is reported to have a positive linear relationship with sleep duration [46], which may be related to the results of this study showing a positive linear relationship between sugar intake and sleep duration in the typical range.

Analysis of the relationship between sleep duration and dietary factors in postmenopausal women aged 40–64 years revealed that the VSSD group had higher energy intake from snacks and more frequent skipping of breakfast and dinner, despite relatively low total energy intake levels. In the early postmenopausal group, above-average PUFA and riboflavin intakes showed negative nonlinear associations with sleep duration, and in the late postmenopausal group, riboflavin intake was strongly associated with an increased risk of LSD. Cholesterol intake was associated with a higher LSD risk in both early and late postmenopausal groups.

Limitations

This study has several limitations. First, as a cross-sectional study using KNHANES data, causal relationships could not be established; only associations could be interpreted. Second, the LSD group with only 56 participants may still pose a risk of low estimation reliability owing to sampling errors despite weight application.

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Third, survey methods differed. The 8th KNHANES collected food intake information from the day before the survey regardless of the day of the week, whereas the 9th KNHANES collected intake information from two days before the survey during weekdays, referring to photos or meal records. Additionally, the 24-hour recall method has limitations in terms of recall bias and representativeness of daily meals. Fourth, sleep duration was self-reported data with concerns regarding response and recall bias. Sleep deprivation due to sleep disorders such as insomnia and insufficient sleep due to busy schedules were not distinguished. Moreover, several factors that may influence sleep duration—such as medical conditions, pain, stress, depression, sleep environment, caffeine intake, hormonal status, and medications (e.g., antidepressants or drugs for insomnia and obstructive sleep apnea)—were not included as covariates in the analysis. Fifth, data on fasting time before sleep and total daily physical activity time, which are vital meal-related factors related to sleep, were not analyzed as variables. Additionally, water intake, which showed a significant association with sleep duration, was excluded from the interpretation because the KNHANES data included water content retained in foods, not including drinking water or water added during cooking.

Conclusion

Dietary factors associated with sleep duration in postmenopausal middle-aged women aged 40–64 years varied according to the duration since menopause. Moreover, specific nutrients or food groups demonstrated different positive or negative associations with sleep duration at levels higher than the average intake. These results suggest that differentiated nutritional strategies considering the duration since menopause are needed to improve sleep quality in menopausal women who commonly experience sleep deficiencies.

CONFLICT OF INTEREST

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

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DATA AVAILABILITY

Data supporting the findings of this study are openly available in the KNHANES at https://knhanes.kdca.go.kr/knhanes/main.do.

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Research Article

Shifting social perceptions of dietitians in Korea after the legislation of nutrition teachers: a keyword network analysis of unstructured data

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Objectives: In Korea, dietitian licenses began to be issued in 1964, and they have been working to prevent diseases and promote people's health in various fields according to the times. This study was conducted to compare differences in social perception of dietitian over time by collecting online unstructured data and analyzing the frequency and network structure of nutritionist-related keywords after the deployment of nutrition teachers began.
Methods: Using 'dietitian' as a keyword, we collected data from NAVER's web, blogs, and news provided by Textom (2024, The IMC) and refined the data. We investigated the frequency ranking of keywords related to dietitians for each period, revealed the network structure using UCINET6 (Freeman) and Netdraw, and clustered similar concepts among keywords through CONCOR (CONvergence of iterated CORrelations) analysis to cluster-related concepts.
Results: Frequency analysis revealed that during the first period, keywords such as 'School' and 'Education' reflecting the institutionalization of nutrition teachers, were highly ranked. However, by the second period, these terms had dropped out of the top 10. Meanwhile, keywords related to healthcare, such as 'Hospital', consistently remained among the most prominent. In the second period, the rankings of the 'License' and 'University transfer' keywords increased significantly. Centrality analysis showed stronger connectivity between dietitians and keywords such as 'Food', 'School', 'Examination', and 'Nutrition' in the second period compared to the first. CONCOR analysis further demonstrated that the 'Major education' cluster of the first period was differentiated into the 'Major education and qualification' and 'Professional competency certification process' clusters of the second period. In addition, the 'Health and welfare' cluster of the first period was divided into the "Health and welfare regional service' clusters of the second period.
Conclusion: The results of this study will be used as basic data for identifying social perception and trends in the dietitian profession, further providing a scope for their improvement.

Keywords: dietitian; social perception; big data

INTRODUCTION

Dietitians are healthcare professionals specializing in meal management and nutritional services to prevent diseases and promote overall health. They are officially recognized as healthcare personnel under the 「Act on Providing Assistance

with Health Professionals」[1]. In Korea, dietitian licenses have been issued since 1964, and as of 2020, approximately 42,000 dietitians are active. More than 78% are employed in foodservice facilities, including industry, schools, hospitals, social welfare facilities, infant care facilities, kindergartens, older adult care facilities, and the military. Additionally, they are active in education, research, the foodservice industry, public officials, and public health centers [2].

With the revision of the「Elementary and Secondary Education Act」in 2003, a nutrition teacher system was introduced in schools in 2007 [3], and the scope is expanding as nutrition teachers are assigned to kindergartens from 2021 [4]. Its scope continues to expand, with nutrition teachers assigned to kindergartens starting in 2021. Meanwhile, clinical dietitians are professionals with national licenses who play a major role in improving the quality of clinical nutrition services provided in hospitals and supporting disease prevention and treatment. Since the enactment of the「National Nutrition Management Act」in 2012 [5], the number of clinical dietitians has steadily increased.

With growing concerns over food poisoning at children's foodservice facilities and the poor quality of meals for children, the Center for Children's Foodservice Management was established in 2011 under the「Special Act on Safety Management of Children's Dietary Life」[6]. In 2022, its scope was expanded under the「Act on Foodservice Safety Support for Social Welfare Facilities for the Elderly and the Disabled」, it was expanded to the Center for Children's and Social Welfare Foodservice Management [7]. As of 2024, approximately 2,500 dietitians are working across 236 centers nationwide [8]. In this way, both the scope and value of the dietitian profession are expanding, and in the Ministry of Employment and Labor's mid- to long-term human resource supply and demand forecasts, an additional 370,000 health and social welfare workers are expected to be hired over the next 5 years (2025–2030) [9]. Accordingly, the demand for dietitians is also expected to increase. Therefore, there is a need to evaluate social perception among dietitians.

Most previous studies on social perception have relied on surveys conducted with sample groups [10, 11]. However, these methods have limitations, as they may not accurately reflect the general characteristics of the population, potentially leading to errors or researcher bias [12]. In contrast, the emerging field of big data analysis offers a more effective approach to understanding societal perceptions and trends by utilizing large datasets and can suggest meaningful opinions in analyzing the changing trends over time for a specific topic [13, 14]. Furthermore, by examining relationships between keywords, data can be visualized, and patterns can be derived, allowing for a clear understanding of the structural characteristics [15]. Today, social networking services are widely used, enabling people to communicate and exchange information and content. Additionally, news articles and online communities provided on internet portal sites reflect the thoughts and opinions of the conveyors of information, making it possible to understand the public perceptions through these sources [16]. Recently, studies utilizing big data have been conducted in the field of food and nutrition, such as analyzing the diet status at a specific point in time based on social media big data [17] or comparing the perception of diet before and after COVID-19 [18].

Studies on social perception of specific occupations are being conducted using social big data, and these studies have shown that changes in social issues or policies have an impact on changes in social perception of specific occupations [19, 20]. Occupational prestige can be defined as the evaluation of a specific occupation shared by members of society, and is useful for examining social changes and changes in perception. A first big issue for dietitians since 2000 was that dietitians who previously worked as school food sanitation officers could legally be assigned to schools as nutrition teachers. Secondary school teachers ranked 6th in occupational prestige in 2009 [21]. By comparing the three years from 2007 (2007–2009), when the nutrition teacher who had a major influence on the dietitian paradigm were placed in each school, with the recent three years (2022–2024), we can assess the changes in the social perception of dietitians due to the revision of laws and regulations related to dietitians and the introduction of the system. The purpose of this study was to understand and use these as basic data to establish and improve dietitian awareness. The specific research questions are as follows:

RQ1: What are the characteristics of dietitian-related keywords between 2007–2009 and 2022–2024 as analyzed through big data?

RQ2: What is the network structure of dietitian-related keywords between 2007–2009 and 2022–2024 as analyzed through big data?

METHODS

Ethics statement

This study utilized publicly available and anonymized datasets. The data used in this research does not contain any personally identifiable information and was provided by the data provider for public access. Therefore, this study does not require approval from an institutional review board. The use of the data strictly adhered to the ethical guidelines and terms of use set by the data provider, which were thoroughly reviewed and meticulously followed before conducting the study.

1. Study design

This study is an exploratory research that analyzes social perceptions of dietitians by collecting and analyzing publicly available data on NAVER using Textom (The IMC).

2. Data collection

The data for this study was collected using the keyword 'dietitian' from the domestic portal site NAVER provided by Textom (2024), a big data analysis program. Data collection was centered on nouns related to 'dietitian' that appeared on NAVER's web pages, blog, news, cafe, and intellectuals. The reason NAVER was chosen as a collection channel is that NAVER has the highest average inflow rate among Korean portal sites. And collecting data from multiple major domestic portals risks duplicate exposure due to overlapping and reproducible content, leading to redundant text [12]. The data collection periods were three years (2007.1.1.–2009.12.31.) from 2007 and most recent three years (2022.1.1.–2024.12.31.), and the purpose was to compare and analyze the initial point in time when awareness of dietitian began to spread and the recent point in time, 16 years later.

The collected data included 1,000 NAVER web pages (560.52 KB), 971 blog posts (528.57 KB), 121 news articles (64.25 KB), 394 cafe posts (216.46 KB), and 1,000 intellectual posts (843.08 KB) for the first period (2007.1.1.–2009.12.31.). For the second period (2022.1.1.–2024.12.31.), the data included 1,000 web pages (521.96 KB), 990 blog posts (583.34 KB), 102 news articles (55.30 KB), 518 café posts (248.10 KB), and 1,000 intellectual posts (672.02 KB) for the second period (2022.1.1.–2024.12.31.).

3. Data cleaning

First, the data preprocessing process was as follows: Since the data collected from Textom was in sentence form, the 'Espresso K' analyzer was used to reflect proper nouns and compound nouns. Only nouns were selected as the parts of speech, followed by morphological analysis and the removal of stop words. Second, the search term 'dietitian' was deleted, as it was considered difficult to interpret meaningfully in structural property and centrality analysis. Compound terms such as 'Open university' and 'National examination' were merged by removing spaces. Additionally, meaningless words (day, thing, time, related, and, etc.) were deleted. This process was reviewed by three experts in food science and nutrition.

4. Analysis method

The analysis method of this study is as follows: First, frequency analysis was performed on refined data using Textom (2024). The top 50 words with the highest frequency for each period were compared and analyzed. Second, the top 50 keywords were converted into a 50×50 1-mode matrix data set, and the network shape and properties were identified using UCINET6 (Freeman). Third, connection centrality analysis was performed for each period. Connection centrality is the sum of the number of words the word is connected to, and a high connection centrality means that there are also many neighboring words connected, so the connection centrality can be calculated to identify the core words at the structural center [21]. Fourth, CONCOR (CONvergence of iterated CORrelations) analysis was performed to present and compare similar groups between keywords for each period. CONCOR analysis divides each keyword into several subgroups based on repeated correlations.

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RESULTS

1. Frequency analysis of keywords related to dietitian

The results of a frequency ranking of the top 50 keywords related to dietitian in the first period (2007–2009) of three years after the nutrition teachers were legislated (Table 1) showed that 'Food' ranked the highest, followed by 'School', 'Nutrition', 'Examination', 'Foodservice', 'Health', 'Hospital', 'Certificate', 'University', 'Education', 'Nutrition', 'Teacher', 'Enrollment', and 'Study'. As in the first period, the keyword with the highest frequency in the second period (2022–2024) was 'Food', followed by 'Examination', 'Enrollment', 'Foodservices', 'Certificate', 'Work', 'Nutrition', 'License', 'Qualification', 'Health', 'School', 'Hospital', 'Nutrition science'.

2. The structural form of the network

The network structure properties of keywords related to dietitian in first period were as follows: Nodes were 50, density was 0.989, average degree was 48.44, average distance was 1.011, and diameter was 2 (Fig. 1). The network properties in second period were as follows: Nodes were 50, density was 0.969, average degree was 47.48, average distance was 1.031, and diameter was 2 (Fig. 2). These results mean that in first period, one keyword was connected to an average of 1.011 other keywords, and

Table 1. Frequency analysis of keywords related to dietitian by period

First period (2007–2009)						Second period (2022–2024)					
Rank	Keyword	Frequency	Rank	Keyword	Frequency	Rank	Keyword	Frequency	Rank	Keyword	Frequency
1	Food	1,461	26	Major	326	1	Food	1,674	26	Career	421
2	School	1,160	27	Career	317	2	Examination	1,477	27	Announcement	419
3	Nutrition	935	28	Recruitment	316	3	Enrollment	1,287	28	Credit	409
4	Examination	900	29	Subject	313	4	Foodservice	1,092	29	Pass	396
5	Foodservice	798	30	Announcement	312	5	Certificate	1,078	30	Recruitment	393
6	Health	728	31	Pass	307	6	Work	970	31	Cooking	380
7	Hospital	720	32	Exercise	294	7	Nutrition	897	32	Specialist	375
8	Certificate	685	33	Specialization	286	8	License	834	33	Application	375
9	University	653	34	National examination	285	9	Qualification	796	34	Major	362
10-1	Education	570	35	Occupation	278	10	Health	762	35	National examination	359
10-2	Nutrition science	570	36	Company	267	11	School	759	36	Cook	354
12	Teacher	534	37	Department	258	12	Hospital	758	37	Organization	353
13	Enrollment	450	38	Welfare	254	13	Nutrition science	741	38	Study	338
14	Study	447	39	Doctor	254	14	Acquisition	724	39	Employment	328
15	Culinary	441	40	Hygienist	254	15	Diet	641	40	Menu	326
16	Qualification	425	41	Society	254	16	Education	617	41	Completion	294
17	Graduation	421	42	Diet	253	17	Graduation	599	42	Recommendation	292
18	Counseling	373	43	Student	251	18	University	597	43	Clinical	287
19	Application	360	44	Patient	246	19	University transfer	558	44	Culinary	284
20	Cook	343	45	Employment	230	20	Application	546	45	Required	275
21	Cooking	339	46	Child	223	21	Open university	534	46	Welfare	274
22	Cuisine	339	47	Business	214	22	Information	526	47	Law	264
23-1	License	337	48	Meal	212	23	Practice	490	48	Region	262
23-2	Public health	337	49	Healthcare	209	24	Subject	477	49	Department	261
25	Information	332	50	Nurse	207	25	Task	437	50	Society	259

in second period, one keyword was connected to an average of 1.031 other keywords, and in both periods, all keywords were connected after passing through a maximum of two keywords. In both periods, keywords within the network were densely connected, showing the complexity of social perception of dietitians.

3. Degree centrality analysis

Degree centrality, which is measured by the number of links connected to a node, can be used to determine the degree of interaction between keywords. The higher the value, the wider the network formed with surrounding keywords, and the keyword can be said to act as a hub. As a result of analyzing degree centrality (Table 2), keywords with high degree centrality rankings for Period 1 were 'Food' (0.192) > 'School' (0.107) > 'Examination' (0.106) > 'Nutrition' (0.094) > 'Certificate' (0.084) > 'University' (0.080) > 'Enrollment' (0.074), etc. Words such as 'Certificate', 'University', 'Enrollment', and 'Graduation' have higher degree centrality than frequency rankings, indicating a tendency for relatively higher connection strength than other keywords. Keywords

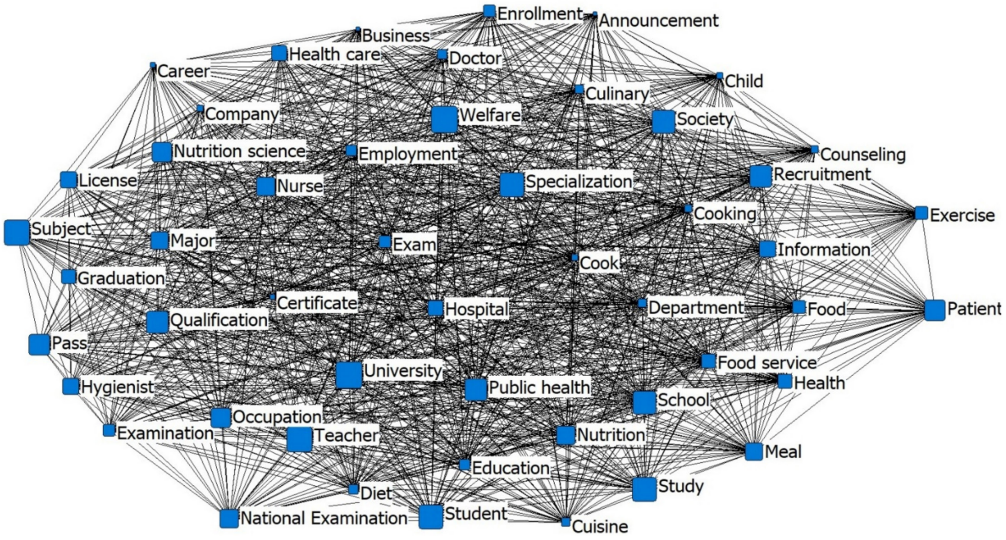

Fig. 1. The overall network of dietitian keywords by the first period (2007–2009).

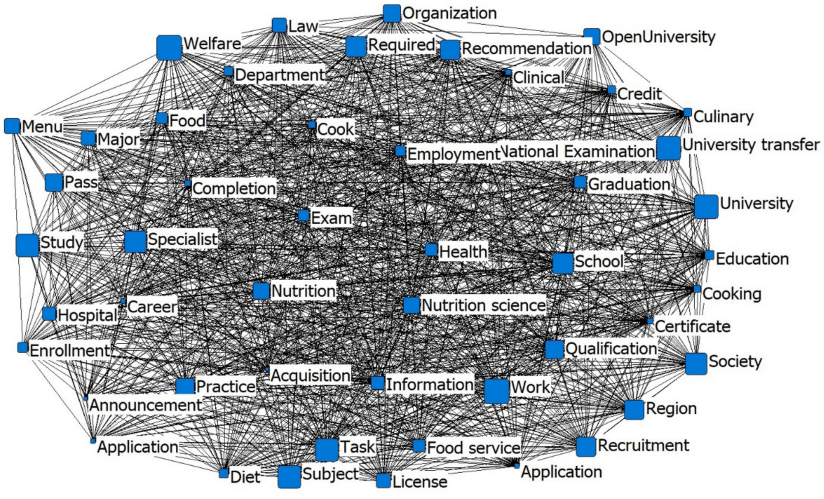

Fig. 2. The overall network of dietitian keywords by the second period (2022–2024).

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Table 2. Degree centrality for keywords related to dietitian by period

First period (2007–2009)						Second period (2022–2024)					
Rank	Keyword	Centrality	Rank	Keyword	Centrality	Rank	Keyword	Centrality	Rank	Keyword	Centrality
1	Food	0.192	11	Foodservice	0.072	1	Food	0.232	11	Application	0.098
2	School	0.107	12	Graduation	0.064	2	Examination	0.182	12	University transfer	0.097
3	Examination	0.106	13	Hospital	0.058	3	Certificate	0.159	13	Work	0.096
4	Nutrition	0.094	14	Education	0.047	4	Enrollment	0.146	14	Graduation	0.092
5	Certificate	0.084	15	Health	0.044	5	Qualification	0.133	15	University	0.085
6	University	0.080	16	Teacher	0.040	6	Foodservice	0.126	16	Hospital	0.079
7	Enrollment	0.074	17	Study	0.038	7	Acquisition	0.121	17	School	0.070
8-1	Nutrition science	0.073	18	Cook	0.037	8	Nutrition	0.118	18	Diet	0.068
8-2	Qualification	0.073	19	Culinary	0.022	9	License	0.114	19	Education	0.061
8-3	National examination	0.073	20	Counseling	0.021	10	Nutrition science	0.105	20	Health	0.098

Table 3. CONCOR analysis of keywords related to dietitian by the first period (2007–2009)

Clusters	Keywords	Number
Major education	University, Student, Subject, Nutrition science, Qualification, Study, Pass, National examination, Major, Examination, Food, Graduation, Student, Certificate, Public Health, Cooking, Department, Employment, License, Hygienist	20
Wellness	Society, Healthcare, Patient, Specialization, Exercise, Health, Meal, Information, Doctor, Foodservice, Culinary, Education, Diet, Counseling, Child, Business	16
Health and welfare	Welfare, Enrollment, Recruitment, Nurse, Hospital, Career, Announcement	7
Occupation	Teacher, School, Occupation, Cuisine, Nutrition, Cook, Company	7

CONCOR, CONvergence of iterated CORrelations.

with high degree centrality rankings in the 2nd period were 'Food' (0.232) > 'Examination' (0.182) > 'Certificate' (0.159) > 'Enrollment' (0.146) > 'Qualification' (0.133) > 'Foodservice' (0.126) > 'Acquisition' (0.121), etc. Words such as 'Certificate', 'Qualification', 'Acquisition', and 'Application' had higher degree centrality than frequency ranking.

4. CONCOR analysis

In order to cluster keywords with similarities in the social perception of dietitian and to identify their characteristics, CONCOR analysis was performed. According to the CONCOR analysis results for first period (Table 3), Cluster 1 contained a total of 20 keywords, including 'University', 'Student', 'Subject', 'Nutrition science', 'Qualification', 'Study', 'Pass', and 'National examination', and was named 'Major education'. Cluster 2 contained a total of 16 keywords, including 'Society', 'Healthcare', 'Patient', 'Exercise', and 'Health', and was named 'Wellness'. Cluster 3 contained a total of 7 keywords, including 'Welfare', 'Enrollment', 'Recruitment', and 'Nurse', and was named 'Health and welfare'. Finally, Cluster 4 contained a total of 7 keywords, including 'Teacher', 'School', and 'Occupation', and was named 'Occupation'.

CONCOR analysis results for the second period (Table 4), cluster 1 included 17 keywords including 'University', 'Open university', 'Specialist', 'Major', 'License', and 'University transfer', and was named 'Major education and qualification'. Cluster 2 included 13 keywords including 'Welfare', 'Work', 'Task', 'Region', and 'Recruitment', and was named 'Health and welfare regional service'. Cluster 3 included 10 keywords including 'Subject', 'Qualification', 'Study', 'Pass', 'National examination', and 'Graduation', and was named 'Professional competency certification process'. Finally, cluster 4 included 10 keywords including 'Society', 'Recommendation', 'School', and 'Foodservice', and was named 'Foodservice management'.

Table 4. CONCOR analysis of keywords related to dietitian by the second period (2022–2024)

Clusters	Keywords	Number
Major education and qualification	University, Open university, Specialist, Major, License, University transfer, Nutrition science, Department, Required, Food, Employment, Law, Cooking, Clinical, Certificate, Credit, Acquisition	17
Health and welfare regional service	Welfare, Work, Task, Region, Recruitment, Cook, Hospital, Education, Information, Enrollment, Career, Announcement, Registration	13
Professional competency certification process	Subject, Qualification, Study, Pass, National examination, Graduation, Application, Practice, Examination, Completion	10
Foodservice management	Society, Recommendation, School, Nutrition, Foodservice, Menu, Organization, Health, Diet, Culinary	10

CONCOR, CONvergence of iterated CORrelations.

DISCUSSION

According to the「National Nutrition Management Act」, a dietitian can take the exam only after graduating from the Department of Nutrition or Food and Nutrition, holding an undergraduate degree in Food Science, Nutrition, or Food and Nutrition, and completing 52 credits in 18 nutrition-related subjects [5]. Reflecting this, the top 10 keywords related to dietitians in this study included 'Food', 'Nutrition', 'Examination', and 'Certificate'. In the first period, keywords such as 'School' (2nd) and 'Education' (10th), which reflect the institutionalization of nutrition teachers, were among the top 10, with 'Teacher' ranking 12th. However, in the second period, these keywords dropped out of the top 10, while healthcare-related keywords like 'Health' (6th place) and 'Hospital' (7th place) ranked 9th and 12th, respectively. Meanwhile, the keyword 'Foodservice,' which is closely associated with the primary work setting for many dietitians, remained prominent, ranking 5th in the first period and 4th in the second. The dietitian licensing system, which was established with the enactment of the「Food Sanitation Act」in 1962, and transitioned to a nationwide examination in 1978, is reflected in the study [22]. The keyword 'License' rose from 23rd in the first period to 8th place in the second period. Additionally, 'University transfer', which did not appear in the top 50 during the first period, ranked 19th in the second period, and considering that employment-related keywords such as 'Recruitment', 'Work', and 'Qualifications' are at the top, the purpose of university transfer is to obtain a professional license and get a job rather than to improve academic ability at university.

The centrality analysis in the first period revealed a higher connectivity between the 'Food', 'School', 'Examination', and 'Nutrition' keywords, as confirmed by the frequency analysis results, but the keywords 'Foodservice', 'Health', and 'Hospital' were outside the top 10. Instead, keywords related to qualification acquisition and credentials, such as 'Enrollment', 'Qualification', and 'Examination', were more closely associated with dietitians. In the second period, the connectivity between keywords like 'Food', 'Examination', 'Certification', 'Foodservice', 'Nutrition', 'License', and 'Acquisition' was stronger than in the first period. As the perception of dietitians is shaped around these keywords, it is essential to provide opportunities to obtain a dietitian license and related certifications through a systematic food and nutrition major curriculum, which includes food, nutrition, and foodservices. This approach can ultimately lead to employment. As a result of structural analysis to see the positioning of keywords related to dietitians, in the first period, a close network was shown centered on the keywords 'Teacher', 'School', 'Health', 'University', and 'Specialization', showing that the legislation of nutrition teachers was influencing social perception. In the second period, connections were concentrated on keywords such as 'Specialist', 'Qualification', 'Work', and 'Task', showing that the expertise of dietitians was being strengthened and their perception the profession was being solidified.

Changes in social issues or policies can change perceptions about occupations [23]. According to the results of the first CONCOR analysis of the social perception of dietitians, the 'Major education' cluster included subjects related to 'Food', 'Nutrition science', 'Public health',

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and 'Cooking', as well as acquired 'Certificate' and 'License'. Wellness is a recent concept in healthcare that has rapidly spread in Korea since 2000 and includes disease treatment and prevention, health promotion, and quality of life improvement [24]. The 'Wellness' cluster included wellness-related keywords such as 'Healthcare', 'Health', 'Meal', 'Culinary', 'Education', and 'Counseling', all of which are connected to physical wellness and linked to dietitians. Additionally, through the 'Health and welfare' cluster, dietitians are recognized as healthcare personnel alongside nurses [1]. The 'Occupation' cluster expressed interest in nutrition teachers, newly institutionalized in the dietitian profession, through keywords such as 'Teacher', 'School', and 'Nutrition'.

The CONCOR analysis results for the second period revealed the advancement and differentiation of dietitian awareness compared to the first period. The keywords forming the 'Major education and qualifications' cluster have evolved from the 'Major education' cluster in the first period. This indicates that a dietitian can now obtain a license only by completing the required curriculum prescribed by law. Additionally, the license can be obtained through institutions such as the Korea Communications and the Communications University or via university transfer. This indicates an awareness of the possibility of obtaining this qualification. The 'Health and welfare regional service' cluster showed the advancement of 'Health and welfare' from the first period, with the recognition that dietitians are active in providing health and welfare services in the community. This was reflected in keywords such as 'Welfare', 'Region', 'Hospital', and 'Education'. Recently, as the position and role of the curriculum have become more important in university education, efforts are being made to increase external competitiveness by operating a competency-based curriculum to improve quality [25]. Reflecting this trend, the 'Professional competency certification process' cluster emerged, differentiating itself from the 'Major education' cluster of the first period. Dietitian competencies are now recognized as being developed and equipped with a focus on 'Subject', 'Practice', 'Examination', and 'Certification'. The 'Foodservice management' cluster included keywords such as 'Menu', 'Culinary', 'Diet', 'Health', and 'Nutrition', which are related to foodservice, the sector in which most dietitians are engaged.

Nonetheless, this study is valuable in that it examined the evolution of social perceptions of dietitians by exploring the structural relationships between keywords after implementing policies, such as the legalization of nutrition teachers and the transition to national certification for clinical dietitians. This study highlights the need to train dietitians who will play active roles in community health, welfare, and foodservice fields through a major curriculum that enables the acquisition of professional competencies as a dietitian.

Limitations

A limitation of this study is that the data were collected only in Korean from domestic social media resources, meaning that languages other than those used in the search terms may have been omitted. The limited data-collection period limited the comparison of perceptions. The reason why we analyzed data from three years is that the early 2000s were a time when Internet use was relatively inactive compared to recent times, so there was a lack of data, and thus, we cannot guarantee that the distribution of comparative data is even. However, since social perception and discourse due to institutional changes are reflected with a certain amount of time lag, we used three years to compare the initial reaction to the introduction of the system and the gradual settlement of discourse.

Conclusion

This study is valuable in that it examined the changes in social perception of dietitians through the structural relationship between keywords after the implementation of the policy of legalizing nutrition teachers related to the occupational prestige of dietitians. Through the results of this study, it was confirmed that the perception of dietitians as a profession is becoming more solid and that there is a need to train dietitians who will work in the fields of community health, welfare, and foodservice with enhanced expertise.

CONFLICT OF INTEREST

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

FUNDING

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DATA AVAILABILITY

The data that support the findings of this study are openly available in "Textom" at https://www.texom.co.kr.

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Research Article

서울시 공공기관 집단급식소 이용자의 지구건강식사 실천의도: 계획된 행동이론과 질적 연구를 기반으로

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Behavioral intention toward planetary health diet among adult users of government worksite cafeterias in Seoul, South Korea: a mixed-methods study based on the theory of planned behavior and focus groups interviews

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Objectives: To reduce urban carbon emissions, in this study, we aimed to suggest strategies for disseminating the planetary health diet (PHD) guidelines to adult cafeterias in a government worksite in Seoul based on the theory of planned behavior (TPB) and focus group interviews (FGI).

Methods: A total of 132 adults who worked at a government worksite in Seoul and used its cafeteria were included for a TPB-based survey. Factor analyses and multiple regression were used to investigate the relationships between attitude (cognitive·affective), subjective norms, and perceived behavioral control (PBC, internal·external) and the behavioral intention to adopt the PHD. To identify the contextual factors related to PHD dissemination, 14 participants underwent in-depth interviews.

Results: Affective attitudes and PBC (internal·external) constructs of the TPB were significantly related with the intention to adopt PHD: external PBC ($\beta = 0.324$, $P < 0.001$), internal PBC ($\beta = 0.269$, $P < 0.01$), and affective attitudes ($\beta = 0.226$, $P < 0.05$). The FGI results highlighted the insufficiency of simply providing healthy meals to encourage the adoption of PHDs, but that menu development and natural acceptance strategies are needed to increase palatability. In addition, the need for strategies to promote PHDs at an organizational level was identified, as it is directly influenced by the company of partners with whom one dines. Furthermore, users' perceptions of how "Meals for the Planet" are delivered and suggestions for its improvement were also interpreted.

Conclusion: Our results suggest that users' beliefs, convictions, and emotions are important while promoting or educating individuals about sustainable PHDs. Our findings are expected to help local governments or private group cafeterias that wish to introduce PHDs in the future, given the growing importance of environmentally conscious eating.

Keywords: theory of planned behavior; qualitative research; diet, healthy; diet, plant-based

INTRODUCTION

최근 온실가스 배출로 인한 지구온난화는 더 심해지고 있으며[1], 이에 급격한 기후 변화와 질환 발병률 증가에 대응할 수 있는 지속가능한 식사에 대한 관심이 집중되고 있다[2]. 2010년 유엔식량농업기구(Food and Agriculture Organization of the United Nations)에서는 지속가능한 식사를 "환경에 미치는 영향이 낮고, 현재와 미래 세대의 식량 및 영양 안보와 건강한 삶에 기여하는 식단으로, 생물다양성과 생태계를 보호하고 존중하며, 문화적으로 수용 가능하고 접근 가능하고, 경제적으로 공정하고 감당할 수 있어야 하며, 영양적으로 적절하고 안전하며 건강해야 하고, 동시에 자연 자원과 인적 자원의 활용을 최적화한 식단(Sustainable diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources) [3]"으로 정의하였다. 이와 관련하여 2019년 EAT-Lancet Commission은 인간과 지구의 건강을 증진하는 것을 목표로 하는 지구건강식사(planetary health diet, PHD)를 제시하였으며[4], PHD는 전 세계적으로 통곡물, 과일, 채소류, 견과류 및 두류와 같은 건강한 식품의 소비를 두 배 이상 늘리고 첨가당, 적색육 등 건강에 좋지 않은 식품의 소비는 절반 이하로 줄이는 지속적으로 증가하는 인구를 위한 건강한 식사를 의미한다[5]. 지구건강식사로 전환 시 도시의 식품 소비로 인한 탄소 배출량을 최대 60% 줄일 수 있으며[6], 이에 서울시도 C40 World Mayors Summit에서 EAT-Lancet 보고서에 맞춰 2030년까지 시민의 문화와 지리를 반영하는 지구건강식사를 달성하겠다고 서명하였다[7]. 하지만, 서울시 시민의 좋은 먹거리에 대한 관심도가 2022년 기준 6.50점(10점 기준)으로, 3년간 크게 변하지 않았으나, 해당 구성 변수인 친환경/저탄소 식품에 관한 관심도는 다소 낮아졌고[8], 우리나라 성인의 지속가능한 식생활 개념인지 여부를 물었을 때 "전혀 듣거나 본 적이 없음"이라고 응답한 대상자는 55.1%로 나타났다[9].

World Health Organization (WHO)은 정부가 보다 건강한 식품과 음료를 제공하여 국민이 건강한 식단을 섭취할 수 있도록 해야 하며, 건강한 공공 식품 조달 및 서비스 정책을 통해 모범을 보일 필요성이 있음을 강조하고 있다[10]. 이러한 세계적 흐름에 따라 서울시는 WHO 건강 도시 파트너쉽 사업 협약을 맺어 지구 환경에 도움을 주는 음식문화 개선 사업에 일환으로 공공시설 집단 급식소에 PHD를 적용하여 시민의 건강 형평성을 제고하고자 하였으며, 이에 일부 서울시 공공시설 집단 급식소에서는 주 1회 PHD인 '지구를 위한 밥상'이 제공되고 있다.

Ajzen [11]이 제안한 계획된 행동이론(theory of planned behavior, TPB)은 인간의 행동을 예측하고 설명하는 데 널리 사용되고 있다. 이 이론은 의도가 우리의 행동을 이끌며, 이러한 의도는 행동에 대한 태도, 주관적 규범, 지각된 행동 통제라는 세 가지 주요 구성 요소에 의해 형성된다. TPB는 여러 선행 연구 분야에서 적용되었으며[12-16], 영양교사의 지속가능한 식생활 교육 의도와 지속가능한 식품 선택 및 식습관과 관련된 소비자 행동을 설명하는 데 효과적이었다고 보고되었다[15, 16]. 그러나 PHD를 제공받는 사람들을 대상으로 PHD를 실천하기 위한 행동 의도를 조사하고, 이용자의 경험과 의견을 직접적으로 탐색한 연구는 없는 실정이다. 따라서 본 연구는 서울시 공공기관 집단 급식소 이용자를 대상으로, 시민의 균형있는 영양소 섭취와 탄소배출 감소, 이 두 가지를 도모하고자 PHD를 모델로 개발된 지속가능한 식생활 실천 지침인 '서울미래밥상' 길라잡이[17] 기반 TPB와 포커스 그룹 인터뷰(focus group interview, FGI)를 통해 PHD 실천 의도에 대한 관련 요인을 알아보고, 동일 대상자에게 실천 의도와 관련된 요인을 심도있게 탐색하고자 하였다.

METHODS

Ethics statement

The entire process of this study was conducted with the approval of the Institutional Review Board of Sangmyung University (IRB-SMU-S-2024-3-009).

1. 연구 설계

본 연구는 TPB 기반 설문 조사와 FGI를 포함한 혼합 연구로, STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) 보고지침과 COREQ (Consolidated criteria for reporting qualitative research)을 참고하여 기술하였다(https://www.strobe-statement.org/).

2. TPB 기반 설문 조사 연구 방법

1) 연구 대상 및 기간

본 연구에서는 TPB를 이용한 설문조사를 통해 성인 대상 공공기관 집단급식소 이용자의 PHD 실천 의도에 미치는 요인을 알아보고자 하였다.

연구 대상은 서울시 내 정부 및 산하기관의 직원식당을 이용하는 성인을 대상으로 2024년 7월 15일부터 8월 1일까지 133명을 대상으로 사전 동의 후 온라인 설문 조사를 하였고, 불완전한

응답 1부를 제외하여, 최종 분석에는 132부의 설문지가 포함되었다.

2) 연구 내용 및 방법

(1) 연구 모형 및 변수

본 연구 모형은 PHD 실천을 위한 인지적 태도(cognitive attitudes), 정서적 태도(affective attitudes), 주관적 규범(subjective norms), 내적 통제(internal perceived behavioral control), 외적 통제(external perceived behavioral control)가 서울시 공공기관 집단급식소 성인 이용자의 PHD 실천 의도에 영향을 미친다는 것을 설명하고 있다(Fig. 1). 모델을 구성하는 변수 중 첫 번째 변수인 「태도」는 특정 행동에 대한 개인의 긍정적 또는 부정적 평가를 의미한다[18]. 본 연구에서는 이전 연구[19, 20]를 바탕으로 태도를 두 가지 범주로 세분화하였으며, 경험에 의하여 학습된 「인지적 태도」와 순간의 감정을 나타내는 「정서적 태도」로 나누었다. 두 번째 변수인 「주관적 규범」은 본인에게 중요한 사람들(예: 가족, 친구, 동료)이 그 행동 변화에 대해 긍정적 혹은 부정적으로 생각하는지에 대한 믿음과 그 믿음에 부응하고자 하는 정도를 의미한다[18]. 세 번째 변수인 「인지된 행동통제력」은 특정 행동을 실천하는 데 본인이 통제할 수 있다고 생각하는 범위이다[18]. 본 연구에서는 선행 연구[19, 20]를 바탕으로 인지된 행동통제력을 두 가지 범주로 세분화하였으며, 개인의 내적 자원, 지식 및 자신감에 대한 인식을 나타내는 「내적 통제」와 외부 환경적 요인이나 사용할 수 있는 자원이 실천 의도에 미치는 영향을 개인이 어떻게 인식하고 있는지를 나타내는 「외적 통제」로 나누었다.

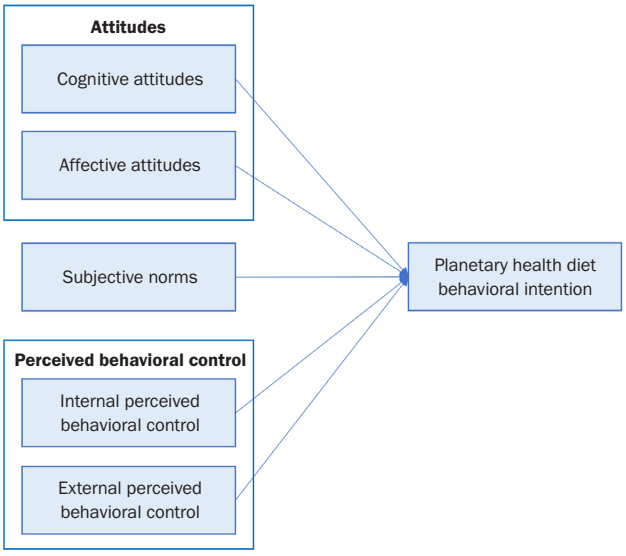

Fig. 1. A study framework.

(2) 설문지 개발

이 설문지는 '서울미래밥상' 길라잡이[17]와 식행동 및 영양 관련 TPB 적용연구[14, 16, 17, 21–23]를 바탕으로 개발되었다. 외식영양학과 대학원생 5명, 영양 교육 전문가 1명, 영양학과 교수 1명, 서울특별시청 직원 7명을 대상으로 파일럿 테스트를 진행하였으며, 이 테스트는 설문 문항의 형식 및 문구, 표시된 내용의 양과 가시성을 평가하였다.

(3) 설문 문항

설문지는 크게 두 가지 범주로 구성되었다. 첫 번째 범주는 대상자의 일반적 특성과 서울 미래밥상에 대한 인지도 및 지식 수준에 초점을 맞춘 6개의 항목으로 구성되었다. 이 항목은 성별, 생년월일, 이용하고 있는 공공기관 급식소 유형, 공공기관 급식소 이용 빈도, 서울미래밥상에 대해 듣거나 본 적이 있는지, 듣거나 본 적이 있다면, 알고 있는 정도에 대한 정보를 수집하였다.

두 번째 범주에서는 TPB를 기반으로 PHD 실천 의도에 미치는 요인을 조사하였다. 인지적 태도 관련 8개 문항[17, 21, 22], 정서적 태도 관련 7개 문항[16, 17, 22, 23], 주관적 규범 관련 4개 문항[14, 24], 내적 통제 관련 7개 문항[17], 외적 통제 관련 5개 문항[17], PHD 실천 의도를 측정하는 5개 항목[23]으로 구성되었으며, 모든 설문지 항목은 5점 리커트 척도를 사용하였다.

3) 통계 분석

통계 분석은 IBM SPSS Statistics 27.0 (IBM Co.)을 사용하였으며, 통계적 유의성은 $P < 0.05$로 정의하였다. 연구 대상자의 인구통계학적 특성은 자료가 범주형이면 빈도수와 백분율로, 연속형이면 평균과 표준편차로 제시하였다. PHD 실천 의도에 영향을 미치는 요인을 측정하는 36개 문항의 타당성을 평가하기 위해 주성분 요인분석과 베리맥스회전을 사용한 탐색적 요인 분석(exploratory factor analysis)을 실시하고, Cronbach's α를 사용한 신뢰도 분석을 통해 설문지 문항 간의 내적 일관성을 평가하였다. TPB 변수의 타당성과 신뢰성 확인 후 기술 통계를 사용하여 평균과 표준편차를 제시하고, 변수들 사이의 독립성 검증을 위하여 다중공선성 값을 확인하였으며, 피어슨 상관계수로 상관관계를 분석하였다. 또한, PHD 실천 의도에 영향을 미치는 요인을 확인하기 위해 다중회귀분석을 실시하였다.

3. FGI 조사 연구 방법

1) 조사 대상 및 기간

연구 대상자는 서울특별시청의 직원식당을 이용하는 성인으로 FGI는 2024년 6월 18일부터 6월 20일까지 총 4회 진행되었다. FGI에 참여한 14명의 대상자는 남성 8명, 여성 6명으로 평균 연

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령은 40.79 ± 10.84세(만 25–59세)였다. 참여자들이 일주일에 공공급식을 이용하는 시간대는 주로 점심(4.00 ± 0.78회)이었으며, 저녁도 비교적 자주 이용하는 편이었으나(2.64 ± 1.01회), 아침(0.14 ± 0.36회)과 간식(0.07 ± 0.27회)은 거의 이용하지 않았다(Table 1).

2) FGI 조사 내용 및 방법

본 연구는 질적연구방법을 사용하여 수행되었으며, PHD 식단이 제공되고 있는 공공급식에 대한 이용자의 인식과, 어떤 요인이 PHD 실천을 도모하거나 방해하는지 분석할 수 있도록 '서울미래밥상[17]' 기반 개방형 질문을 사용하였고(Table 2), FGI 진행 경험이 풍부한 연구 책임자와 해당 교수로부터 사전 훈련을 받은 연구원이 공동으로 진행하였다.

FGI는 여러 명의 이용자가 모여 PHD에 대하여 논의하는 방식으로, 자료 수집 과정 중 진행자가 이용자의 대화 참여를 유도하여 순조롭게 진행될 수 있도록 하였다[25]. 모든 FGI는 약 1시간 동안 진행되었고, 조사 대상자들에게 연구의 목적과 면접 방법, 면접 시간 등을 설명한 후 자발적 참여 의사를 밝힌 대상자에 한하여 FGI를 실시하였다. 연구 목적을 설명 후 참여 및 인터뷰 내용 녹취에 대한 동의를 받은 후에 진행하였고, 음원은 녹취록 작성 후 파기하였다.

인터뷰는 각 영역별 중심 질문을 설정하고 이용자의 답변에 따라 질문을 확장해 나갔다. PHD에 대한 인식 및 경험과 서울미래밥상 기반 식단 구성 수용 정도, 그리고 이용자가 스스로 PHD를 실천할 수 있는 방안과 현재 식단의 개선점 및 향후 발전 방향에 대한 제언에 중점을 두었다. 이와 같은 인터뷰 설계를 통해, PHD 실천 요인을 보다 심도 있게 분석하였다.

RESULTS

1. TPB 기반 설문조사 결과

1) 인구통계학적 특성과 서울 미래밥상에 대한 인지도 및 지식 수준

설문조사에 참여한 132명의 인구통계학적 특성은 Table 3과 같다. 응답의 대다수(n = 83, 62.88%)는 여성이었다. 평균 연령은 40.73 ± 9.31세였으며, 30대가 31.82%로 가장 많았다. 현재 이용 중인 공공기관 급식소 유형은 서울특별시 자치 구청(34.85%), 서울특별시청(34.85%)이 많았다. 조식, 석식, 간식의 이용 횟수는 대부분 주에 1회 이하 이용한다고 응답하였으며, 중식은 평균 3.32 ± 1.26회 섭취하는 것으로 나타났다.

이어서, 서울시 지속가능한 식생활 실천 지침인 서울미래밥상에 대한 인지도 및 지식 수준을 조사하였다(Table 4). '서울미래밥상'에 대해 보거나 들어본 적이 있는지 물었을 때 59.85%가 "아니오" 라고 응답하였고, 서울미래밥상에 대해 인지하고 있다고 응답한 참여자(n = 53)를 대상으로 지식 수준을 추가로 평가했을 때, 3.08 ± 1.03점으로 보통 이상의 지식 수준을 보였다.

2) TPB 구성요소의 타당도, 신뢰도 및 인식수준

연구 모형 구성요소의 타당도, 신뢰도를 분석한 결과와 PHD에 대한 인식 수준은 Table 5 및 본문에 서술하였다.

요인 분석의 절차는 각 변수의 값을 0.4 기준으로 정하였고 주

Table 1. Characteristics of the focus group interview participants

Participants	Sex	Age (year)	Government worksite cafeteria meal usage per week			
			Breakfast	Lunch	Dinner	Light meal/snack
1	Male	59	0	4	3	0
2	Male	45	0	4	1	0
3	Female	33	0	5	3	0
4	Female	45	0	5	3	0
5	Male	36	0	5	3	0
6	Male	42	0	4	3	0
7	Female	49	0	5	5	0
8	Male	53	0	3	2	0
9	Female	25	0	3	2	0
10	Male	32	1	3	3	1
11	Female	28	0	4	2	0
12	Male	54	1	4	3	0
13	Female	43	0	4	1	0
14	Male	27	0	3	3	0
Mean ± standard deviation		40.79 ± 10.84	0.14 ± 0.36	4.00 ± 0.78	2.64 ± 1.01	0.07 ± 0.27

Table 2. List of questions for the interview conducted with government worksite cafeteria users

Categories	Questions
PHD	1. Awareness of PHD
	1) Are you aware of 'Meals for the Planet[1)]'?
	2) What do you think are the benefits of 'Meals for the Planet'?
	3) What do you think are the downsides of 'Meals for the Planet'?
	2. Experience of using PHD
	1) Do you use the cafeteria on the day when 'Meals for the Planet' is provided?
	2) What was the reaction of your coworkers when you served 'Meals for the planet'?
	3) Have you ever avoided using the cafeteria because of the menu?
Seoul Mirae Bapsang[2)]	1. Awareness of the Seoul Mirae Bapsang
	1) What are your thoughts and feelings about 'the Seoul Mirae Bapsang'?
	2) Are you willing to practice 'the Seoul Mirae Bapsang' on a daily basis?
	2. Opinions on the composition of the Seoul Mirae Bapsang -based meals
	1) Do you feel disappointed if fried foods are served less than twice a week for lunch?
	2) How many times per week, or how many times per month, do you think it is possible to have a meatless day (where fish is served instead of beef or pork as the main entrée)?
	3) How many times per week, or how many times per month, do you think it is feasible to have a meatless day (where a plant-based protein such as tofu is served instead of beef or pork as the main entrée)?
	4) What are your thoughts on reducing the number of side dishes?
	5) What do you think about adding an extra bowl size and offering two different options or having a soup-free day?

PHD, planetary health diet.
[1)]Planetary health diet provided by public institutional food services under the Seoul Metropolitan Government.
[2)]Seoul Metropolitan Government guidelines for a sustainable diet: a practical guide.

성분 요인분석과 베리맥스회전방식을 사용하였으며, 아이겐 값은 1보다 높게 설정하여 분석하였다. 6개의 요인이 추출되었으며, 「인지적 태도」의 표준 적절성의 Kaiser-Meyer-Olkin 값은 0.884이었고, Bartlett 구형성 검정은 $\chi^2 = 775.096$ ($df = 28$), $P < 0.001$로 나타났다. 총분산 설명력은 63.622%였으며, Cronbach's α는 0.913이었다. 「정서적 태도」의 표준 적절성의 Kaiser-Meyer-Olkin 값은 0.877, Bartlett 구형성 검정은 $\chi^2 = 674.151$ ($df = 21$), $P < 0.001$로 나타났다. 총분산 설명력은 60.706%였으며, Cronbach's α는 0.901이었다. 「주관적 규범」의 표준 적절성의 Kaiser-Meyer-Olkin 값은 0.791, Bartlett 구형성 검정은 $\chi^2 = 416.478$ ($df = 6$), $P < 0.001$, 총분산 설명력은 77.989%, Cronbach's α는 0.905였다. 「인지된 행동통제력」은 요인분석을 통해 2개의 요인으로 묶었고, 선행 연구에 근거하여 내적 통제, 외적 통제로 명명하였다. 해당 요인의 표준 적절성 Kaiser-Meyer-Olkin 값은 0.904, Bartlett 구형성 검정은 $\chi^2 = 1{,}505.397$ ($df = 66$), $P < 0.001$, 총분산 설명력은 75.623%, 내적 통제의 Cronbach's α는 0.940, 외적 통제의 Cronbach's α는 0.915였다. 「PHD 실천 의도」의 표준 적절성의 Kaiser-Meyer-Olkin 값은 0.877, Bartlett 구형성 검정은 $\chi^2 = 801.680$ ($df = 10$), $P < 0.001$, 총분산 설명력은 84.666%, Cronbach's α는 0.954로 모든 요인에서 높은 신뢰도를 나타냈다.

구성요소의 타당도와 신뢰도가 확인됨에 따라, 각 구성요소의 인식수준을 분석하였다. 구성 요소 간 점수를 비교한 결과, 인지적 태도의 평균 점수가 가장 높았고(4.09), 그 다음으로 정서적 태도(4.03), PHD 실천 의도(3.82), 주관적 규범(3.66), 외적 통제(3.40), 내적 통제(3.26) 순이었다.

3) TPB 구성요소 간의 상관관계

계획된 행동이론 구성요소(인지적 태도, 정서적 태도, 주관적 규범, 내적 통제, 외적 통제, PHD 실천의도), 나이간 피어슨 상관계수는 Table 6과 같다. 계획된 행동이론의 모든 구성 요소 간에는 유의한 상관관계가 있었으나, 나이는 어느 변수와도 유의한 상관관계가 없었다.

4) TPB 구성요소와 지구건강식사 실천 의도 간의 관련성

계획된 행동이론의 인지적 태도, 정서적 태도, 주관적 규범, 내적통제, 외적통제와 PHD 실천 의도에 영향을 미치는 요인을 조사하고자 다중회귀분석을 실시한 결과는 Table 7에 제시되어 있다. 그 결과 회귀 모형은 통계적으로 유의하게 나타났으며($P < 0.001$), 회귀 모형의 설명력은 약 61.0%로 나타났다($R^2 = 0.610$, $adjR^2 = 0.595$). 한편, Durbin-Watson 통계량은 2.326으로 잔차의 독립성 가정에 문제는 없는 것으로 평가되었고, 분산 팽창 지

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Table 3. General characteristics of the study participants (n = 132)

Variable	Value
Sex	
Male	49 (37.12)
Female	83 (62.88)
Age (year)	
25–29	19 (14.39)
30–39	42 (31.82)
40–49	39 (29.55)
50–58	32 (24.24)
Mean ± SD	40.73 ± 9.31
Type of government worksite cafeteria you use	
Seoul Metropolitan Government	46 (34.85)
Seoul Metropolitan Government Autonomous District Office	46 (34.85)
Hospital affiliated with Seoul Metropolitan Government	15 (11.36)
Seoul Metropolitan Government Directly Subordinate Organization	25 (18.94)
On average, how often do you have breakfasts at the government worksite cafeteria a week?	
≤ 1 time	120 (90.91)
2–3 times	4 (3.03)
≥ 4 times	8 (6.06)
Mean ± SD	0.38 ± 1.12
On average, how often do you have lunches at the government worksite cafeteria a week?	
≤ 1 time	13 (9.85)
2–3 times	57 (43.18)
≥ 4 times	62 (46.97)
Mean ± SD	3.32 ± 1.26
On average, how often do you have dinners at the government worksite cafeteria a week?	
≤ 1 time	96 (72.73)
2–3 times	33 (25.00)
≥ 4 times	3 (2.27)
Mean ± SD	0.87 ± 1.16
On average, how often do you have snacks at the government worksite cafeteria a week?	
≤ 1 time	125 (94.70)
2–3 times	5 (3.79)
≥ 4 times	2 (1.52)
Mean ± SD	0.20 ± 0.67

n (%) or Mean ± SD.

수(variance inflation factor)도 모두 10 미만으로 나타나 다중공선성 문제는 없는 것으로 나타났다.

회귀 계수의 유의성 검증 결과, 감성적 태도(β = 0.226, P < 0.05), 내적 통제(β = 0.269, P < 0.01), 외적 통제(β = 0.324, P < 0.001)에서 PHD 실천의도에 유의한 정(+)의 영향을 미치는 것으로 나타났다. 표준화 계수의 크기를 비교하면, 외적 통제(β = 0.324), 내적 통제(β = 0.269), 감성적 태도(β = 0.226)순으로, 전반적인 PHD 실천 의도에 큰 영향을 미치는 것으로 나타났다. 이러한 관련성은 성별과 연령을 보정한 후에도 TPB 구성요소의 유의성에 변함이 없었으며(P < 0.001), 성별과 연령은 통계적으로 유의하지 않았다.

Table 4. Awareness and knowledge of the Seoul Mirae Bapsang

Variables	Value
Have you ever heard or seen about the Seoul Mirae Bapsang[1)]? (n = 132)	
Yes	53 (40.15)
No	79 (59.85)
How much do you know about the Seoul Mirae Bapsang? (n = 53[2)])	
Mean ± SD	3.08 ± 1.03

n (%) or Mean ± SD.
[1)]Seoul Metropolitan Government guidelines for a sustainable diet: A practical guide.
[2)]Knowledge level was assessed only among participants who answered "Yes" to the awareness question.

2. FGI 조사 결과

PHD인 '지구를 위한 밥상'을 제공받고 있는 서울특별시청 직원을 대상으로 FGI를 통해 PHD에 대한 태도 및 행동 변화 촉진 요인을 분석한 결과, 3개의 범주와 8개의 상위 개념이 도출되었다 (Table 8).

1) PHD에 대한 인식 및 태도

(1) 맛에 대한 인식

PHD 식단은 맛이 없을 것 같다는 의견이 다수 존재하였으며, 실제 식단을 선택하는 데서도 맛이 결정적인 기준으로 작용하였다. 하지만 맛 개선이 이루어진다면 '지구를 위한 밥상' 이용 의향이 높아질 것으로 나타났다.

"그냥 뉘앙스가 건강하겠다. 맛은 그렇게 있지 않을 수도 있겠다 그런 느낌이 들어요." (참여자 6)

"진짜 맛이 정말 중요한 것 같아요. 맛에 따라서 사람들이 구내식당에 갈 것인지 안 갈 것인지를 결정할 것 같아요." (참여자 3)

"일단 맛이 있어야 되는데 맛만 있으면 먹겠죠." (참여자 6)

"저는 이제 지구를 위한 밥상을 잘 이용을 안 해서 한 달에 한 번 정도 이용을 하는데, 이게 메뉴를 보고 솔직히 이용을 하거든요. 그래서 지구를 위한 밥상도 맛있게 만들면, 많이 이용할 것 같

Table 5. Exploratory factor analysis of the variables of the theory of planned behavior

Variables	Value	Factor loading
Cognitive attitudes, Cronbach's α = 0.913		
I need to choose a diet for my health.	4.21 ± 0.81	0.679
I need to choose a diet for the environment.	3.95 ± 0.87	0.752
I need to choose low-carbon and less processed foods for my health and the environment.	3.99 ± 0.80	0.813
I need to eat a balanced, plant-based diet for my health and the environment.	3.89 ± 0.87	0.753
I need to recycle and reduce food waste for my health and the environment.	4.17 ± 0.78	0.724
'The Seoul Mirae Bapsang[1)]' has a positive effect on my health.	4.14 ± 0.72	0.872
'The Seoul Mirae Bapsang' has a positive impact on the environment.	4.20 ± 0.71	0.860
'The Seoul Mirae Bapsang' has a positive impact on my health and the environment.	4.17 ± 0.71	0.900
Mean ± SD	4.09 ± 0.62	
Affective attitudes, Cronbach's α = 0.901		
Perception of whether a diet for my health and the environment is beneficial (e.g., The Seoul Mirae Bapsang).	4.26 ± 0.66	0.874
Perception of whether a diet for my health and the environment is useful (e.g., The Seoul Mirae Bapsang).	4.17 ± 0.74	0.897
Perception of whether a diet for my health and the environment is good (e.g., The Seoul Mirae Bapsang).	4.14 ± 0.76	0.876
Perception of whether a diet for my health and the environment is enjoyable (e.g., The Seoul Mirae Bapsang).	3.66 ± 0.95	0.745
Perception of whether a diet for my health and the environment is desirable (e.g., The Seoul Mirae Bapsang).	4.33 ± 0.70	0.866
Perception of whether a diet for my health and the environment is convenient (e.g., The Seoul Mirae Bapsang).	3.44 ± 1.01	0.581
Perception of whether a diet for my health and the environment is important (e.g., The Seoul Mirae Bapsang).	4.20 ± 0.77	0.831
Mean ± SD	4.03 ± 0.64	
Subjective norms, Cronbach's α = 0.905		
People around me (including family and coworkers) think I should be making dietary choices for my health and the environment.	3.86 ± 0.87	0.739
I believe that the government worksite cafeteria I currently use promotes a diet that is good for both my health and the environment.	3.61 ± 0.95	0.920
I think the city of Seoul is promoting a diet for my health and the environment.	3.67 ± 0.98	0.943
I think that government agencies (society) are promoting a diet for my health and the environment.	3.48 ± 1.04	0.916
Mean ± SD	3.66 ± 0.85	
Internal perceived behavioral control, Cronbach's α = 0.940		
I can practice making dietary choices for health and the environment without help from others	3.36 ± 1.07	0.783
I can practice making dietary choices for health and the environment even when tempted.	3.05 ± 1.11	0.817
I can practice eating for my health and the environment even if it doesn't match my preferences.	3.24 ± 1.15	0.864
I can practice eating for my health and the environment even if I don't feel full.	3.49 ± 1.14	0.787
I can practice eating for my health and the environment even if it doesn't taste good.	3.04 ± 1.17	0.846
I can practice eating for my health and the environment even if I lack information.	3.35 ± 1.02	0.663
I can practice eating for my health and the environment even if it increases my purchasing costs.	3.28 ± 1.09	0.640
Mean ± SD	3.26 ± 0.95	
External perceived behavioral control, Cronbach's α = 0.915		
I can practice a diet for my health and the environment even when eco-friendly ingredients are not easily available.	3.31 ± 1.09	0.795
I can practice a diet for my health and the environment even when low-carbon foods are difficult to obtain.	3.24 ± 1.08	0.841
I can practice a diet for my health and the environment even when ugly agricultural products are difficult to obtain.	3.54 ± 1.03	0.908
I can practice a diet for my health and the environment even when ugly farm products are inconvenient to use.	3.55 ± 0.99	0.744
I can practice a diet for my health and the environment even when government worksite meal costs rise.	3.35 ± 1.16	0.663
Mean ± SD	3.40 ± 0.93	
PHD behavioral intentions, Cronbach's α = 0.954		
I intend to follow a diet for my health and the environment within the next three months.	3.83 ± 0.87	0.949
I intend to follow and maintain a diet for my health and the environment within the next three months.	3.73 ± 0.88	0.951
I intend to choose low-carbon and less processed foods for my health and the environment within the next three months.	3.80 ± 0.90	0.949
I intend to eat a mostly plant-based, balanced diet for my health and the environment within the next three months.	3.77 ± 0.92	0.913
I intend to upcycle food and minimize leftovers for my health and the environment within the next three months.	3.95 ± 0.77	0.833
Mean ± SD	3.82 ± 0.80	

Mean ± SD.

PHD, planetary health diet.

[1)]Seoul Metropolitan Government guidelines for a sustainable diet: a practical guide.

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Table 6. Pearson correlation coefficients among the constructs of the theory of planned behavior and age

Variables	1	2	3	4	5	6	7
1. Cognitive attitudes	1						
2. Affective attitudes	0.799**	1					
3. Subjective norms	0.591**	0.688**	1				
4. Internal perceived behavioral control	0.482**	0.557**	0.618**	1			
5. External perceived behavioral control	0.407**	0.460**	0.495**	0.753**	1		
6. PHD behavioral intentions	0.555**	0.617**	0.554**	0.696**	0.678**	1	
7. Age	0.011	0.044	0.006	0.158	0.062	0.128	1.000

PHD, planetary health diet.
**$P < 0.01$.

Table 7. Regression analysis for factors influencing the planetary health diet behavioral intention

Independent variable	B	S.E.	β	t	VIF	Model fit
Cognitive attitudes	0.139	0.120	0.108	1.161	2.799	$F = 39.426^{***}$
Affective attitudes	0.283	0.131	0.226	2.161*	3.533	$R^2 = 0.610$
Subjective norms	0.008	0.078	0.008	0.099	2.251	$adjR^2 = 0.595$
Internal perceived behavioral control	0.226	0.080	0.269	2.839**	2.895	*D-W* = 2.326
External perceived behavioral control	0.280	0.073	0.324	3.811***	2.329	
Cognitive attitudes	0.137	0.122	0.107	1.125	2.881	$F = 28.124^{***}$
Affective attitudes	0.277	0.131	0.221	2.109*	3.538	$R^2 = 0.610$
Subjective norms	0.016	0.079	0.017	0.202	2.274	$adjR^2 = 0.592$
Internal perceived behavioral control	0.216	0.083	0.257	2.594*	3.155	*D-W* = 2.354
External perceived behavioral control	0.282	0.075	0.326	3.770***	2.397	
Sex	−0.035	0.097	−0.021	−0.357	1.106	
Age	0.005	0.005	0.058	1.018	1.055	

S.E., standard error; VIF, variance inflation factor.
*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$ by multiple regression analysis.

아요." (참여자 2)

(2) 포만감 부족

현재 제공되고 있는 '지구를 위한 밥상'은 포만감이 부족해 금방 허기감을 느끼게 된다는 의견이 다수 제기되었으며, 이에 따라 추가적인 간식 섭취가 이어지고 있음을 알 수 있었다.

"지구를 위한 밥상을 먹고나면 뭔가 먹고나면 허한 느낌이에요. 허해서 밥 먹고 디저트를 찾게 되더라고요. 오히려 그래서 그날은 평소에는 아메리카노만 마시다가 커피라도 단거를 먹게 되는 것 같아요." (참여자 3)

"약간 오후 되면 약간 좀 허기지는 느낌이 있어서…" (참여자 13)

"배가 빨리 고파지는 것 같아요." (참여자 11)

2) PHD 선택에 영향을 미치는 사회적·환경적 요인

(1) 동료 및 조직적 영향

참여자들은 식사 결정에 있어서 개인의 선택보다는 조직 분위기, 동료의 의견이 큰 영향을 미친다고 하였다.

"팀원들하고 식사하다 보니까 지구를 위한 밥상이 나오는 날에는 한 명이 나갈까 하면 '그럴까' 하고 나가죠." (참여자 2)

"아무래도 메뉴가 영향을 미쳐요. 저도 메뉴를 보긴 보지만 팀원들이 '오늘은 메뉴가 좀 그러네요. 팀장님 나가죠.' 그러면 제가 그걸 또 안 갈 수도 없고 그러죠." (참여자 1)

(2) 메뉴에 따른 이용 패턴

자극적이고 선호도가 높은 메뉴(특히 고기류)가 없는 경우와 채식 위주의 메뉴일 경우에는 자연스럽게 외식을 고려하게 되는 경향을 보였으며, 전반적으로 메뉴 만족도에 따라 식사 장소 선택에 직접적인 연관성이 있었다.

"거의 기본적으로 구내식당 가긴 하는데, 만약에 외식한다고 하면 메뉴 때문에 나가는 게 좀 크죠." (참여자 13)

"입에 확 당길 것 같은 좀 자극적인 음식이라고 해야 되나 좀 고기류가 근데 대부분 좀 그런 것 같긴 한데 채식의 날은 그런 게

Table 8. Perceptions, influencing factors, and implementation strategies for the planetary health diet

Theme	Sub-theme	Constructed meaning
Perceptions and attitudes toward PHD	Taste perception	• Willingness to use PHD if taste improves
	Lack of satiety	• Perception that PHD meals do not provide lasting fullness
Social and environmental factors influencing PHD choices	Peer and organizational influence	• Tendency to follow group decisions over personal preference in meal choice
	Menu-based habits	• Vegetarian-oriented menus lead to increased consideration of dining out
Strategies to promote and implement PHD	Branding	• Preference for naming that highlights personal health benefits
	Meal composition	• Acceptance of fried foods limited to a frequency of twice a week or less
		• Preference for fish varies depending on type and cooking method
		• Perception that fewer side dishes could negatively impact acceptance of PHD meals
		• Positive response to alternatives such as smaller soup portions or providing scorched rice water (sungnyung)
	PHD adoption strategy	• Willingness to increase acceptance to 1–2 times per week if taste and variety improve
		• Strategy to promote natural acceptance of PHD through appealing and modern menu development
		• Expectation of increased PHD usage if offering days are adjusted
	Promotion & education	• Avoidance of complex explanations in favor of easy-to-understand visual communication

PHD, planetary health diet.

없다 보니까 그럴 때는 이제 메뉴 보시고 나가서 먹자 이렇게 말씀 많이 하시는 것 같아요." (참여자 9)

3) PHD 실천 및 확산 전략

(1) 브랜딩

'지구를 위한 밥상'과 같은 명칭은 채식에 대한 의무감으로 인식되어 거부감을 유발할 수 있다는 문제를 제기하였으며, 이에 지구를 위한 가치보다는 나의 건강을 강조하는 명칭이 더 긍정적인 반응을 얻을 수 있을 것이라고 제안하였다.

"지구를 위한 밥상이라는 이미지가 약간 좀 채식을 해야 될 것 같고 그러니까 좀 그런 이미지가 있기 때문에 메뉴를 할 때 구성을 너무 지구를 위한 밥상을 크게 타이틀하기보다는 좀 아닌 듯하게 하면 더 나을 것 같아요." (참여자 13)

"명칭을 좀 나를 위한 건강의 날 이런 걸로 하는 게 더 좋지 않을까 라는 생각이 들어요. '먹는 것까지 지구를 위해야 돼?' 이런 느낌도 있을 것 같거든요." (참여자 6)

(2) 식단 구성

대다수의 참여자가 튀김 메뉴에 대한 부정적인 인식을 보였으며, 주로 건강에 대한 우려와 냉동 식품에 대한 기피가 이유로 언급되었고, 이에 주 2회 이하 제공에 대해서는 수용 가능하다는 의견이었다.

"저는 고기를 튀겨나온 돈가스 이런 거 별로 안 좋아해가지고 2회 이하는 괜찮아요." (참여자 4)

"저는 아까 말씀드렸던 것처럼 튀김이면 대부분 냉동식품이거든요. 저는 그걸 좀 안 좋아해요." (참여자 7)

"저도 튀김을 잘 안 먹긴 해가지고 건강에 안 좋아서." (참여자 14)

생선은 생선 종류와 조리 방식에 따라 선호도가 크게 달라졌으며, 가시가 적은 생선이나 순살 생선이 제공되고 비린내가 개선된다면 주 1–2회 이상 제공도 받아들일 의향이 있다고 밝혔다.

"2회까지는 괜찮아요. 근데 이게 생선이 제 생각에는 이렇게 가시가 많은 거는 확실히 먹는 시간도 늘어나고 그래서 바르는 게 약간 순살 위주로 좀 하시면 고등어 이런 걸로." (참여자 14)

"생선도 어떤 거 나오느냐에 따라 또 다른 것 같아요. 가시가 좀 덜 나오는 생선 나올 때는 좀 괜찮고 또 비린내 안 나는 거 생선도 또 비린내 많이 나는 것도 많이 나더라고요. 이런게 좀 개선이 되면 고기 대신 두 번 세 번 나와도 돼요." (참여자 12)

다만, 탄소 배출량 감소를 위해 반찬 수를 줄이면 이미 선호도가 낮은 식단에 추가적인 불만요소가 될 수 있다는 의견을 제시하였다.

"반찬에 대해서 가짓수 줄이는 거요? 그러면 지구의 밥상이 안 그래도 맛없는 날인데 오히려 더 안 오실 것 같아요." (참여자 6)

'국 없는 날' 도입에 대해서도 식사의 만족도 저하가 될 수 있다는 우려의 반응을 보였다. 특히 연령대가 높은 이용자의 경우 국이 없으면 식사하지 않는 경향이 있으며, 국 미제공 시 음식물

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을 섭취할 때 퍽퍽하다고 느껴 무리가 있을 것 같다고 응답하였다. 다만 작은 크기의 국그릇 추가 배치 방안과 숭늉 제공과 같은 국을 대체할 수 있는 방법에 대한 긍정적인 의견이 제시되었다.

"국 그릇을 줄여도 상관없고 근데 다른 직원들 나이 많으신 직원은 국이 없으면 퍽퍽해서 밥을 안 드시는 분이 있으니까 과연 가능할까라는 생각이 듭니다." (참여자 5)

"저는 전에 먹던 급식에서도 국 없는 날이 있었어요. 그 대신 숭늉이 나왔거든요. 그래가지고 그거는 메뉴를 어떻게 잘 텁텁하지 않으면 국 없어도 먹을 수 있을 것 같아요." (참여자 13)

(3) PHD 도입 전략

'지구를 위한 밥상' 제공 횟수에 대해서는 현재 제공되고 있는 횟수(주 1회)가 적절하다고 응답하였으나, 기호도 및 다양성을 고려한 메뉴 개발이 충분히 이루어졌을 경우에는 주 1–2회까지 수용할 의향이 있음을 밝혔다.

"지금 주 1회가 적당한 것 같아요." (참여자 6)

"메뉴가 잘 개발되어서 제공된다면 주 1–2회까지는 가능할 것 같아요." (참여자 1, 4)

참여자들은 고기를 대체할 수 있으면서 맛있는 메뉴 개발이 필요하다고 응답하였으며, 고기를 대체할 경우 선호하는 메뉴는 두부요리와 같은 단백질 공급이 되는 식물성 재료와 해조류를 활용한 식단이었고, 라따뚜이, 통밀 롤, 또띠아 등 이국적이고 트렌드를 반영한 메뉴를 활용하여 자연스럽게 PHD를 수용할 수 있도록 유도하는 전략이 필요하다고 언급하였다.

"횟수를 늘리는 건 상관이 없는데 메뉴는 제 생각에는 채소를 많이 먹을 수 있는 게 유도 그러니까 너무 그거 하지 말고 압박보다 약간 유도하게끔 하는 게 좋을 것 같아요. 비빔밥처럼 무의식적으로 섭취할 수 있게끔." (참여자 14)

"두부는 일단은 생각보다 많이 안 나오는 것 같아서 좀 늘었으면 좋겠고요." (참여자 14)

"약간 미역이나 이런 해조류를 좋아해서." (참여자 11)

"조금 이국적인 메뉴가 있으면은 괜찮지 않을까요. 여기 라페 통밀롤 이런 거나 라따뚜이 이런 것도 채식이잖아요." (참여자 10)

"또띠아 같은 거에 채소 싸먹을 수 있게 하는 것도 괜찮을 것 같아요. 그러면 채소 많이 먹을 수 있잖아요." (참여자 13)

다만, '지구를 위한 밥상' 확대 도입 시 이용자의 식사 패턴을 반영할 필요성이 제기되었다. 현재 '지구를 위한 밥상'을 자주 이용하지 않는 이유로 금요일에 제공되고 있다는 점을 언급하였다. 금요일에는 다른 요일에 비하여 상대적으로 맛있는 음식을 먹고 싶다는 심리가 작용하여 구내 식당보다는 외식을 하게 되는 경향이 있다고 응답하였으며 이에 '지구를 위한 밥상' 제공 요일을 변경할 경우에는 더 자주 이용할 것 같다는 의견이 있었다.

"지구를 위한 밥상은 보통 금요일날 나오는 데요. 금요일날은 뭔가 좀 맛있는 걸 먹고 싶어서 나가는 경우가 종종 있어요." (참여자 3)

"저는 채식의 날이라고 나가고 그런 것 같지 않은 것 같고요. 그냥 아무래도 금요일이다 보니까 그냥 나가서 먹자 그런 느낌이에요." (참여자 10)

"그리고 저희도 마찬가지인 것 같아요. 금요일에 아무래도 휴가자들도 많고 사람들이 꽉 차 있지 않으니까 사람들 없으니까 나가서 먹고." (참여자 11)

"목요일이라면 자주 갈 것 같기도 해요." (참여자 3)

(4) 홍보 및 교육

PHD가 직원들의 호응을 얻기 위해서는 홍보가 필요하다고 언급하였다. 특히 건강에 관심 있는 직원대상 맞춤형 정보 제공방법과 게시판, 포스터처럼 직원들이 바쁜 업무 중에도 쉽게 확인할 수 있도록 복잡한 설명 보다는 시각적으로 간단 명료한 홍보 수단을 선호하였고, 일부 이용자는 유튜브나 SNS 등 소셜 미디어 마케팅을 활용한 접근 방식은 젊은 세대에서 긍정적인 영향을 줄 수 있음을 언급하였다.

"홍보는 게시판 있잖아요. 거기다 올리는 것만으로도 충분할 것 같다 이런 생각이 드네요." (참여자 10)

"한 장짜리 포스터를 제일 많이 보고 직원들 바쁘니까 직관적으로 한 장짜리면 좋을 것 같아요." (참여자 5)

"제 주변에서 아까 당뇨가 있으신 팀장님도 있고 건강에 관심 있는 직원이 한 두 명 있으니까 이 식단을 먹었을 때 몇 칼로리, 당뇨병 예방 효과가 있다던가 음식의 효능을 홍보하면 와서 드실 분들 많거든요. 홍보가 중요한 것 같습니다." (참여자 5)

'오늘 음식은 특히 당뇨병 환자들에게 좋은 음식' 한 줄만 살짝 써줘도 '오 그래?' 할 것 같긴 하거든요." (참여자 1)

"젊은 분들은 많이 유튜브 쇼츠나 인스타그램 릴스 같은 거 맨날 보니까 그런 거를 활용하면 좋을 것 같은데…" (참여자 14)

DISCUSSION

본 연구는 TPB 기반 설문조사를 통해 PHD 실천에 영향을 미치는 주요 요인을 정량적으로 파악하고, FGI를 통해 설문조사에서 드러나지 않은 맥락적 요인 탐색 및 PHD를 제공받는 공공 기관 급식 이용자의 의견을 수렴하였다. 설문 결과, PHD 실천 의도에 영향을 미치는 요인은 정서적 태도, 인지된 행동통제력(내적·외적)으로 나타났으며, 인지적 태도와 주관적 규범은 유의미하지 않았다. 이와 함께, FGI를 통해 PHD에 대한 인식 및 태도(맛에 대한 인식, 포만감 부족)와 사회적·환경적 요인(동료 및 조직적 영

향, 메뉴에 따른 이용 패턴)에 의해 PHD 선택에 영향을 받는 것으로 나타났고, PHD 실천 및 확산 전략으로 PHD 실천 장애 요인을 해결할 수 있는 방법(식단 구성)과 PHD를 활성화시킬 수 있는 전략(브랜딩, PHD 도입 전략, 홍보 및 교육)이 도출되었다.

설문 결과, 참여자들은 PHD에 대한 인지적·감성적 태도 점수는 전반적으로 긍정적으로 나타났으나, FGI에서 PHD는 '맛이 없을 것 같다', '포만감이 부족하다'는 실질적인 우려가 제기되었고, 선호하는 메뉴(고기류)가 없고 채식위주의 메뉴일 경우에는 공공 기관 급식을 이용하지 않는 경향을 보였다. 이는 이용자가 PHD에 대해 긍정적인 태도를 가지고 있더라도 품질, 맛과 같이 개인의 만족이 충족되지 않으면 행동으로 이어지지 않음을 시사한다[26]. 이러한 연구 결과는 건강한 식단을 제공하는 것만으로는 실천을 유도하기 어렵고, 개인의 기호도를 고려한 접근이 필요함을 강조한다[27]. 따라서 PHD 실천 장려를 위해서는 음식의 기호도를 높일 수 있는 메뉴 개발 병행이 필수적이며, 이용자의 만족도를 고려한 접근이 중요함을 알 수 있다. 이에 대응하기 위한 실천 전략으로 FGI에서는 생선 조리방식과 국 제공 방식을 조정하는 것뿐만 아니라, 두부 요리와 해조류를 활용한 메뉴, 트렌디한 식단 개발과 같은 식단 구성에 대한 다양한 개선 방안이 제안되었다. 국외 연구에서도 지속가능한 식사를 위해서는 현실적이고 수용 가능성의 중요성을 강조하였으며, 이에 기호도(맛, 다양성), 식사의 매력도를 고려한 식단이 제안되었다[28]. 또한, PHD 도입을 위해서는 개인의 기호도 충족뿐만 아니라 사회적·구조적 개선이 병행되어야 함을 알 수 있었다. 설문 조사에서는 주관적 규범이 PHD 행동의도에 유의미한 연관성을 보이지 않았으나, FGI에서는 PHD에 대한 사회적 인식이 긍정적이더라도 실천 과정에서 주변인의 영향을 받을 수 있다는 점이 보였으며, 이전 연구에서도 함께 식사하는 파트너의 식습관이 개인의 식습관에 직접적인 영향을 미친다는 것을 확인할 수 있었다[29]. 더불어, 인지된 행동통제력(내적·외적)이 분석 결과에서 행동 의도에 가장 큰 영향을 미치는 것으로 나타났으며, 이는 지속가능한 식사 실천 의도와 지속가능한 식생활 교육의도에 관한 선행연구를 살펴본 결과와 유사한 경향을 보였다[12, 15, 30]. 그러나, 인지된 행동통제력(내적·외적)의 구성 요소 평균 점수는 전반적으로 낮게 나타나, 개인 스스로 PHD를 실천할 가능성이 낮음을 보였다. 이는 기존 연구에서도 반복적으로 지적된 바 있으며, 제도적 지원 부족, 교육 자료 부족, 메뉴 다양성 부족 등 환경적 요인이 개인의 통제력 인식 저하로 이어졌을 가능성이 있다[12, 15]. 따라서 PHD를 장려하기 위해서는 개인의 인식을 높이는 것뿐만 아니라, 조직적 수준에서의 PHD 실천을 유도할 수 있는 체계적이고 효과적인 정보 제공이 필수적이다[31, 32]. FGI 결과에 따르면 이용자들은 단순한 정보 전달 보다는 흥미를 유발하고 직관적인 이해를 돕는 홍보 방식이 필요하다고 응답하였다. 이에 따라 포스터와 카드 뉴스 같은 시각적 매체와 유튜브, 쇼츠 등 쇼셜 미디어 마케팅을 활용한 홍보 전략이 제안되었으며, 이러한 결과는 지속가능한 식사 실천을 위한 커뮤니케이션 전략의 중요성을 강조한 기존의 연구와도 맥락을 같이한다[26, 33, 34].

현재 WHO를 비롯한 여러 국가에서는 지속가능한 식생활을 장려하기 위해 식생활 지침 제공 및 지속가능한 식품 시스템 구축 등의 노력을 하고 있다. 필리핀의 캐손시티는 지속가능한 식생활 실천을 취해 국가 안보 및 식품 기준 정책을 설정하고 있고[35], 프랑스 파리에서는 공공급식 시설에서 지속가능한 식사 확장을 위한 12가지 정책 목표를 갖고 실천 중에 있다[36]. 서울시 역시 이와 같은 국제적 흐름에 발 맞춰 지속가능한 식생활 확장을 위해 노력을 기울이고 있으며, 이러한 정책 변화가 실질적 실천으로 이어지기 위해서는 실제 이용자들의 수용성과 행동 변화를 유도할 수 있는 구체적인 전략이 병행되어야 한다. 이러한 맥락에서 본 연구는 PHD 문화 조성을 위한 정책 설계 및 실천 전략 수립 과정에서 수용성과 실효성을 높이기 위한 실증적인 기초자료로 활용될 수 있을 것으로 기대된다.

Limitations

본 연구는 서울특별시 내 공공기관 집단급식소 이용자를 대상으로 진행되었으며, 연구 대상이 특정 지역의 공공급식 이용자에 국한되어 있다는 점에서 한계점을 지닌다. 따라서, 향후 서울 이외의 도시 및 지역에서도 유사한 결과가 도출될 수 있을지 추가적인 연구가 필요하다고 사료된다. 또한 TPB 기반 설문 조사는 PHD 실천 의도에 대한 요인을 파악했으나, 이 의도가 실제 행동(PHD 식단을 선택하고 먹었는지)으로 이어졌는지는 조사하지 않았다는 점에서 한계점을 갖고 있다. 특히 FGI 결과에서도 나타났듯이, 개인은 PHD 식단을 선택하고 싶어도 기호도나 사회적 분위기에 의해 실천하기 어려울 수 있다. 이에, 향후 연구에서는 행동 추적 조사를 통해 PHD 실천 의도와 실제로 PHD 식단을 선택하고 먹었는지까지 관계를 분석할 필요성이 있다고 사료된다. 그럼에도 불구하고 본 연구는 TPB 기반 설문조사를 통해 PHD 실천 의도에 영향을 미치는 요인을 확인하고, FGI를 통해 실질적인 PHD 실천 촉진 요인 및 방해 요인을 탐색하여, 단순한 수치 분석을 넘어 정량적·정성적 연구를 함께 사용함으로써 맥락적 이해관계를 제공하였다는 점에 의의가 있다.

Conclusion

본 연구는 TPB 기반 설문조사 및 공공급식 이용자 대상 FGI를 통해 서울시 공공기관 집단급식소 이용자의 PHD 실천 의도에 영향을 미치는 요인을 탐색하여 PHD를 공공 급식에 적용하기

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위한 실행 가이드 기초자료를 제공하고자 수행되었다. TPB 구성 요소에 대한 다중회귀분석을 수행하였으며, 정서적 태도, 인지된 행동통제력(내적·외적)이 PHD 실천의도에 잠재적 결정요인으로 나타났다. 이는 PHD에 대해 긍정적인 태도를 갖고 있거나 스스로 실천할 수 있다고 느끼는 경우에 PHD를 실천에 적극적인 태도를 보일 수 있음을 시사하며, FGI를 통해 건강 중심의 접근만으로는 PHD 실천을 유도하기 어렵고, 개인의 기호도를 반영한 식단 구성과 직장 내 환경 개선 및 사회적 지지와 같은 구조적 요소가 함께 고려되어야 함을 알 수 있었다. 따라서 본 연구를 통해 확인된 촉진 요인을 강화하고 장벽을 해결함으로써 향후 공공기관 집단급식소의 PHD 제공 및 확대 시 보다 실질적으로 이루어질 수 있으리라 기대한다.

CONFLICT OF INTEREST

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

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DATA AVAILABILITY

Research data is available from the corresponding author upon request.

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Research Article

식물성 육류 대체식품에 대한 성인 소비자의 인식 및 관련 요인

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Adult consumers' perception of plant-based meat substitutes and related factors in Korea: a cross-sectional study

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Objectives: We aimed to examine differences in experience, consumption, and perception of plant-based meat substitutes according to consumer characteristics, and to identify associated factors.
Methods: In this cross-sectional study conducted in Korea, 410 adult consumers were surveyed regarding their eating habits, experience with and consumption of plant-based meat substitutes, and their intentions and perceptions of these products. Statistical analyses were conducted.
Results: Approximately 84% of participants had heard of plant-based meat substitutes, most commonly through mass media and social media. Overall, 65.12% reported having consumed plant-based substitutes, with higher consumption observed among older and more health-conscious individuals. The most common reason for consumption was curiosity about new foods (36.33%), whereas the primary reason for non-consumption was lack of opportunity (61.54%). Additionally, 77.32% of respondents indicated willingness to try plant-based substitutes, with taste identified as the most influential factor in purchasing decisions. Perception of plant-based meat substitutes was rated 3.82 out of 5, with significantly higher awareness among individuals aged 50–64, married individuals, housewives, graduate students or graduates, and those with irregular meal times or infrequent dining out.
Conclusion: Older, married, more educated, and health-conscious individuals who dine out less frequently tend to have higher perception scores for plant-based meat substitutes, along with greater experience and stronger future use intention.

Keywords: meat substitutes; perception; adult; consumer behavior

INTRODUCTION

전세계적으로 인구증가에 따라 식량 부족 문제, 동물복지 및 윤리성 문제, 건강과 지속가능

성에 대한 관심이 높아지면서 육류 대체식품에 대한 소비자 요구가 증가하고 관련 시장이 확대되고 있다[1-3]. 세계 육류 대체식품의 유형별 시장은 식물 단백질 기반 대체육 시장이 전체 육류 대체식품 시장 규모의 87.2%로 가장 큰 비중을 차지하고 있다[4]. 또한 2026년에는 세계 식물성 단백질 기반 대체육 시장 규모가 156억 달러에 이를 것으로 예측되었다[5]. 국내 식물성 육류 대체식품 시장 규모는 2016년 4,760만 달러이며, 2017년부터 연평균 15.7% 성장하여 2026년에는 2억 1,600만 달러에 이를 것으로 전망된다[4].

식품의 개발과 판매, 식문화 변화는 소비자 인지와 인식, 선택에 따라 크게 영향을 받으므로 이를 파악하는 것은 매우 중요하다. 식품의 속성뿐만 아니라 소비자의 연령, 성별, 문화적 배경 등 다양한 특성은 식품의 수용성이나 선호도, 선택에 영향을 미친다[6]. 따라서 제품에 대한 소비자 인식을 파악하는 것은 소비자들이 제품의 맛, 질감, 영양, 가격 등에서 어떤 부분에 가치를 두는지 이해할 수 있으며, 이는 소비자 요구를 반영한 제품과 정보를 구축하는 데 기여하고 정책 개발에도 중요한 기초자료로 활용될 수 있다[7].

대체육 시장이 확대되면서 국내에서는 주로 식물성 육류 대체식품 시장의 성장 가능성과 기술적 발전을 주요 주제로 다루고 있으며, 식물성 육류 대체식품의 지속가능성과 건강에 미치는 긍정적인 영향을 강조하면서 앞으로의 제품 개발 동향을 파악하는 데 중점을 두고 있다[4, 8]. 식물성 육류 대체식품에 대한 소비자 인식은 건강, 환경, 지속가능성 등 다양한 요인에 의해 영향을 받고, 특히 맛과 식감이 소비자 선택에 중요한 요소로 작용한다고 보고되었다[9, 10]. 현재 국내외에서 식물성 육류 대체식품에 대한 소비자 인식, 구매 의향, 섭취 동기를 다룬 연구가 점차 증가하고 있으며 그에 따라 설문지 개발과 관련된 연구는 이루어지고 있지만[11-14], 소비자 특성에 따른 인식차이와 관련 요인을 통합적으로 분석한 국내 연구는 상대적으로 제한적이다. 따라서 소비자의 인식과 구매 동기를 평가하는 연구가 필요한 상태이며, 이를 통해 소비자 맞춤형 식물성 육류 대체식품의 제품 개발과 시장 확대를 위한 구체적인 전략을 마련할 수 있을 것이다.

본 연구의 목적은 식물성 육류 대체식품에 대한 소비자의 경험 및 소비 실태와 소비자 특성에 따른 인식도의 차이를 분석하여 관련 요인을 제시하는 것이다. 이에 성인 소비자를 대상으로 식물성 육류 대체식품에 대한 설문조사 및 분석을 통해 소비자들의 제품 선택에 필요한 정보를 제공하고 궁극적으로 소비자 특성을 반영한 식물성 육류 대체식품 개발에 활용할 수 있는 기초자료를 마련하고자 하였다.

METHODS

Ethics statement

This study was approved by the Institutional Review Board of Kongju National University (KNU_IRB_2023-093). Participants were informed of the study purpose, research procedures, anticipated benefits, potential risks, and safety measures. Written informed consent was obtained from all participants. All procedures were conducted in accordance with applicable ethical guidelines.

1. 연구설계

본 연구는 성인 소비자를 대상으로 한 단면연구로서 설문조사를 실시하였으며, STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) 보고지침(https://www.strobe-statement.org/)에 따라 기술하였다.

2. 조사대상 및 기간

본 조사는 19세-64세 성인 남녀를 대상으로 하였으며, 조사 기간은 2023년 10월 1일부터 12월 31일까지였다. 참여자의 소개 등으로 자발적인 참여 의사를 밝힌 사람을 대상자를 포함하고 눈덩이 표집 방법을 통해 자기기입식 온라인 설문조사(Google Forms)를 실시하였다. 총 414명의 조사대상자가 설문에 참여하였으며, 연구에 동의하지 않는 대상자 4명을 제외하고 최종 410명의 설문자료를 분석에 사용하였다.

3. 조사내용 및 방법

본 연구의 설문지는 선행연구[11-14]를 참고하여 연구 목적에 맞는 문항으로 구성하였으며, 15명을 대상으로 예비조사를 실시하고 수정한 후 최종 완성하였다. 설문 문항은 식물성 육류 대체식품에 대한 인식, 식물성 육류 대체식품에 대한 경험 및 소비 실태, 식물성 육류 대체식품에 대한 소비 의사, 조사대상자의 일반사항으로 분류하여 구성하였다. 조사대상자의 일반적 특성은 성별, 연령, 결혼 유무, 직업, 교육수준, 건강 관심 및 식습관[불규칙한 식사시간, 편식, 과식, 잦은 외식(배달음식 포함), 잦은 인스턴트식품 섭취, 잦은 결식, 짜게 먹기, 채식주의]의 7개 문항으로 구성하였다. 식물성 육류 대체식품에 대한 경험 및 소비 실태는 식물성 육류 대체식품에 대해 들어본 경험, 들어본 경로, 섭취 경험, 섭취 빈도, 섭취 장소, 섭취하는 이유, 섭취하지 않는 이유의 7개 문항으로 구성하였다. 식물성 육류 대체식품에 대한 소비 의사는 앞으로 식물성 육류 대체식품의 소비 의사, 식물성 육류 대체식품 구매 시 가장 중요한 요인과

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구매하지 않을 시 가장 중요한 요인의 3개 문항으로 구성하였다. 식물성 육류 대체식품에 대한 인식도 문항은 선행연구[11, 12]를 참고하여 식물성 육류 대체식품이 친환경적인지, 동물복지에 도움이 되는지, 영양적으로 우수한지, 충분한 식이섬유를 얻을 수 있는지, 충분한 단백질을 얻을 수 있는지의 5개 문항으로 구성하였다. 인식도는 5점 척도로 구성한 후 '매우 그렇다'는 5점, '그렇다'는 4점, '보통이다'는 3점, '그렇지 않다'는 2점, '전혀 그렇지 않다'는 1점으로 점수화하여 점수가 높을수록 인식이 좋은 것으로 평가하였다.

4. 통계분석

본 연구의 모든 통계분석은 SAS version 9.4 (SAS Institute Inc.)를 이용하여 실시하였다. 식물성 육류 대체식품에 대한 인식도는 평균과 표준편차를 산출하였으며, 경험 및 섭취 실태, 구매 및 섭취 의사의 경우에는 빈도와 백분율을 산출하였다. 성별, 연령, 건강 관심 정도에 따른 실태와 일반사항 및 식습관 유무에 따른 인식도 차이는 비연속변수일 경우 chi-square test 및 Fisher's exact test를 실시하여 유의성을 검정하였으며, 연속변수의 경우 두 군간 차이는 unpaired t-test와 3군 이상은 일원분산분석(one-way analysis of variance)을 실시한 후 유의성이 나타났을 때 Duncan's multiple range test로 사후검정하였다. 식물성 육류 대체식품에 대한 인식도 5문항의 일치도는 Cronbach's α 분석을 실시하여 α값이 0.7 이상일 때 신뢰도가 있는 것으로 판정하였으며[15], 본 연구의 Cronbach's α값은 0.78이었다. 모든 통계의 유의성 검정은 $P < 0.05$ 수준에서 실시하였다.

RESULTS

1. 조사대상자의 일반사항

조사대상자의 일반사항은 Table 1과 같다. 전체 대상자 중 20–29세가 가장 높은 비율을 차지하였고, 성별에 따라 남성은 50–64세, 여성은 20–29세에 집중되는 경향을 보여 연령에 따라 유의한 차이가 있었다($P < 0.001$). 결혼 여부에서는 남성은 기혼자, 여성은 미혼자의 비율이 높았으며($P < 0.001$), 직업에서는 남녀 간 분포에 유의한 차이를 보여 남성은 직장인과 자영업자, 여성은 학생과 주부의 비율이 상대적으로 높았다($P < 0.001$). 교육 수준은 전반적으로 대학교 졸업 이상이 다수를 차지하였으며, 성별에 따른 차이는 보이지 않았다.

2. 건강 관심과 식습관

조사대상자의 건강 관심과 식습관은 Table 2와 같다. 전체 대상자에서 약 69%가 건강에 관심이 있다고 응답하였으며, 성별 간 유의한 차이는 없었다. 식습관에서는 불규칙한 식사시간이 가장 높았으며, 그 외에도 잦은 외식, 과식, 잦은 인스턴트식품 섭취 등이 높은 비율을 보였다.

3. 식물성 육류 대체식품 경험 및 소비 실태

조사대상자의 성별, 연령, 건강 관심에 따른 식물성 육류 대체식품에 대한 경험 및 소비 실태는 Table 3과 같다. 식물성 육류 대체식품에 대해 들어본 경험이 84.39%로, 건강에 관심 있는 대상자가 더 높았으며($P < 0.05$), 주로 접한 경로는 대중매체였고, 남

Table 1. Demographic characteristics of study participants

Variable		Total (n = 410)	Male participants (n = 146)	Female participants (n = 264)	χ^2 (*P*-value)
Age (year)	20–29	182 (44.39)	46 (31.51)	136 (51.52)	40.75 (< 0.001)
	30–49	110 (26.83)	30 (20.55)	80 (30.30)	
	50–64	118 (28.78)	70 (47.95)	48 (18.18)	
Marital status	Single[1)]	239 (58.29)	68 (46.58)	171 (64.77)	12.81 (< 0.001)
	Married	171 (41.71)	78 (53.42)	93 (35.23)	
Job	Student	97 (23.66)	29 (19.86)	68 (25.76)	43.98 (< 0.001)
	Office worker	188 (45.85)	74 (50.68)	114 (43.18)	
	Self-employed	52 (12.68)	33 (22.60)	19 (7.20)	
	Homemaker	43 (10.49)	0 (0.00)	43 (16.29)	
	Unemployed or other	30 (7.32)	10 (6.85)	20 (7.58)	
Education level	Below high school	70 (17.07)	21 (14.38)	49 (18.56)	3.25 (0.197)
	College or university	257 (62.68)	89 (60.96)	168 (63.64)	
	Graduate school or above	83 (20.24)	36 (24.66)	47 (17.80)	

n (%).
P-values were calculated using the χ^2 test.
[1)]Includes divorced and bereaved individuals.

Table 2. Interest in health and eating habits

Variable		Total (n = 410)	Male participants (n = 146)	Female participants (n = 264)	χ^2 (*P*-value)
Interest in health	No	128 (31.22)	37 (25.34)	91 (34.47)	3.65 (0.056)
	Yes	282 (68.78)	109 (74.66)	173 (65.53)	
Eating habits[1)]	Irregular mealtimes	182 (44.39)	63 (43.15)	119 (45.08)	-
	Imbalanced diet	64 (15.61)	16 (10.96)	48 (18.18)	
	Overeating	118 (28.78)	39 (26.71)	79 (29.92)	
	Dining out (incl. delivery)	146 (35.61)	44 (30.14)	102 (38.64)	
	Consumption of instant food	107 (26.10)	23 (15.75)	84 (31.82)	
	Skipping meals	44 (10.73)	9 (6.16)	35 (13.26)	
	Eating salty	103 (25.12)	34 (23.29)	69 (26.14)	
	Vegetarianism	31 (7.56)	12 (8.22)	19 (7.20)	

n (%).
P-values were calculated using the χ^2 test.
[1)]Multiple response—participants could select more than one option.

성은 대중매체, 여성은 SNS에서 더 많이 접한 것으로 나타났다($P < 0.01$). 섭취 경험은 65.12%로, 연령이 많을수록 섭취 비율이 높았으며($P < 0.01$), 섭취 빈도는 연령이 높을수록 한 달에 한 번 이상 섭취하는 비율이 높았다($P < 0.05$). 섭취 장소는 연령대별로 20–29세는 음식점, 30–49세는 슈퍼마켓, 50–64세는 음식점에서 주로 섭취하였다($P < 0.001$). 섭취 이유로는 새로운 음식을 시도하는 것을 좋아해서(36.33%)가 가장 많았으며, 연령이 높을수록 새로운 음식을 시도하는 것을 좋아하는 비율이 낮게 나타나고, 친환경적이어서의 비율이 높았다($P < 0.001$). 섭취하지 않는 이유는 섭취할 기회가 없어서(61.54%)가 가장 많았으며, 그 외에는 맛이 없거나 이점을 잘 몰라서 라는 응답이 있었다.

4. 식물성 육류 대체식품 소비 의사

조사대상자의 성별, 연령, 건강 관심에 따른 식물성 육류 대체식품에 대한 소비 의사는 Table 4와 같다. 식물성 육류 대체식품에 대한 소비 의사는 317명(77.32%)이 있다고 답하였으며, 연령과 건강 관심에 따라 유의한 차이를 보여 20–29세 66.48%, 30–49세 80.91%, 50–64세 90.68%로 나타났고($P < 0.001$), 건강 관심이 없는 대상자(68.75%)가 관심 있는 대상자(81.21%)보다 낮았다($P < 0.01$). 식물성 육류 대체식품을 구매할 때 가장 중요하게 생각하는 요인은 맛(52.68%), 영양(24.15%), 식품원료(8.78%), 가격(7.32%), 환경(6.34%), 브랜드(0.49%), 편의성(0.24%) 순이었으며, 연령에 따라서 영양을 중요시하는 비율이 20–29세, 30–49세, 50–64세 각각 15.93%, 20.00%, 40.68%로 높아 유의한 차이를 보였다($P < 0.001$). 또한 건강에 관심 없는 대상자는 맛(65.63%), 영양(13.82%), 가격(8.59%) 순이었으며, 건강에 관심 있는 대상자는 맛(46.81%), 영양(29.08) 순으로 응답 비율에 유의한 차이를 보였다($P < 0.001$). 식물성 육류 대체식품을 구매하지 않는 가장 중요한 요인은 맛(48.05%), 가격(24.88%), 영양(14.15%), 식품 알레르기(6.10%), 환경(5.61%) 순이었으며, 남자는 맛(54.11%), 가격(17.12%), 영양(17.12%) 순이었고 여자는 맛(44.70%), 가격(29.17%), 영양(12.50%) 순으로 유의한 차이를 보였다($P < 0.05$). 연령에 따라서 가격을 중요시하는 비율이 20–29세, 30–49세, 50–64세 각각 29.67%, 23.64%, 18.64%로 낮아 유의한 차이를 보였으며($P < 0.01$), 건강에 관심 없는 대상자는 맛(58.59%), 가격(25.00%), 영양(7.03%) 순이었고, 관심 있는 대상자는 맛(43.26%), 가격(24.82%), 영양(17.38%) 순으로 유의한 차이를 보였다($P < 0.05$).

5. 식물성 육류 대체식품에 대한 인식도

조사대상자의 일반사항에 따른 식물성 육류 대체식품의 인식도는 Table 5와 같다. 전체 대상자의 식물성 육류 대체식품의 인식도는 5점 만점에 3.82점이었으며, 남녀간 유의한 차이가 없었다. 그러나 연령에 따라 50–64세가 4.02점으로 가장 높았으며, 30–49세(3.74점), 20–29세(3.73점) 순으로 높아 유의한 차이를 보였다($P < 0.001$). 결혼 여부에 따라 기혼자가 3.96점으로 미혼자의 3.71점보다 유의하게 높았다($P < 0.001$). 직업에 따라 주부가 3.99점으로 가장 높았으며, 자영업자(3.97점), 직장인(3.82점), 학생(3.69점), 무직 및 기타(3.68점) 순으로 높아 유의한 차이를 보였다($P < 0.05$). 교육 수준에 따라 대학원 재학 또는 졸업이 3.94점으로 가장 높았으며, 고등학교 졸업(3.92점), 대학교 졸업(3.75점) 순으로 유의한 차이를 보였다($P < 0.05$). 조사대상자의 식습관에 따른 식물성 육류 대체식품 인식도는 Table 6과 같다. 인식도의 전체 점수는 식사시간이 불규칙한 대상자가 그

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Table 3. Consumption patterns of plant-based meat substitutes

Variable	Total (n = 410)	Sex		χ^2 (*P*-value)	Age (year)			χ^2 (*P*-value)	Interest in health		χ^2 (*P*-value)
		Male (n = 146)	Female (n = 264)		20–29 (n = 182)	30–49 (n = 110)	50–64 (n = 118)		No (n = 128)	Yes (n = 282)	
Have you heard of plant-based meat substitutes? (n = 410)											
Yes	346 (84.39)	122 (83.56)	224 (84.85)	0.12 (0.731)	150 (82.42)	93 (84.55)	103 (87.29)	1.29 (0.524)	100 (78.13)	246 (87.23)	5.55 (0.019)
No	64 (15.61)	24 (16.44)	40 (15.15)		32 (17.58)	17 (15.45)	15 (12.71)		28 (21.88)	36 (12.77)	
How did you hear about plant-based meat substitutes? (n = 346)											
Mass media (TV, newspapers)	201 (58.09)	78 (63.93)	123 (54.91)	19.05 (0.001)	66 (44.00)	62 (66.67)	73 (70.87)	46.11 (< 0.001)	59 (59.00)	142 (57.72)	2.76 (0.600)
SNS	85 (24.57)	17 (13.93)	68 (30.36)		61 (40.67)	17 (18.28)	7 (6.80)		27 (27.00)	58 (23.58)	
Books, magazines	24 (6.94)	8 (6.56)	16 (7.14)		10 (6.67)	8 (8.60)	6 (5.83)		5 (5.00)	19 (7.72)	
Acquaintances (family, friends)	32 (9.25)	15 (12.30)	17 (7.59)		12 (8.00)	5 (5.38)	15 (14.56)		9 (9.00)	23 (9.35)	
Others	4 (1.16)	4 (3.28)	0 (0.00)		1 (0.67)	1 (1.08)	2 (1.94)		0 (0.00)	4 (1.63)	
Do you have experience of plant-based meat substitutes? (n = 410)											
Yes	267 (65.12)	93 (63.70)	174 (65.91)	0.20 (0.653)	101 (55.49)	78 (70.91)	88 (74.58)	13.69 (0.001)	66 (51.56)	201 (71.28)	15.06 (< 0.001)
No	143 (34.88)	53 (36.30)	90 (34.09)		81 (44.51)	32 (29.09)	30 (25.42)		62 (48.44)	81 (28.72)	
How often do you consume plant-based meat substitutes?[1)] (n = 267)											
Less than once a month	204 (76.40)	73 (78.49)	131 (75.29)	8.29 (0.078)	87 (86.14)	55 (70.51)	62 (70.45)	15.99 (0.014)	49 (74.24)	155 (77.11)	2.50 (0.558)
1–3 times a month	42 (15.73)	10 (10.75)	32 (18.39)		12 (11.88)	16 (20.51)	14 (15.91)		13 (19.70)	29 (14.43)	
1–3 times a week	14 (5.24)	6 (6.45)	8 (4.60)		1 (0.99)	4 (5.13)	9 (10.23)		2 (3.03)	12 (5.97)	
4–6 times a week	5 (1.87)	4 (4.30)	1 (0.57)		0 (0.00)	2 (2.56)	3 (3.41)		1 (1.52)	4 (1.99)	
Every day	2 (0.75)	0 (0.00)	2 (1.15)		1 (0.99)	1 (1.28)	0 (0.00)		1 (1.52)	1 (0.50)	
What is the place of eating plant-based meat substitutes? (n = 267)											
Restaurant	99 (37.08)	37 (39.78)	62 (35.63)	10.50 (0.062)	32 (31.68)[1)]	24 (30.77)	43 (48.86)	22.65 (< 0.001)	30 (45.45)[1)]	69 (34.33)	4.84 (0.436)
School or cafeteria	49 (18.35)	19 (20.43)	30 (17.24)		25 (24.75)	15 (19.23)	9 (10.23)		13 (19.70)	36 (17.91)	
Supermarkets or large mart	70 (26.22)	22 (23.66)	48 (27.59)		21 (20.79)	25 (32.05)	24 (27.27)		14 (21.21)	56 (27.86)	
Convenience store	10 (3.75)	7 (7.53)	3 (1.72)		8 (7.92)	0 (0.00)	2 (2.27)		3 (4.55)	7 (3.48)	
Online mall	24 (8.99)	6 (6.45)	18 (10.34)		8 (7.92)	9 (11.54)	7 (7.95)		3 (4.55)	21 (10.45)	
Others	15 (5.62)	2 (2.15)	13 (7.48)		7 (6.93)	5 (6.41)	3 (3.41)		3 (4.55)	12 (5.97)	
Why do you eat plant-based meat substitutes? (n = 267)											
Tasty good	15 (5.62)	4 (4.30)	11 (6.32)	9.81 (0.133)	4 (3.96)	8 (10.26)	3 (3.41)	40.08 (< 0.001)	8 (11.11)	7 (3.48)	10.99 (0.089)
Loving to try new food	97 (36.33)	40 (43.01)	57 (32.76)		43 (42.57)	31 (39.74)	23 (26.14)		25 (33.33)	72 (35.82)	
Nutritional excellence	29 (10.86)	5 (5.38)	24 (13.79)		4 (3.96)	9 (11.54)	16 (18.18)		7 (10.61)	22 (10.95)	
Environmentally friendly	48 (17.98)	18 (19.35)	30 (17.24)		16 (15.84)	13 (16.67)	19 (21.59)		10 (22.22)	38 (18.91)	
Helping animal welfare	28 (10.49)	6 (6.45)	22 (12.64)		18 (17.82)	6 (7.69)	4 (4.55)		5 (11.11)	23 (11.44)	
Prevention of diseases	21 (7.87)	7 (7.53)	14 (8.05)		2 (1.98)	5 (6.41)	14 (15.91)		2 (3.03)	19 (9.45)	
Others	29 (10.86)	13 (13.98)	16 (9.20)		14 (13.86)	6 (7.69)	9 (10.23)		9 (22.22)	20 (9.95)	
Why don't you eat plant-based meat substitutes?[1)] (n = 143)											
No opportunity to eat	88 (61.54)	33 (62.26)	55 (61.11)	9.04 (0.081)	44 (54.32)	19 (59.38)	25 (83.33)	9.58 (0.493)	35 (56.45)	53 (65.43)	2.44 (0.786)
Not sure about the benefits of eating it	17 (11.89)	6 (11.32)	11 (12.22)		11 (13.58)	4 (12.50)	2 (6.67)		9 (14.52)	8 (9.88)	
Not tasty good	25 (17.48)	13 (24.53)	12 (13.33)		17 (20.99)	5 (15.63)	3 (10.00)		12 (19.35)	13 (16.05)	
Expensive	4 (2.80)	0 (0.00)	4 (4.44)		3 (3.70)	1 (3.13)	0 (0.00)		1 (1.61)	3 (3.70)	
Doesn't like trying new foods	7 (4.90)	0 (0.00)	7 (7.78)		5 (6.17)	2 (6.25)	0 (0.00)		4 (6.45)	3 (3.70)	
Others	2 (1.40)	1 (1.89)	1 (1.12)		1 (1.23)	1 (3.13)	0 (0.00)		1 (1.61)	1 (1.23)	

n (%).

P-values were calculated using the χ^2 test.

[1)]*P*-values were determined by Fisher's exact test.

Table 4. Intention to consume plant-based meat substitutes among participants

Variable	Total (n = 410)	Sex		χ^2 (*P*-value)	Age (year)			χ^2 (*P*-value)	Interest in health		χ^2 (*P*-value)
		Male (n = 146)	Female (n = 264)		20–29 (n = 182)	30–49 (n = 110)	50–64 (n = 118)		No (n = 128)	Yes (n = 282)	
Are you willing to consume plant-based meat substitutes in the future?											
Yes	317 (77.32)	104 (71.23)	213 (80.68)	4.79 (0.986)	121 (66.48)	89 (80.91)	107 (90.68)	25.00 (< 0.001)	88 (68.75)	229 (81.21)	7.79 (0.005)
No	93 (24.68)	42 (28.77)	51 (19.32)		61 (33.52)	21 (19.09)	11 (9.32)		40 (31.25)	53 (18.79)	
If you buy plant-based meat substitutes, what is the most important factor?[1)]											
Taste	216 (52.68)	77 (52.74)	139 (52.65)	2.04 (0.986)	108 (59.34)	68 (61.82)	40 (33.90)	47.97 (< 0.001)	84 (65.63)	132 (46.81)	24.21 (< 0.001)
Price	30 (7.32)	10 (6.85)	20 (7.58)		21 (11.54)	4 (3.64)	5 (4.24)		11 (8.59)	19 (6.74)	
Nutrition	99 (24.15)	37 (25.34)	62 (23.48)		29 (15.93)	22 (20.00)	48 (40.68)		17 (13.28)	82 (29.08)	
Environment	26 (6.34)	10 (6.85)	16 (6.06)		13 (7.14)	4 (3.64)	9 (7.63)		10 (7.81)	16 (5.67)	
Brand	2 (0.49)	0 (0.00)	2 (0.76)		1 (0.55)	0 (0.00)	1 (0.85)		0 (0.00)	2 (0.71)	
Food material	36 (8.78)	12 (8.22)	24 (9.09)		9 (4.95)	12 (10.91)	15 (12.71)		5 (3.91)	31 (10.99)	
Convenience	1 (0.24)	0 (0.00)	1 (0.38)		1 (0.55)	0 (0.00)	0 (0.00)		1 (0.78)	0 (0.00)	
Others	0 (0.00)	0 (0.00)	0 (0.00)		0 (0.00)	0 (0.00)	0 (0.00)		0 (0.00)	0 (0.00)	
If you don't buy plant-based meat substitutes, what is the most important factor?											
Taste	197 (48.05)	79 (54.11)	118 (44.70)	11.86 (0.037)	89 (48.90)	60 (54.55)	48 (40.68)	29.71 (0.001)	75 (58.59)	122 (43.26)	13.01 (0.023)
Price	102 (24.88)	25 (17.12)	77 (29.17)		54 (29.67)	26 (23.64)	22 (18.64)		32 (25.00)	70 (24.82)	
Nutrition	58 (14.15)	25 (17.12)	33 (12.50)		20 (10.99)	10 (9.09)	28 (23.73)		9 (7.03)	49 (17.38)	
Environment	23 (5.61)	5 (3.42)	18 (6.82)		9 (4.95)	7 (6.36)	7 (5.93)		6 (4.69)	17 (6.03)	
Food allergy	25 (6.10)	9 (6.16)	16 (6.06)		10 (5.49)	7 (6.36)	8 (6.78)		5 (3.91)	20 (7.09)	
Others	5 (1.22)	3 (2.05)	2 (0.78)		0 (0.00)	0 (0.00)	5 (4.24)		1 (0.78)	4 (1.42)	

n (%).

P-values were determined by χ^2 test.

[1)]*P*-values were determined by Fisher's exact test.

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Table 5. Perception of plant-based meat substitutes according to characteristics of the study participants

Variable		Average	Question 1[1)]	Question 2	Question 3	Question 4	Question 5
	Total (n = 410)	3.82 ± 0.63	3.91 ± 0.81	4.07 ± 0.86	3.53 ± 0.94	3.90 ± 0.76	3.68 ± 0.92
Sex	Male (n = 146)	3.76 ± 0.70	3.85 ± 0.91	3.82 ± 1.03	3.55 ± 0.95	3.91 ± 0.72	3.67 ± 0.95
	Female (n = 264)	3.85 ± 0.59	3.94 ± 0.74	4.20 ± 0.73	3.51 ± 0.96	3.90 ± 0.79	3.69 ± 0.90
	t (*P*-value)[2)]	−1.27 (0.205)	−1.02 (0.308)	−3.94 (< 0.001)	0.41 (0.683)	0.12 (0.905)	−0.15 (0.880)
Age (year)	20–29 (n = 182)	3.73 ± 0.57[b3)]	3.85 ± 0.75[b]	4.02 ± 0.89	3.40 ± 0.91[b]	3.86 ± 0.75[b]	3.52 ± 0.91[b]
	30–49 (n = 110)	3.74 ± 0.71[b]	3.85 ± 0.84[b]	4.12 ± 0.83	3.39 ± 1.01[b]	3.79 ± 0.85[b]	3.57 ± 1.03[b]
	50–64 (n = 118)	4.02 ± 0.60[a]	4.06 ± 0.85[a]	4.08 ± 0.86[a]	3.86 ± 0.84[a]	4.08 ± 0.68[a]	4.03 ± 0.72[a]
	F (*P*-value)[4)]	9.06 (< 0.001)	2.97 (0.053)	0.46 (0.629)	11.02 (< 0.001)	4.54 (0.011)	12.44 (< 0.001)
Marital status	Single (n = 239)[5)]	3.71 ± 0.61	3.80 ± 0.80	4.03 ± 0.89	3.35 ± 0.96	3.84 ± 0.74	3.52 ± 0.92
	Married (n = 171)	3.96 ± 0.63	4.04 ± 0.80	4.11 ± 0.83	3.77 ± 0.85	3.99 ± 0.79	3.90 ± 0.87
	t (*P*-value)[2)]	−4.08 (< 0.001)	0.00 (< 0.001)	−0.90 (0.370)	−4.52 (< 0.001)	−2.01 (0.046)	−4.19 (< 0.001)
Job	Student (n = 97)	3.69 ± 0.59[b]	3.76 ± 0.81[b]	3.94 ± 0.97	3.37 ± 0.89[b]	3.87 ± 0.77	3.52 ± 0.84[bc]
	Office worker (n = 188)	3.82 ± 0.63[ab]	3.90 ± 0.81[ab]	4.13 ± 0.81	3.50 ± 0.96[ab]	3.86 ± 0.75	3.71 ± 0.89[ab]
	Self-employed (n = 52)	3.97 ± 0.68[a]	4.05 ± 0.85[ab]	4.13 ± 0.84	3.79 ± 0.94[a]	4.00 ± 0.77	3.88 ± 0.96[a]
	Homemaker (n = 43)	3.99 ± 0.70[a]	4.16 ± 0.75[a]	3.95 ± 0.97	3.84 ± 0.92[a]	4.07 ± 0.88	3.93 ± 1.01[a]
	Unemployed or other (n = 30)	3.68 ± 0.50[b]	3.77 ± 0.68[b]	4.10 ± 0.66	3.33 ± 0.84[b]	3.90 ± 0.66	3.30 ± 0.98[c]
	F (*P*-value)[4)]	3.00 (0.019)	2.57 (0.037)	1.09 (0.361)	3.26 (0.012)	0.91 (0.457)	3.66 (0.006)
Education	Below high school (n = 70)	3.92 ± 0.70[ab]	3.90 ± 0.87[ab]	4.10 ± 0.80[ab]	3.70 ± 0.92	4.00 ± 0.78	3.89 ± 0.86[a]
	College or university (n = 257)	3.75 ±0.59[b]	3.84 ± 0.81[b]	3.98 ± 0.90[b]	3.46 ± 0.93	3.87 ± 0.72	3.60 ± 0.93[b]
	Graduate school or above (n = 83)	3.94 ± 0.66[a]	4.11 ± 0.72[a]	4.29 ± 0.77[a]	3.61 ± 0.96	3.93 ± 0.88	3.77 ± 0.90[ab]
	F (*P*-value)[4)]	4.02 (0.019)	3.40 (0.034)	4.03 (0.019)	2.30 (0.101)	0.82 (0.441)	3.29 (0.038)
Interest in health	No (n = 128)	3.76 ± 0.64	3.91 ± 0.71	4.02 ± 0.86	3.50 ± 0.88	3.74 ± 0.84	3.64 ± 0.96
	Yes (n = 282)	3.84 ± 0.62	3.90 ± 0.85	4.09 ± 0.86	3.54 ± 0.97	3.98 ± 0.72	3.70 ± 0.90
	t (*P*-value)[2)]	−1.19 (0.234)	0.12 (0.902)	−0.79 (0.428)	−0.42 (0.672)	−2.75 (0.006)	−0.59 (0.555)

Mean ± SD.

[1)]Question 1: Plant-based meat substitutes are eco-friendly. Question 2: Plant-based meat substitutes help animal welfare. Question 3: Plant-based meat substitutes are nutritionally excellent. Question 4: Plant-based meat substitutes can obtain sufficient dietary fiber. Question 5: Plant-based meat substitutes can obtain sufficient protein.

[2)]*P*-values were determined by unpaired t-test.

[3)]Values with different alphabets (a, b, c) within a column are significantly different by Duncan' multiple range test ($P < 0.05$).

[4)]*P*-values were determined by one-way analysis of variance (ANOVA).

[5)]Including divorce and bereavement.

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렇지 않은 대상자보다 유의하게 높았으며(3.90점 vs. 3.75점, $P < 0.05$), 외식을 자주 하지 않는 대상자가 자주 하는 대상자보다 유의적으로 높았다(3.89점 vs. 3.69점, $P < 0.01$).

DISCUSSION

본 연구에서 식물성 육류 대체식품에 대한 소비자 경험, 섭취 실태, 구매 및 섭취 의사, 인식도를 조사하고 소비자 특성에 따른 차이를 평가하였다. 본 연구에서 식물성 육류 대체식품에 대해 들어본 경험이 84.39%로, 건강에 관심 있는 대상자가 더 높아 건강에 대한 관심도와 식물성 육류 대체식품에 대한 경험 간에 긍정적인 관련성이 있음을 시사한다. 본 연구대상자들은 주로 대중매체와 SNS를 통해 식물성 육류 대체식품을 접하는 것으로 나타났다. 한국농수산식품유통공사의 식육가공품 소비행태조사[16]에서 전체 500명의 대상자 중 대체육을 인지하고 있는 비율은 56.2%로 나타나서 본 연구보다 낮은 과반 정도의 소비자가 식물성 육류 대체식품에 대해 인지하고 있음을 알 수 있다. 이 조사에서 식물성 육류 대체식품을 들어본 경로는 주로 신문/인터넷 기사(32.0%), TV/유튜브(19.6%), TV/포털사이트/유튜브 등의 광고(18.5%)로 대중매체와 SNS가 주요 정보 경로로 나타났다. 이러한 결과를 고려할 때, 다양한 특성의 소비자를 겨냥한 정보 전달 매체가 식물성 육류 대체식품의 경험과 소비를 촉진하는 데 중요한 역할을 할 것으로 보인다.

본 연구에서 식물성 육류 대체식품의 섭취 장소는 30–49세가 슈퍼마켓이나 대형마트를 통한 섭취 비율이 높았는데, 이는 이 연령대가 경제활동이 활발한 시기로 안정된 구매력을 바탕으로 식물성 육류 대체식품을 선택할 여건을 갖추고 있기 때문으로 해석할 수 있다. 식물성 육류 대체식품 섭취 이유는 20–29세에서 새로운 음식을 시도하는 것을 선호하는 비율이 42.57%로 가장 높았다. Knaapila 등[17]은 핀란드 20–39세 젊은 세대의 약 41%가 식물성 육류 대체식품을 정기적으로 섭취하고 있으며, 43%는 섭취를 시도한 적이 있다고 보고하였다. Michel 등[18]은 유럽 소비자들의 식물성 육류 대체식품에 대한 소비 동기를 분석했을 때, 식물성 육류 대체식품의 주된 소비 동기는 건강과 환경의 문제로부터 비롯되었으며, 특히 젊은 세대에서 높은 관심을 보였다고 하였다. 이러한 결과들을 통해 젊은 층이 변화에 대한 수용성과 새로운 식품에 대한 개방성이 더 크다는 것을 알 수 있다. 한편, 본 연구에서 식물성 육류 대체식품을 섭취하지 않는 이유는 섭취할 기회가 없어서가 61.54%로 가장 높았는데, 한국농수산식품유통공사 조사에서는 대체육을 알고 있으나 구입하지 않은 이유로 구입할 수 있는 곳이 많지 않아서라는 응답(47.9%)이 가장 높게 보고되었다[12]. 이는 섭취 기회의 부족이 주요 장벽으로 작용하고 있음을 보여준다. 이러한 연구 결과를 통해 식물성 육류 대체식품이 건강을 중시하는 소비자들 사이에서 주목받고 있음을 확인하였으나, 실제 섭취 빈도는 낮아 섭취 기회와 소비 확대를 위한 식품 접근성의 개선이 필요할 것으로 보인다.

본 연구에서 나이가 많을수록 식물성 육류 대체식품의 이용의사가 높았고 건강 관심이 있는 대상자가 높았다. Grasso 등[19]은 65세 이상 노인 1,825명을 대상으로 식물성 단백질의 수용성을 조사했을 때, 전체 대상자의 58%가 식물성 단백질을 이용할 의사를 보여 높은 수준이라고 보고하였다. 이는 고령층에서 식물성 단백질 및 육류 대체식품에 대한 친숙함과 높은 건강상의 긍정적 인식과 관련이 있을 것으로 보인다. 즉 고령층은 건강 유지와 영양 충족을 위해 식물성 단백질을 포함한 대체식품에 대한 긍정적인 태도가 반영된 것으로 해석할 수 있을 것이다. 따라서 고령층의 생리적인 특성을 반영하고 영양 요구를 충족할 수 있는 식물성 육류 대체식품의 지속적인 개발과 함께 건강에 미치는 이점을 강조하는 마케팅 전략이 필요하다고 생각한다.

본 연구에서 식물성 육류 대체식품 구매 시 가장 중요하게 생각하는 요인은 맛(52.68%)이었으며, 구매하지 않는 가장 중요한 요인도 맛(48.05%)이었다. 이를 통해 소비자들은 식물성 육류 대체식품을 구매하거나 구매하지 않는 요인으로 맛을 가장 중요 시 한다는 것을 알 수 있다. 나이에 따라 영양을 중요시하는 비율이 20–29세 15.93%, 30–39세 20.00%, 50–64세 40.68%였으며 건강 관심이 있는 대상자에서 높게 나타나 나이가 많을수록 건강에 대한 관심이 커지면서 영양적 가치를 더 중요시한다는 가능성을 생각해볼 수 있을 것이다. 또한 구매하지 않을 때 여자가 남자보다 가격을 중요시하는 경향을 보였는데, 이는 가정 내에서 식재료 구매를 주도하는 여성들이 경제성을 더 고려하는 소비 성향이 반영된 것으로 해석할 수 있다. Han 등[13]은 소비자가 콩고기를 구매할 때 가장 중요하게 고려하는 요인으로 맛(46.9%)이 가장 높았으며, 콩고기를 구매할 의향이 없는 소비자의 가장 큰 요인도 역시 맛과 식감 부족(68.1%)이 가장 높다고 하였다. Hoek 등[9]은 네덜란드 소비자들의 육류 대체식품 소비를 조사한 결과 식물성 육류 대체식품 선택 시 소비자들은 맛, 텍스처, 가격이 중요한 요인이라고 평가하였으며, 이 세 가지 요소의 개선이 필요하다고 보고하였다. 이러한 결과를 종합할 때 맛은 소비자의 요구가 높은 요인이지만 식물성 육류 대체식품 구매의 장애물로도 작용하므로 대체육 제품의 시장 확장에 맛의 개선이 중요한 역할을 할 것으로 보인다. 따라서 식물성 육류 대체식품의 맛과 식감을 개선한 제품 개발이 이루어져야 할 것이다.

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Table 6. Perception of plant-based meat substitutes according to eating habits of the study participants

Variable		Average	Question 1[1)]	Question 2	Question 3	Question 4	Question 5
Irregular mealtimes	Yes (n = 182)	3.90 ± 0.62	4.01 ± 0.69	4.04 ± 0.86	3.67 ± 0.93	3.95 ± 0.76	3.82 ± 0.88
	No (n = 228)	3.75 ± 0.63	3.82 ± 0.88	4.09 ± 0.87	3.42 ± 0.93	3.87 ± 0.77	3.57 ± 0.93
	t (*P*-value)[2)]	−2.28 (0.023)	−2.40 (0.017)	0.57 (0.567)	−2.73 (0.007)	−0.95 (0.343)	−2.74 (0.006)
Imbalanced diet	Yes (n = 64)	3.85 ± 0.48	3.91 ± 0.75	4.14 ± 0.89	3.58 ± 0.77	3.88 ± 0.58	3.75 ± 0.73
	No (n = 346)	3.81 ± 0.65	3.91 ±0.82	4.05 ± 0.86	3.52 ± 0.97	3.91 ± 0.80	3.67 ± 0.95
	t (*P*-value)[2)]	−0.55 (0.584)	0.01 (0. 991)	−0.75 (0.452)	−0.53 (0.599)	0.42 (0.674)	−0.78 (0.435)
Overeating	Yes (n = 118)	3.84 ± 0.55	3.92 ± 0.71	4.07 ± 0.75	3.55 ± 0.86	3.90 ± 0.78	3.78 ± 0.76
	No (n = 292)	3.81 ± 0.66	3.90 ± 0.85	4.07 ± 0.91	3.52 ± 0.97	3.91 ± 0.76	3.64 ± 0.97
	t (*P*-value)[2)]	−0.58 (0.560)	−0.28 (0.778)	−0.03 (0.975)	−0.29 (0.768)	0.11 (0.912)	−1.54 (0.125)
Dining out (incl. delivery)	Yes (n = 146)	3.69 ± 0.62	3.84 ± 0.77	4.02 ± 0.85	3.39 ± 0.91	3.77 ± 0.77	3.43 ± 0.95
	No (n = 264)	3.89 ± 0.63	3.95 ± 0.83	4.09 ± 0.87	3.61 ± 0.95	3.98 ± 0.75	3.82 ± 0.87
	t (*P*-value)[2)]	3.10 (0.002)	1.34 (0.181)	0.79 (0.430)	2.23 (0.026)	2.73 (0.007)	4.16 (< 0.001)
Consumption of instant food	Yes (n =107)	3.74 ± 0.56	3.97 ± 0.73	4.11 ± 0.76	3.31 ± 0.82	3.78 ± 0.77	3.53 ± 0.88
	No (n = 3 03)	3.84 ± 0.65	3.88 ± 0.83	4.05 ± 0.90	3.61 ± 0.97	3.95 ± 0.76	3.73 ± 0.93
	t (*P*-value)[2)]	1.48 (0.140)	−0.96 (0.336)	-0.70 (0.485)	3.09 (0.002)	2.04 (0.042)	1.94 (0.053)
Skipping meals	Yes (n = 44)	3.65 ± 0.70	3.70 ± 0.90	3.89 ± 1.06	3.30 ± 1.00	3.86 ± 0.82	3.50 ± 0.93
	No (n = 366)	3.84 ± 0.62	3.93 ± 0.79	4.09 ± 0.84	3.56 ± 0.93	3.91 ± 0.76	3.70 ± 0.92
	t (*P*-value)[2)]	1.87 (0.062)	1.77 (0.078)	1.21 (0.231)	1.75 (0.081)	0.38 (0.706)	1.38 (0.168)
Eating salty	Yes (n = 103)	3.82 ± 0.64	3.98 ± 0.83	4.09 ± 0.86	3.50 ± 1.03	3.90 ± 0.68	3.61 ± 1.02
	No (n = 307)	3.82 ± 0.63	3.88 ± 0.80	4.06 ± 0.86	3.54 ± 0.91	3.91 ± 0.79	3.70 ± 0.88
	t (*P*-value)[2)]	0.04 (0.970)	−1.06 (0.288)	−0.29 (0.771)	0.42 (0.671)	0.03 (0.976)	0.88 (0.380)
Vegetarianism	Yes (n = 31)	3.95 ± 0.78	3.97 ± 0.98	4.13 ± 1.15	3.74 ± 1.06	4.06 ± 0.85	3.87 ± 0.96
	No (n = 379)	3.81 ± 0.62	3.90 ± 0.79	4.06 ± 0.84	3.51 ± 0.93	3.89 ± 0.76	3.66 ± 0.91
	t (*P*-value)[2)]	−1.26 (0.208)	−0.43 (0.665)	−0.32 (0.748)	−1.3 1(0.191)	−1.21 (0.227)	−1.20 (0.230)

Mean ± SD.

[1)]Question 1: Plant-based meat substitutes are eco-friendly. Question 2: Plant-based meat substitutes help animal welfare. Question 3: Plant-based meat substitutes are nutritionally excellent. Question 4: Plant-based meat substitutes can obtain sufficient dietary fiber. Question 5: Plant-based meat substitutes can obtain sufficient protein.

[2)]*P*-values were determined by unpaired t-test.

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본 연구에서 전체 대상자의 식물성 육류 대체식품에 대한 인식도는 5점 만점에 3.82점으로 보통 이상으로 인식하고 있는 것으로 나타났다. 식물성 육류 대체식품의 인식도는 조사대상자의 나이, 결혼 유무, 직업, 교육 수준에 따라 유의한 차이를 보여 50–64세, 기혼자, 주부, 대학원 재학 또는 졸업이 가장 높았다. 인식도의 세부 항목별로 보면 '식물성 육류 대체식품은 친환경적이다'는 기혼자, 주부, 대학원 졸업자가 높았으며, '식물성 육류 대체식품은 동물복지에 도움을 준다'는 여자와 대학원 졸업자가, '식물성 육류 대체식품은 영양적으로 우수하다'는 50–64세, 기혼자, 주부가 높은 점수를 보였다. 또한 '식물성 육류 대체식품을 통해 충분한 식이섬유소를 얻을 수 있다'는 50–64세, 기혼자가, '식물성 육류 대체식품을 통해 충분한 단백질을 얻을 수 있다'는 50–64세, 기혼자, 주부에서 높았다. Estell 등[11]은 소비자와 영양 전문가의 식물성 육류 대체식품에 대한 태도와 인식을 분석했을 때, 전체 응답자의 56.4%가 식물성 대체육 섭취가 좋은 영양 섭취를 촉진하고 환경친화적이라고 하였으며, 영양 전문가의 74.2%가 식물성 대체육 섭취를 통해 높은 식이섬유를 얻을 수 있다고 인식하는 것을 보고하였다. Siegrist와 Hartmann [20]은 나이, 성별, 교육 수준이 식물성 육류 대체식품 소비와 관련성이 있으며, 여성, 젊은 나이, 높은 교육 수준을 가진 사람들이 식물성 육류 대체식품에 대한 긍정적인 인식이 높아 이러한 제품을 섭취할 가능성이 높다고 보고하였다. 이는 본 연구 결과와 유사하지만 젊은 층보다 고령층의 인식이 더 높다는 점에서 차이를 보였다. 본 연구 결과는 나이가 많을수록 식품에 대한 경험과 신뢰가 쌓여 대체식품에 대한 긍정적인 태도가 형성될 수 있고, 과거보다 다양한 식품을 접할 기회가 많아지면서 새로운 식습관을 수용하려는 경향이 반영된 결과로 해석할 수 있을 것이다[21, 22]. 앞으로 식물성 육류 대체식품의 인식과 소비를 확산하기 위해서는 다양한 연령대와 생활 방식에 적합한 교육과 홍보 활동이 필요할 것으로 보인다.

본 연구에서 조사대상자의 식습관에 따라 식물성 육류 대체식품에 대한 인식도를 비교하였을 때, 식사시간이 불규칙하거나 잦은 외식을 하지 않는 대상자가 각각 3.90점, 3.89점으로 가장 높았으며, 특히 '식물성 육류 대체식품은 친환경적이다', '식물성 육류 대체식품은 영양적으로 우수하다', '식물성 육류 대체식품을 통해 충분한 식이섬유소를 얻을 수 있다', '식물성 육류 대체식품을 통해 충분한 단백질을 얻을 수 있다'에 긍정적인 인식을 보였다. 이는 불규칙한 식사 습관이 간편하면서도 건강을 고려한 다양한 식품을 선택하게 되고, 외식을 피하는 사람들이 식품의 성분과 영양정보를 더욱 중요하게 생각해서 나타난 결과로 해석할 수 있을 것이다. Contini 등[23]은 이탈리아 소비자 600명의 70%가 건강한 식단을 유지하기 위해 식물성 즉석조리식품의 선택을 고려하고, 시간 압박이 식물성 즉석조리식품 선택에 직접적인 영향을 준다고 하였다. 앞으로 식물성 육류 대체식품이 다양한 식습관을 가진 소비자들에게 적합하며 건강하고 실용적인 선택지로 자리 잡기 위해서는 건강 지향적인 소비자층을 대상으로 한 홍보전략과 제품 개발을 강화하는 것이 필요할 것으로 보인다.

이상의 본 연구의 주요 결과들은 기존 연구[11, 19]에서 보고된 바와 같이, 연령 증가와 건강 관심이 식물성 육류 대체식품에 대한 긍정적 태도와 연관된다는 점과 일치한다. 특히 젊은 층은 새로운 음식에 대한 개방성, 고령층은 건강과 영양적 가치 중심의 소비태도를 보여 식물성 육류 대체식품에 대한 소비 동기가 연령대에 따라 다르며, 대중매체와 SNS가 주요 정보 경로로 작용하여 정보 확산력이 소비자 인식과 소비에 영향을 준다는 점을 확인할 수 있었다. 대체육 시장과 소비자 층이 확대되고 있는 상황[3, 4]에서 향후 제품 개발 및 홍보 전략은 미래의 젊은 소비자의 특성과 평균수명 증가로 인한 고령 소비자의 특성을 반영해야 할 것이다.

Limitations

본 연구는 몇 가지 제한점을 가지고 있다. 첫째, 눈덩이 표집을 통한 온라인 설문조사 방식으로 참여자를 모집하였기 때문에 일부 소비자들의 특성에 따라 식물성 육류 대체식품의 인식, 구매 및 섭취실태를 평가한 본 연구 결과를 전체 소비자로 일반화하는 데 한계가 있을 것이다. 둘째, 식물성 육류 대체식품의 인식도를 평가하고 관련 요인을 분석하는 데 있어 조사대상자의 다양한 특성을 조사 및 통제하지 못한 한계점을 가지고 있다. 마지막으로, 본 연구는 설문조사에 의한 횡단연구로 식물성 육류 대체식품의 인식도와 관련 요인 간의 인과관계를 설명할 수 없는 한계가 있다. 이와 같은 제한점에도 불구하고 본 연구는 식물성 육류 대체식품에 대한 소비자 인식, 경험 및 소비 실태와 소비자 특성에 따른 인식도의 차이를 분석함으로써 식물성 육류 대체식품 개발과 관련 산업에 활용될 수 있는 결과를 제시하였다는 점에서 의의가 있다. 앞으로 본 연구의 제한점을 보완하여 큰 소비자 집단에서 다양한 특성을 고려하고 관련 요인과의 인과관계를 설명할 수 있는 후속 연구들이 이루어져야 할 것이다.

Conclusion

본 연구에서 식물성 육류 대체식품에 대한 인식은 소비자의 생활 패턴, 건강 관심도, 연령에 따라 다르며, 이러한 소비자 니즈를 고려한 맞춤형 제품 개발의 접근이 필요하다는 것을 제시하였다. 본 연구 결과는 식물성 육류 대체식품에 대한 소비자의 제품 선택 및 생산자의 제품 개발에 활용될 수 있으며, 앞으로

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식물성 육류 대체식품의 특성을 직접적으로 평가하는 연구로 확대되어야 할 것이다.

CONFLICT OF INTEREST

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

FUNDING

None.

DATA AVAILABILITY

Research data is available upon request to the corresponding author.

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

4) Abstract: A structured abstract of 250~300 words must be written in English under the following headings: Objectives, Methods, Results, and Conclusion. Abstracts should be accompanied by keywords in English.

5) Keywords: A Three to five keywords are recommended with one or two words except for technical terms. The terminology should be listed, in principle, in MeSH (www.nlm.nih.gov/mesh/MBrowser.html). Keywords are written in lowercase letters except for proper nouns,

and keywords are separated by a semicolon (;).

6) **Abbreviations:** All abbreviations must be defined in parentheses at first mention in the text. Abbreviations used in a table or figure should be defined in their respective table footnote or figure legend.

7) **Numbers and measurements:** Numbers should be presented in Arabic numerals. For most measurements, the International System of Units (SI) is recommended. The unit symbol should be placed after the numerical value and a space should be left between the numerical value and the unit symbol except %, ˚C.

8) **References**

- References should be numbered consecutively in the order in which they appear in the text using Arabic numerals in brackets.
- When more than one reference is cited at the same point in the text, they are included in the same bracket as below.

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

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

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

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

(1) Journal articles

① *Published journal articles*

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

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

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

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

② *Forthcoming journal articles*

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

<Example> Kim YS, Lee HM, Kim JH. Sodium-related eating behaviors of parents and its relationship to eating behaviors of their preschool children. Korean J Community Nutr 2015. Forthcoming.

(2) Books

① *Entire books*

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

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

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

② *Book chapter*

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

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

③ *Translated books*

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

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

(3) Scientific reports

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

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

(4) Thesis and dissertaion

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

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

(5) Conference papers

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

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

(6) Articles in magazine or newspaper

① *Magazine articles*

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

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

② *Newspaper articles*

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

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

(7) Materials on the internet

① *Web sites*

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

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

② *Web page*

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

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

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

9. PUBLICATION

Once the review process is completed, the manuscript cannot undergo any modifications in their contents or changes of the authors. PDF page proofs will be emailed

to the corresponding author and should be returned within 3 days. The author pays the publication fee for the published paper, including manuscript editing fees, reference proofreading fees, and file processing fees. Authors who choose to withdraw a manuscript after it has undergone peer-review will be charged the review fee.

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.

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Author(s): _____

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투고규정

KJCN
Korean Journal of Community Nutrition

(2024년 10월 15일 개정)

1. 학회지의 특성

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

2. 투고 자격

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

3. 원고의 종류

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

4. 연구 및 출판윤리

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

5. 성(SEX)/젠더(GENDER)에 대한 고려

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

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

6. 논문투고

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

7. 전문가 심사

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

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

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.

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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.

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- 연구지원내역(Funding)

  해당하는 내용이 없더라도 'None.' 으로 기재한다.

〈예〉

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3) 원고의 구성: 원고의 부제목은 모두 영문으로 작성하고, 구성은 다음과 같다. Title page, Abstract, Introduction, Methods, Results, Discussion, 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 띄어쓴다.
8) **참고문헌**
• 본문 중에는 인용된 순서대로 [ ] 안에 번호로 기재한다.
• 본문의 한 문장에서 여러 개의 참고문헌을 인용할 때에는 다음과 같이 기재한다.

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

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

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

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

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9) 표 또는 그림

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

9. 출판

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

논문투고와 출판 관련 모든 문의사항은 편집사무실로 연락한다.

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대한지역사회영양학회지 연구윤리규정

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

제1장 총칙

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

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

제2장 연구자의 윤리규정

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

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

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

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

제7조 (출판 업적의 명기)

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

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

제8조 (인용 및 참고 표시)

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

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

제9조 (논문 편집위원회의 역할및 윤리)

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

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

제10조 (논문 심사위원의 역할및 윤리)

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

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

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

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

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

제3장 연구윤리위원회의 설치와 운영

제11조 (위원회의 기능)

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

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

제12조 (위원회의 구성)

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

제13조 (연구부정행위의 제보 및 접수)

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

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

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

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

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

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

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

자가점검표

(2024년 10월 15일 개정)

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

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

(continued to the next page)

(Continued)

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