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Original Research

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The level of food literacy and its association with food intake and obesity status among Seoul citizens: results from Seoul Food Survey 2021

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ABSTRACT

BACKGROUND/OBJECTIVES: Food literacy (FL) is a crucial skill for selecting sustainable and healthy food options, necessitating the identification of vulnerable groups in the community using valid measurement tools. Identifying weak domains in FL is essential for enhancing the overall FL. This study examined the FL levels of Seoul citizens based on their sociodemographic characteristics and assessed the relationship between FL, food intake, and weight status.
SUBJECTS/METHODS: This study utilized the data from the Seoul Food Survey, a cross-sectional study employing representative samples of Seoul citizens. Data collection occurred from September to October 2021, with 4,039 citizens aged 18 yrs and above participating in face-to-face surveys. Thirty-three FL items were assessed, comprising 14 items in the nutrition and safety (NS) domain, eight items in the cultural and relational (CR) domain, and 11 items in the socio-ecological (SE) domain. In addition, data on food intake sufficiency and obesity status were collected. The descriptive statistics, *t*-tests, analysis of variance, and logistic regression analysis were used for analysis.
RESULTS: Men, students, young adults, older citizens, and people experiencing food insecurity had the lowest scores for all the FL domains. The highest quartile group of NS scores had a higher probability of consuming adequate servings of vegetables and fruits, with significant linear trends observed (P for trend < 0.05). In all three FL domains, the odds ratio for obesity was significantly lower in the groups with high FL scores (P < 0.05).
CONCLUSIONS: A close relationship was observed between low FL, obesity, and food intake, even after controlling for other covariates. Vulnerable groups with low FL were also identified. Therefore, it is essential to develop programs to improve FL and the health and well-being of these groups.

Keywords: Food; literacy; food intake; obesity; Seoul; Republic of Korea

INTRODUCTION

Food literacy (FL) refers to the capability to understand and use various food-related information while considering the impact of food choices on health and society [1,2].

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Conflict of Interest

The authors declare no potential conflicts of interests.

Author Contributions

Conceptualization: Yoo H, Jo E, Lee H, Ko E, Jang E, Sim J, Kim K, Park S; Formal analysis: Yoo H, Park S; Methodology: Yoo H, Kim K, Park S; Supervision: Park S; Validation: Kim K and Park S; Writing - original draft: Yoo H, Park S; Writing - review & editing: Yoo H, Jo E, Lee H, Ko E, Jang E, Sim J, Kim K, Park S.

Previous studies on FL have focused on the functional aspects of an individual's food consumption and intake. The FL assessment tool mainly assesses the functional aspects of FL but does not include food competency related to community, society, and ecology for a sustainable diet. Therefore, the authors proposed a broader definition of FL that encompasses an understanding of the cultural values of foods and making food choices that consider the community, society, and environment for sustainable diets and happier life. Three main domains were proposed: nutrition and safety FL, cultural and relational FL, and socio-ecological FL, and the FL assessment tool consisting of 33 items was developed [3].

Previous research suggested that healthy eating helps maintain well-being and happiness [4-6], highlighting FL as crucial for achieving a happier and healthier dietary life [7,8]. Individuals with higher FL are more likely to eat breakfast, have regular meals, and consume fewer foods high in salt and sugar [9,10]. Conversely, those with lower FL are more likely to consume inadequate amounts of fruits and vegetables and drink beverages high in sugar [11] and have a higher likelihood of experiencing food insecurity [12]. Similarly, FL facilitates better food choices for a healthier and more sustainable diet [13] and is significantly associated with the health indices, food security, and healthy eating [12-14].

As the importance of FL continues to grow, various tools for measuring FL are being developed worldwide [15-19]. Previous FL measuring tools vary considerably in terms of the number of domains, item content, total score, and measurement scales [19]. For example, Krause *et al.* [17] developed a tool comprising 16 items that assess functional, interactive, and critical FL components. Each item was scored on a 4- or 5-point Likert scale, resulting in a total score ranging from 7 to 52 points. Similarly, Palumbo *et al.* [20] developed a tool consisting of 47 items across three domains: plan and manage FL; select and choose FL; and prepare and consume FL. In this scale, each item was scored on a 4-point Likert scale, with a total score ranging from 0 to 50 points. Palumbo *et al.* [14] assessed the level of FL by developing a measurement tool for Italians. They reported that the elderly, individuals with lower education levels, and those with lower economic statuses tended to have lower FL, and individuals with lower FL were more likely to have poorer health conditions.

Therefore, it is crucial to identify vulnerable groups in terms of FL using the FL assessment tool [11] and identify the specific weak domains within the three main domains to improve FL. Accordingly, the aims of this study were 1) to identify the vulnerable groups of FL according to their sociodemographic characteristics by examining FL of Seoul citizens and 2) to assess the association between FL and food intake sufficiency and obesity status.

SUBJECTS AND METHODS

Study design and data collection procedure

This study utilized the 2021 Seoul Food Survey data to assess FL and food consumption and obesity among Seoul citizens. Stratified and multistage clustered probability sampling was used to select 4,039 respondents aged 18 and older. Data were collected from September 13 to October 29, 2021, through questionnaires conducted by trained data collectors from K-Stat, a survey company. Data collectors visited households selected for the sample, and all participants received local gift certificates as compensation for participating in the survey. Written consent was gained from all participants, and the Dankook University Institute Review Board approved this study protocol (DKU 2020-01-006).

Measures

Sociodemographic characteristics, weight status, and food security status of Seoul citizens

This study assessed the sociodemographic factors, including gender, age, education attainment, household type, occupation, employment type, monthly household income, subjective social class, and food security status. These variables were reclassified for more appropriate statistical analysis. For example, participants were divided into six age groups: 18–29, 30–39, 40–49, 50–59, 60–69, and 70+ yrs. Education attainment was classified into three groups: less than high school, high school graduates, and more than college entrance. The household type was categorized as one-person households, households with couples, and households with 2 generations. Food security was determined using the responses to dietary situation questions, classifying participants into "Quantity and quality sufficient," "Quantity sufficient but not quality," or "Quantity and quality insufficient." Body mass index (BMI) was calculated based on the self-reported height and weight, categorizing individuals as underweight (< 18.5 kg/m^2), normal (18.5–22.9 kg/m^2), overweight (23–24.9 kg/m^2), and obese (≥ 25 kg/m^2) [21].

FL

FL was assessed using three main domains comprised of 33 items. The first domain, nutrition and safety FL, included 14 questions evaluating the ability to acquire, understand, and apply food and nutrition knowledge. The second domain, cultural and relational FL, consisted of 8 items examining the relationship between individuals and food, attitudes towards food-related relationships, and understanding of community and food culture. The third domain, socio-ecological FL, encompassed 11 items assessing environmental and food sustainability, and social and ecological consequences related to food, such as food inequality, urban and rural disparities, and ethical consumption (e.g., animal welfare and fair trade). The items were rated on a 5-point Likert scale, ranging from "Strongly disagree" to "Strongly agree." The FL scale was validated and assessed for reliability with further details on the questionnaire in the cited literature [3].

Simple food frequency survey

A simple food frequency questionnaire was used to assess the mean frequency of consumption for the main food groups. The food groups examined were whole grains, raw vegetables, vegetable side dishes, kimchi and pickles, meats (grilled, fried, stew, and soup), processed meat, fish, eggs, beans, fresh fruits, milk, and instant foods. The participants selected nine options, ranging from "less than once a month" to "more than three times a day." Furthermore, sugar-sweetened beverages, instant noodles, fast food, and alcoholic beverages were investigated, with 5 choices ranging from "I rarely eat" to "I eat at least once a day." For the analysis, food groups were reclassified into similar categories: whole grains, proteins, total vegetables, vegetables excluding kimchi and pickles, sugar-sweetened beverages, instant noodles, and fast food.

Statistical analysis

This study determined the representative values for Seoul citizens by applying individual sampling weights to all analyses. The FL levels were derived from responses to 3 FL domains, with scores generated through descriptive statistics and logistic regression analysis. The FL scores were analyzed in relation to the sociodemographic factors, with a perfect score of 100 points. Each item across FL domains was rated on a 5-point Likert scale, ranging from 0 to 4 points. The total score was obtained by summing all items, and average FL scores were calculated in each domain by dividing the sum of scores by the number of questions,

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then multiplying the result by 25 to achieve a perfect score of 100. The total FL scores were calculated by summing the three main domain scores and dividing by three. These FL scores in different sociodemographic groups were tested for statistical significance using t-test and analysis of variance (ANOVA) tests.

Multiple logistic regression analysis assessed the association between FL and recommended food intake sufficiency and obesity factors after controlling for various sociodemographic factors. According to the nutrient intake criteria among Koreans, consumption frequency was as follows: whole grains ≥ once/day, proteins ≥ 5 times/day for men and ≥ 4 times/day for women, total vegetables ≥ 7 times/day, vegetables excluding kimchi and pickles, and fruit ≥ 3 times/day for men and ≥ twice/day for women [22]. No recommended intake standards existed for sugar-sweetened beverages, instant noodles, and fast food. Therefore, the response distributions were examined, and a reference intake of fewer than three times a week was established, considering an eating frequency of once every 2 days. The obesity status was analyzed based on a BMI of 25 kg/m^2 or more. The FL scores were divided into quartiles (Q1–Q4). The multicollinearity was identified by calculating the variance inflation factor (VIF) values. All VIF values in the regression analysis model did not exceed 2. Statistical significance was set to $P < 0.05$, and all statistical analyses were conducted using STATA/SE 17.0 (StataCorp LLC, College Station, TX, USA).

RESULTS

Sociodemographic characteristics, weight status, and food security status of Seoul Food Survey participants

Table 1 lists the sociodemographic characteristics, weight status, and food security status of the participants in the 2021 Seoul Food Survey. A total of 4,039 subjects participated in the survey, with 48.1% being men and 51.9% women. The study population was distributed evenly across all age groups, ranging from 18 to 70 yrs old. The weight status was categorized as normal for 55.0% of participants, overweight for 28.9%, obese for 13.7%, and underweight for 2.4%. In terms of the monthly household income, the largest percentage (27.7%) fell within the 5–7 million KRW range, while the smallest proportion (9.6%) fell within the < 2 million KRW range. The food security status indicated that 79.4% of respondents reported quantity and quality sufficient, 16.2% reported quantity sufficient but not quality, and 4.4% reported quantity and quality insufficient.

FL scores according to sociodemographic characteristics

Table 2 lists the FL scores converted to a 100-point scale for the three FL domains and the total FL levels according to sociodemographic characteristics. The mean score for nutrition and safety FL was 62.0 points. The score was significantly higher in women (66.9 points) compared to men (56.7 points) ($P < 0.001$). The age group with the lowest FL scores was 18–29 yrs (57.4 points), and the highest was 40–49 yrs (64.9 points) ($P < 0.001$). One-person households had the highest FL score (63.1 points) ($P = 0.008$). FL scores varied significantly by occupation, with the highest scores observed among housewives (69.3 points) and the lowest among students (53.5 points) ($P < 0.001$). In terms of the food security status, the score was highest in the quantity and quality sufficient group (63.3 points) and lowest in the quantity and quality insufficient group (54.8 points) ($P < 0.001$).

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Table 1. Sociodemographic characteristics, weight status, and food security status of the study population, 2021 Seoul Food Survey

Characteristics	Participant (%)
Total	4,039 (100.0)
Gender	
Men	1,943 (48.1)
Women	2,096 (51.9)
Age groups	
18–29	805 (19.9)
30–39	705 (17.5)
40–49	721 (17.9)
50–59	726 (18.0)
60–69	752 (18.6)
≥ 70	329 (8.2)
Education attainments	
Less than high school	403 (10.0)
High school graduates	1,173 (29.0)
More than college entrance	2,463 (61.0)
Weight status*	
Underweight	95 (2.4)
Normal	2,221 (55.0)
Overweight	1,169 (28.9)
Obese	554 (13.7)
Household types	
One person households	724 (17.9)
Households with couples	967 (24.0)
Households with 2 generations	2,263 (56.0)
Others	85 (2.1)
Occupations	
Professionals	1,416 (35.1)
Service/sales	976 (24.2)
Manual workers	401 (9.9)
Students	324 (8.0)
Housewives	742 (18.4)
Unemployed	180 (4.5)
Type of employment	
Wage workers (permanent position)	1,904 (47.1)
Temporary (contract based)	397 (9.8)
Business owners	450 (11.1)
Others	42 (1.0)
N/A (Students, homemakers, unemployed)	1,246 (30.9)
Monthly household income (KRW)	
< 2 million	389 (9.6)
2–3.5 million	932 (23.1)
3.5–5 million	1,047 (25.9)
5–7 million	1,117 (27.7)
≥ 7 million	555 (13.7)
Subjective social class	
Lowest	528 (13.1)
Lower middle	739 (18.3)
Middle	1,082 (26.8)
Upper middle	670 (16.6)
Highest	1,020 (25.2)
Food security status†	
Quantity and quality sufficient	3,208 (79.4)
Quantity sufficient but not quality	655 (16.2)
Quantity and quality insufficient	176 (4.4)

KRW, Korean won.
*Weight status was categorized based on body mass index (kg/m^2): underweight < 18.5, normal 18.5–22.9, overweight 23–24.9, and obese ≥ 25. †Food security status did not include participants who are not consuming enough foods for personal weight loss purposes.

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Table 2. FL scores according to sociodemographic characteristics (100-point score)

Characteristics	FL scores							
	NS		CR		SE		Total FL*	
	Mean ± SD	*P*-values	Mean ± SD	*P*-values	Mean ± SD	*P*-values	Mean ± SD	*P*-values
Total	62.0 ± 13.0		59.6 ± 12.0		62.7 ± 10.1		61.4 ± 10.0	
Gender		< 0.001		< 0.001		< 0.001		< 0.001
Men	56.7 ± 12.6		57.1 ± 12.1		60.6 ± 10.1		58.1 ± 9.9	
Women	66.9 ± 11.3		61.9 ± 11.5		64.7 ± 9.6		64.5 ± 9.2	
Age groups		< 0.001		0.063		< 0.001		< 0.001
18–29	57.4 ± 13.2		56.6 ± 12.6		59.3 ± 10.0		57.8 ± 10.4	
30–39	63.5 ± 12.0		61.0 ± 11.7		63.8 ± 11.0		62.7 ± 10.0	
40–49	64.9 ± 12.6		61.5 ± 12.2		64.3 ± 9.8		63.5 ± 9.7	
50–59	62.8 ± 12.9		60.7 ± 11.6		64.0 ± 9.2		62.5 ± 9.6	
60–69	62.4 ± 13.1		59.1 ± 11.4		62.8 ± 9.5		61.5 ± 9.6	
≥ 70	60.7 ± 12.6		57.9 ± 11.4		62.7 ± 9.8		60.4 ± 9.5	
Education attainments		< 0.001		0.037		0.538		0.001
< High school	63.8 ± 11.3		59.7 ± 11.0		63.6 ± 9.5		62.3 ± 8.9	
High school graduates	63.3 ± 12.9		60.4 ± 11.8		62.4 ± 9.2		62.0 ± 9.7	
≥ College entrance	61.1 ± 13.2		59.1 ± 12.3		62.8 ± 10.5		61.0 ± 10.4	
Weight status†		< 0.001		0.175		0.147		0.001
Underweight	64.4 ± 12.0		58.6 ± 10.3		62.1 ± 9.0		61.7 ± 9.1	
Normal	62.9 ± 13.0		59.9 ± 12.2		62.8 ± 9.8		61.9 ± 10.1	
Overweight	60.9 ± 12.9		58.9 ± 11.9		63.1 ± 10.3		61.0 ± 10.0	
Obese	60.3 ± 13.0		59.4 ± 11.8		61.6 ± 10.5		60.4 ± 10.1	
Household types		0.008		0.013		0.764		0.957
One person households	63.1 ± 12.0		57.8 ± 11.8		62.2 ± 9.5		61.0 ± 9.9	
Households with couples	61.6 ± 13.4		60.3 ± 11.9		62.7 ± 10.3		61.6 ± 10.1	
Households with 2 generations	62.0 ± 13.2		59.9 ± 12.2		63.2 ± 10.1		61.7 ± 10.1	
Others	56.3 ± 9.0		56.4 ± 8.2		55.1 ± 8.1		55.9 ± 7.5	
Occupations		< 0.001		0.048		0.252		0.001
Professionals	61.1 ± 12.6		59.7 ± 11.8		63.3 ± 10.0		61.4 ± 9.7	
Service/sales	63.5 ± 12.6		60.2 ± 11.4		62.6 ± 9.3		62.1 ± 9.4	
Manual workers	56.7 ± 13.4		54.6 ± 12.9		59.8 ± 11.0		57.1 ± 10.9	
Students	53.5 ± 12.0		54.2 ± 12.7		57.7 ± 10.5		55.2 ± 10.1	
Housewives	69.3 ± 9.6		63.8 ± 10.6		65.9 ± 8.9		66.4 ± 7.9	
Unemployed	57.1 ± 13.9		57.6 ± 11.6		61.7 ± 10.7		58.8 ± 10.5	
Type of employment		< 0.001		0.004		0.074		0.001
Wage workers	61.5 ± 12.5		59.8 ± 11.8		62.9 ± 10.00		61.4 ± 9.8	
Temporary	60.8 ± 13.6		56.6 ± 12.7		61.7 ± 10.7		59.7 ± 10.7	
Business owners	60.1 ± 13.4		58.1 ± 11.6		61.5 ± 9.1		59.9 ± 9.5	
Others	73.3 ± 10.9		63.3 ± 12.6		66.2 ± 8.5		67.6 ± 8.7	
Monthly household income (KRW)		0.079		< 0.001		< 0.001		< 0.001
< 2 million	61.2 ± 10.9		56.4 ± 11.7		61.6 ± 8.9		59.7 ± 8.7	
2–3.5 million	61.7 ± 13.1		58.5 ± 12.3		61.2 ± 10.6		60.5 ± 10.6	
3.5–5 million	61.3 ± 12.4		59.3 ± 11.7		62.2 ± 9.4		60.9 ± 9.5	
5–7 million	63.4 ± 12.5		61.6 ± 11.4		63.8 ± 9.7		63.0 ± 9.5	
≥ 7 million	61.3 ± 15.8		59.8 ± 12.9		64.9 ± 11.2		62.0 ± 11.4	
Subjective social class		< 0.001		< 0.001		0.151		< 0.001
Lowest	58.2 ± 14.0		57.1 ± 12.4		61.2 ± 10.9		58.8 ± 10.5	
Lower middle	60.3 ± 13.8		58.3 ± 11.6		62.9 ± 10.1		60.5 ± 9.8	
Middle	63.4 ± 12.5		60.9 ± 12.1		63.4 ± 9.8		62.6 ± 9.7	
Upper middle	62.4 ± 11.4		60.1 ± 11.4		63.1 ± 9.7		61.9 ± 9.5	
Highest	63.4 ± 12.9		59.9 ± 12.1		62.5 ± 10.0		61.9 ± 10.5	
Food security status‡		< 0.001		< 0.001		< 0.001		< 0.001
Quantity and quality sufficient	63.3 ± 12.7		61.2 ± 11.3		63.8 ± 9.6		62.8 ± 9.4	
Quantity sufficient but not quality	57.5 ± 13.3		53.3 ± 12.4		58.9 ± 10.3		56.5 ± 10.5	
Quantity and quality insufficient	54.8 ± 11.8		52.1 ± 13.2		56.3 ± 11.1		54.4 ± 10.8	

P-values were obtained from a *t*-test and analysis of variance global test.
FL, food literacy; NS, nutrition and safety; CR, cultural and relational; SE, socio-ecological; SD, standard deviation; KRW, Korean won.
*Total FL values were the means of the subtotals from 3 domains. †Weight status was categorized based on body mass index (kg/m^2): underweight < 18.5, normal 18.5–22.9, overweight 23–24.9, and obese ≥ 25. ‡Food security status did not include participants who are not consuming enough foods for personal weight loss purposes.

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The average score for cultural and relational FL was 59.6 points, with higher scores in women (61.9 points) than in men (57.1 points) ($P < 0.001$). The FL scores varied across age groups, with the lowest scores in the 18–29 yrs and 70+ yrs groups and the highest scores in the 40–49 yrs group, but the differences were not statistically significant ($P = 0.063$). One-person households had the lowest FL score (57.8 points) ($P = 0.013$). The FL scores differed significantly by occupation, with relatively high scores among housewives (63.8 points) and service/sales occupations (60.2 points) and the lowest scores among students (54.2 points) ($P = 0.048$). Regarding the food security status, the score was highest in the quantity and quality sufficient group (61.2 points) and lowest in the quantity and quality insufficient group (52.1 points) ($P < 0.001$).

The average score for the socio-ecological FL was 62.7 points. Similar to other domains, the score was higher in women (64.7 points) than in men (60.6 points) ($P < 0.001$). The FL scores increased with age, reaching a peak and declining after age 50 ($P < 0.001$). In terms of the food security status, the score was highest in the quantity and quality sufficient group (63.8 points) and lowest in the quantity and quality insufficient group (56.3 points) ($P < 0.001$).

The average score for total FL was 61.4 points, with higher scores in women (64.5 points) than in men (58.1 points) ($P < 0.001$). The FL scores were lowest in the group of 18–29 yrs old (57.8 points) and highest in the group of 40–49 yrs old (63.5 points) ($P < 0.001$). Lower levels of educational attainment were associated with higher FL scores ($P = 0.001$). The FL scores varied significantly by occupation, with the highest scores among housewives (66.4 points) and the lowest among students (55.2 points) ($P = 0.001$). In terms of the food security status, the score was highest in the quantity and quality sufficient group (62.8 points) and lowest in the quantity and quality insufficient group (54.4 points) ($P < 0.001$). In summary, the vulnerable groups for FL were men, young adults aged 18–29, people aged 70 and older, students, and the food insecure group.

The level of FL by key sociodemographic characteristics

A gender-stratified analysis was conducted to explore the differences in FL levels based on sociodemographic factors, as shown in **Table 3**. Among men, the FL scores were lowest in the 18–29, 60s, and 70+ age groups, but the differences were not significant ($P = 0.248$). Among women, the FL scores were lowest in the 18–29 age group and highest in the 40s ($P < 0.001$). The FL scores increased with education attainment in men ($P < 0.001$), while in women, the scores began to decline after high school graduation ($P < 0.001$). The FL scores were not associated with the weight status in men ($P = 0.438$), but in women, higher FL scores were associated with overweight and obesity ($P = 0.001$). The higher monthly household income was associated with higher FL scores in both genders ($P < 0.001$), but scores declined after the 5–7 million KRW range. The FL scores were lower in the food security and food insecurity groups for men than women. Furthermore, the FL scores were significantly lower in the food insecurity group for both genders ($P < 0.001$). Therefore, the differences in FL levels between men and women were identified based on the sociodemographic factors.

Association between the scores in nutrition and safety FL and the intake sufficiency by food groups

Table 4 lists the association between the scores in nutrition and safety FL and the intake sufficiency by food groups. Among the three main FL domains, nutrition and safety FL showed the strongest association with the food intake. Higher scores in nutrition and safety FL increased the probability of meeting the recommended intake frequency for whole

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Table 3. The level of food literacy by key sociodemographic characteristics stratified by gender (100-point score)

Characteristics	Men		Women	
	Mean ± SD	*P*-values	Mean ± SD	*P*-values
Total	58.1 ± 9.9		64.5 ± 9.2	
Age groups		0.248		< 0.001
18–29	56.3 ± 10.1		59.2 ± 10.6	
30–39	59.9 ± 9.7		65.7 ± 9.3	
40–49	60.1 ± 9.7		67.0 ± 8.4	
50–59	58.8 ± 9.6		66.0 ± 8.2	
60–69	56.3 ± 9.5		65.8 ± 7.3	
≥ 70	56.6 ± 10.5		63.4 ± 7.4	
Education attainment		< 0.001		< 0.001
< High school	55.5 ± 9.1		65.1 ± 7.3	
High school graduates	56.9 ± 9.5		65.5 ± 8.1	
≥ college entrance	58.8 ± 10.0		63.7 ± 10.1	
Weight status*		0.438		0.001
Underweight	61.0 ± 9.1		61.9 ± 9.2	
Normal	58.0 ± 9.7		64.2 ± 9.6	
Overweight	58.6 ± 10.0		65.5 ± 8.1	
Obese	57.3 ± 10.0		65.3 ± 8.1	
Household types		0.841		0.026
One person households	58.1 ± 10.1		62.6 ± 9.4	
Households with couples	57.9 ± 10.0		65.8 ± 8.2	
Households with 2 generations	58.4 ± 9.8		65.0 ± 9.3	
Others	52.3 ± 7.5		58.3 ± 6.6	
Occupations		< 0.001		< 0.001
Professionals	60.4 ± 9.4		62.9 ± 10.1	
Service/sales	58.7 ± 9.4		65.4 ± 8.3	
Manual workers	53.5 ± 10.0		65.5 ± 7.9	
Students	54.0 ± 9.4		56.8 ± 10.9	
Housewives	59.7 ± 7.9		66.4 ± 7.9	
Unemployed	57.2 ± 10.4		63.7 ± 9.3	
Type of employment		< 0.001		0.025
Wage workers	59.7 ± 9.5		63.8 ± 9.8	
Temporary	52.7 ± 10.5		64.7 ± 7.6	
Business owners	58.1 ± 9.5		64.1 ± 8.1	
Others	60.6 ± 10.6		68.3 ± 8.3	
Monthly household income (KRW)		< 0.001		< 0.001
< 2 million	53.5 ± 9.2		62.5 ± 6.9	
2–3.5 million	57.3 ± 10.4		63.2 ± 10.0	
3.5–5 million	58.3 ± 9.0		63.7 ± 9.1	
5–7 million	59.6 ± 9.4		66.5 ± 8.3	
≥ 7 million	58.1 ± 11.2		66.1 ± 10.1	
Subjective social class		< 0.001		0.002
Lowest	54.9 ± 9.6		61.4 ± 10.3	
Lower middle	55.6 ± 9.2		64.6 ± 8.3	
Middle	58.7 ± 9.8		66.5 ± 7.8	
Upper middle	59.7 ± 9.3		64.1 ± 9.1	
Highest	59.4 ± 10.4		64.5 ± 10.0	
Food security status†		< 0.001		< 0.001
Quantity and quality sufficient	59.5 ± 9.2		65.9 ± 8.5	
Quantity sufficient but not quality	53.7 ± 10.6		58.9 ± 9.8	
Quantity and quality insufficient	48.6 ± 9.8		59.7 ± 8.7	

P-values were obtained from a *t*-test and analysis of variance global test.
SD, standard deviation; KRW, Korean won.
*Weight status was categorized based on body mass index (kg/m^2): underweight < 18.5, normal 18.5–22.9, overweight 23–24.9, and obese ≥ 25. †Food security status did not include participants who are not consuming enough foods for personal weight loss purposes.

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grains, total vegetables, vegetables excluding kimchi and pickles, and fruit ($P < 0.05$). For example, individuals in the fourth quartile group (Q4) had a 1.52 times higher probability of meeting the recommended intake frequency for whole grains than those in the lower first quartile group (Q1). Similarly, in the total vegetables, Q4 had a 1.69 times higher probability of meeting the recommended intake frequency than Q1. In vegetables excluding kimchi and pickles, Q4 had a 1.41 times higher probability of meeting the recommended intake frequency than Q1. Lastly, in fruit, Q4 had a 1.83 times higher probability of meeting the recommended intake frequency than Q1. On the other hand, there were no statistically significant differences in the intake sufficiency of sugar-sweetened beverages, instant noodles, and fast food between Q2, Q3, and Q4 compared to Q1.

Association between FL and obesity status

Table 5 lists the association between FL scores in the three main domains and the total FL with the obesity status based on a BMI of 25 kg/m^2 or more. The results showed that obesity status was associated with the FL scores. In the nutrition and safety FL domain, Q3 had an approximately 30% lower risk of obesity than Q1, with lower scores. The result was

Table 4. Association between the scores in nutrition and safety FL and the food intake sufficiency by food groups

Food groups	Nutrition and safety FL*	ORs†	*P*-value	95% CI		*P* for trend
Whole grains	Q1 (Reference)	1.00				0.006
	Q2	1.19	0.117	0.96	1.49	
	Q3	1.05	0.633	0.85	1.30	
	Q4	1.52	0.001	1.18	1.91	
Proteins	Q1 (Reference)	1.00				0.573
	Q2	1.78	0.002	1.24	2.54	
	Q3	1.64	0.007	1.14	2.35	
	Q4	1.16	0.471	0.77	1.75	
Total vegetables	Q1 (Reference)	1.00				< 0.001
	Q2	0.81	0.085	0.64	1.03	
	Q3	1.07	0.569	0.85	1.34	
	Q4	1.69	< 0.001	1.31	2.17	
Vegetables excluding kimchi or pickles	Q1 (Reference)	1.00				0.007
	Q2	0.90	0.340	0.72	1.12	
	Q3	0.94	0.565	0.76	1.17	
	Q4	1.41	0.006	1.10	1.80	
Fruits	Q1 (Reference)	1.00				< 0.001
	Q2	1.51	0.024	1.06	2.15	
	Q3	1.90	< 0.001	1.36	2.67	
	Q4	1.83	0.001	1.28	2.63	
Sugar-sweetened beverage	Q1 (Reference)	1.00				0.599
	Q2	1.65	< 0.001	1.33	2.05	
	Q3	1.33	0.008	1.08	1.65	
	Q4	1.00	0.980	0.79	1.28	
Instant noodles	Q1 (Reference)	1.00				0.449
	Q2	0.68	0.051	0.46	1.00	
	Q3	0.61	0.011	0.42	0.89	
	Q4	0.86	0.524	0.53	1.38	
Fast food	Q1 (Reference)	1.00				0.606
	Q2	0.50	0.008	0.30	0.84	
	Q3	0.60	0.065	0.34	1.03	
	Q4	1.17	0.699	0.53	2.56	

Note: Whole grains, proteins, total vegetables, vegetables excluding kimchi or pickles, fruits: intake above recommended intake standard (1), intake below recommended intake standard (0), and sugar-sweetened beverage, instant noodles, fast food: less than three times a week (1), and more than three times a week (0). All models were adjusted for sex, age, education attainments, household type, employment status, occupation, monthly household income, subjective social class, and food security status for any potential confounding effect. FL, food literacy; OR, odds ratio; CI, confidence interval.
*The nutrition and safety FL variable was used as a quartile variable(Q1–Q4); †ORs were obtained by logistic regression.

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Table 5. Association between FL and obesity status

FL*		ORs†	*P*-value	95% CI		*P* for linear trend
NS						0.061
	Q1 (Reference)	1.00				
	Q2	0.77	0.066	0.59	1.02	
	Q3	0.69	0.011	0.52	0.92	
	Q4	0.73	0.076	0.51	1.03	
CR						0.407
	Q1 (Reference)	1.00				
	Q2	0.87	0.266	0.67	1.12	
	Q3	0.70	0.034	0.51	0.97	
	Q4	1.23	0.188	0.90	1.69	
SE						0.245
	Q1 (Reference)	1.00				
	Q2	0.70	0.007	0.53	0.91	
	Q3	0.59	< 0.001	0.44	0.79	
	Q4	0.87	0.379	0.64	1.19	
Total FL						0.065
	Q1 (Reference)	1.00				
	Q2	0.90	0.416	0.69	1.17	
	Q3	0.69	0.015	0.51	0.93	
	Q4	0.79	0.153	0.57	1.09	

Note: All models were adjusted for sex, age, education attainments, household type, employment status, occupation, monthly household income, subjective social class, and food security status for any potential confounding effect.
FL, food literacy; NS, nutrition and safety; CR, cultural and relational; SE, socio-ecological; OR, odds ratio; CI, confidence interval.
*The food literacy variable used the quartile variable (Q1–Q4). †ORs were obtained by ordered logistic regression. (0 = not obese, 1 = obese [body mass index ≥ 25 kg/m^2]).

significantly significant (odds ratio [OR], 0.69; $P = 0.011$). In the cultural and relational FL domain, the risk of obesity was reduced significantly in Q3 compared to Q1 (OR, 0.70; $P = 0.034$). In the socio-ecological FL domain, both Q2 (OR, 0.70; $P = 0.007$) and Q3 (OR, 0.59; $P < 0.001$) had a significantly lower risk of obesity than Q1, with lower scores. Finally, in the total FL, Q3 had an approximately 30% lower risk of obesity than Q1 with lower scores, and the result was statistically significant (OR, 0.69; $P = 0.015$).

DISCUSSION

This study provides valuable insights into FL among a representative sample of Seoul citizens and highlights the association between FL, food intake, and weight status. The findings indicate that certain population groups exhibit lower FL, including men, young adults aged 18–29, older adults aged 70 and above, students, and individuals experiencing food insecurity. Moreover, the study showed that higher scores in the nutrition and food safety domain of FL are related to an increased intake frequency of key food groups. Furthermore, the study identified an association between FL and the obesity status, with higher FL scores associated with a reduced risk of obesity.

A comparison of the results of this study with previous research showed that sociodemographic factors play a significant role in FL levels. Similar to Begley *et al.* [11], this study found that older age, higher education levels, and lower fruit and vegetable intake are associated with lower FL levels [15]. Although it is challenging to compare the FL levels directly due to differences in the FL scale used, the results align with previous findings regarding the association between the nutritional aspects of FL and the intake sufficiency of key food groups.

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The association between FL and obesity has been reported in previous studies, showing a negative correlation [23,24]. This study expands on previous research by analyzing the correlation between FL and obesity by dividing the FL scores into quartile groups. Although no significant linear trend was observed in the relationship between obesity and the quartiles of the FL scores in the three main domains, additional analyses revealed a parabolic curve with significant results. The risk of obesity decreased with increasing quartiles in all domains, but an increasing trend was observed in the fourth quartile. Further studies will be needed to understand this pattern and its implications.

Dietary patterns significantly impact an individual's health status, with certain foods associated with weight gain or loss [25-27]. In this study, higher scores in the nutrition and food safety domain of FL were associated with a higher probability of meeting the recommended fruit and vegetable intake frequency and a lower risk of obesity. Given the positive impact of proper dietary habits on health [28,29], developing policies and programs is crucial for promoting nutrition and food safety competency.

Meals have an essential social function, and their significance extends beyond mere nutrition [30]. The cultural and relational domain of FL focuses on the social aspects of food, including the attitudes towards food-related relationships and understanding the community and food culture. The scores in this domain were relatively lower than in other domains, suggesting room for improvement. Meals shared with others are vital for happiness and are associated with self-management, daily activities, and health-related quality of life [30,31]. Therefore, FL programs targeting the cultural and relational domain are essential for promoting a happy and fulfilling life. Nevertheless, individuals with obesity showed higher scores in the cultural and relational domain, suggesting the need to promote healthy and appropriate lifestyles within this context.

An analysis of the FL patterns in men and women showed that men had lower nutrition and food safety FL scores. This finding aligns with previous studies reporting that men are less likely to enjoy cooking and have cooking skills than women [32,33]. Cooking competency programs targeting men are relatively rare [34,35]. Developing programs that strengthen cooking competency in men is crucial because these interventions have shown positive effects on confidence in cooking, nutritional knowledge, and increased vegetable and fruit intake [35-37].

The FL scores of students and young adults aged 18–29 were consistently low across all FL domains. Previous studies suggested that college students and young adults exhibit lower scores on dietary indices and have higher obesity rates than other age groups [38,39]. Furthermore, they tend to make less healthy food choices and engage in emotional eating, which can contribute to weight gain [40-42]. Considering that dietary habits established in a person's 20s have long-term implications for health [43,44], it is crucial to prioritize FL improvement programs targeting young adults.

Food insecurity is associated with lower FL levels, poor diet quality, obesity, diabetes, and mental health issues [45,46]. This study corroborates these findings, showing that the food-insecure group had lower FL scores across all domains. Improving FL may provide valuable support for individuals experiencing food insecurity, enabling them to cope with and manage their diets more effectively [12].

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This study had some limitations. First, the BMI was calculated based on self-reported data, which may introduce inaccuracies and should be interpreted cautiously. Second, the study population consisted of Seoul citizens, which may limit the generalizability of the findings to the broader population. The levels of educational attainment and economic status were relatively higher in the study sample than the national population. Despite these limitations, this study helps understand the FL levels among Seoul citizens, identifies associations with sociodemographic factors, food intake, and obesity status, and provides valuable insights for future policy and educational strategies.

In conclusion, this study highlighted the levels of FL among Seoul citizens and identified the vulnerable population groups with lower FL. The associations between FL, food intake, and obesity status emphasize the importance of promoting FL for healthier dietary choices and improved well-being. These findings can assist in developing targeted programs and interventions to enhance FL and improve the health outcomes of vulnerable groups.

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