

Original Research



Dietary status and the relationship between dietary competencies, cooking skills, and nutrition quotient of middle-aged adults living alone in Korea

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ABSTRACT

BACKGROUND/OBJECTIVES: Living alone has a bearing on unhealthy lifestyle choices, such as skipping meals, unbalanced diets, smoking, and drinking, raising concerns about health problems. This study aimed to examine the dietary habits, competencies, and cooking skills of adults living alone and their relationship with the nutritional quotient (NQ).

SUBJECTS/METHODS: We conducted an online survey spanning April 20–26, 2023 that was administered to 500 adults aged 35–64 yrs who were living alone in Korea. The questionnaire included questions regarding general information, eating habits, cooking environment, dietary competencies, cooking skills, and NQ. The results were stratified according to sex and age.

RESULTS: Middle-aged adults who were living alone responded that the main reason they skipped meals when eating alone was “because meal preparation is a hassle.” Middle-aged adults living alone consumed fewer vegetables, fruits, and milk than the recommended levels. The dietary competencies of the participants were 3.14 out of 5.0, and their cooking skills were 3.77 out of 5.0. Female had significantly higher scores for most items than male ($P < 0.05$). In addition, after adjusting for confounding factors, the odds of a high NQ score in the group with high dietary competencies was 3.75 (95% confidence interval [CI], 2.15–6.55; P for trend < 0.001), and the odds of a high NQ score for participants with higher cooking skills were 3.99 (95% CI, 2.27–7.02).

CONCLUSION: These findings provide fundamental data for developing tailored nutrition education programs for adults aged 35–64 yrs living alone, considering age and sex differences.

Keywords: Living alone; cooking; dietary; empowerment; middle aged

INTRODUCTION

Recent global societal shifts have significantly altered household compositions, resulting in a rapid increase in single-person households. This is particularly evident in South Korea,

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Conflicts of Interest

The authors declare no potential conflicts of interests.

Author Contributions

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where single-person households have become the predominant household type. Single-person households accounted for 31.7% (6.643 million) of South Korea's households in 2020, rising to 33.4% (7.2 million) in 2021, surpassing traditional multi-person households of 4 or more persons by up to 1.8 times. This number of single-person households is estimated to continue to increase, reaching 8.3 million by 2030 and 9.05 million by 2050 [1].

The prevalence of single-person households among middle-aged adults has also increased notably, mirroring the increase in social isolation in this demographic group. The number of single-person households among middle-aged adults increased significantly, from 539,000 in 2000 to 1.618 million in 2015 [2]. Over the same period, the proportion of adults aged 35–64 yrs in all single-person households increased from 39.9% to 48.1%. The factors contributing to this surge in single-person households among middle-aged adults include single marital status, divorce, bereavement, and family breakdown.

Household structure significantly influences dietary patterns and health outcomes. In single-person households, where food responsibilities are borne solely by the adults, dietary habits exhibit unique characteristics that are influenced by attitudes toward eating and health consciousness. Undesirable lifestyle habits, such as irregular meal patterns, skipping meals, smoking, and excessive alcohol consumption, are commonly observed in this demographic group [3-5]. Processed foods, convenience foods, and eating out are often preferred over preparing meals with fresh ingredients [6,7], leading to an inadequate intake of healthy foods such as vegetables, fruits, and fish [8].

Previous studies have highlighted the prevalence of dietary issues among middle-aged adults living alone, who skip breakfast at a higher rate [9-11], are more likely to eat alone or eat out [10-13], and have a generally lower food security level [9] compared with those in the same age range living in multi-person households. As a result, reduced intakes of proteins, major minerals, and vitamins are also frequently noted in this demographic population [11], contributing to poorer overall health outcomes and a higher prevalence of metabolic syndrome compared with people living in multi-person households [9,11,14].

Single-person households comprising middle-aged adults may face challenges such as economic hardships and social isolation, which can exacerbate dietary problems. The eating habits of middle-aged adults are directly linked to the risk of chronic diseases, with the quality of food choices playing a critical role in overall health [9,15]. Studies have shown that balanced nutrition and regular meal patterns significantly reduce the risk of metabolic syndrome and cardiovascular diseases [16-18]. Therefore, considering the onset of several metabolic abnormalities in this age range, effective dietary interventions are crucial. Strengthening food and cooking skills may be a viable solution for improving the dietary quality of middle-aged adults living alone. Cooking competency positively influences eating behavior [19-22]. For instance, individuals with better cooking skills are less likely to choose convenience or processed foods, and are more likely to consume vegetables [23-26].

Self-efficacy related to cooking skills is associated with healthier food consumption [27,28]. Individuals with high confidence in their cooking and nutrition knowledge are more likely to recognize the importance of vegetable consumption and select products based on ingredients and nutritional information labels [29]. Those with higher diet quality scores also showed greater confidence in their cooking and food skills and lower consumption of takeout foods [30].

Cooking and food skills vary according to sex and age, with older adults and female typically exhibiting higher skills [30]. Adults who live alone often have lower vegetable intakes due to a lack of the necessary skills to prepare vegetable-based meals [31,32]. Lower cooking skills have also been linked to higher mortality risk, particularly among those living alone [33]. Therefore, there is a need to deepen the current understanding of eating habits and behaviors, dining and cooking environments, and cooking and purchasing capabilities. Such understanding may be essential for developing targeted intervention and education programs aimed at promoting healthier eating behaviors among middle-aged adults living alone.

While previous research has primarily focused on dietary issues among older adults who live alone, this study examined the dietary habits, cooking behaviors, and purchasing environments of middle-aged adults (aged 35–64 yrs) living alone. By analyzing the effect of dietary competencies and cooking skills on healthy eating habits, this study provides foundational insights for developing efficient dietary management intervention programs for this demographic group.

SUBJECTS AND METHODS

Study population and survey

To investigate dietary characteristics, dietary competencies, cooking skills, and their relationship with nutritional quotient (NQ) in middle-aged adults (aged 35–64 yrs) living alone, an online survey was conducted between April 20–26 of 2023 that targeted this demographic group. A professional online survey agency recruited 500 registered panelists from various regions. The survey considered sex, age group, and residential area (metropolitan and non-metropolitan). Only those who had lived alone for at least 6 mon were included, and all participants provided written informed consent prior to the study. This study was approved by the Institutional Review Board (IRB) of Korea National University of Transportation (approval No. KNUT IRB 2023-06).

Study instrument

The questionnaire for this study was developed by modifying and supplementing the items used in previous studies [34–36] to fit the study's objectives. The survey questions included general information (educational level, economic activity, marital status, period of living alone, smoking status, frequency of alcohol consumption, and regular exercise), eating habits (frequency of meals, reasons for skipping meals when eating alone, frequency of consumption of vegetables, fruits, milk, and dairy products, and reasons for not consuming these), awareness of eating habits (dietary satisfaction, awareness of one's own healthy diet), cooking environment (space, equipment, utensils, storage space, seasonings), food purchasing environment (availability of grocery stores with various and healthy food, appropriateness of prices, etc.), dietary competencies (5 questions), and cooking skills (5 questions) of the participants.

Awareness of healthy diet, cooking environment, food purchase environment, dietary competencies, and cooking skills were measured on a 5-point Likert scale. The scale ranged from "1 (strongly disagree)" to "5 (strongly agree)". Satisfaction with diet was scored from "1 (very dissatisfied)" to "5 (very satisfied)". To evaluate the quality of meals and nutritional statuses of the respondents, the questionnaire also included items from the NQ for Korean adults [36]. The NQ developed by the Ministry of Food and Drug Safety is a tool created

to comprehensively evaluate the eating behavior, meal quality, and nutritional status of an individual or group. The NQ for adults comprises a total of 18 questions and is divided into 3 areas: balance, moderation, and practice. The initial questionnaire was finalized after a preliminary survey of 15 middle-aged adults living alone, the items were revised and supplemented based on the results of the preliminary survey.

Data analysis

All the data were analyzed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). For continuous variables, means and standard deviations were calculated. Unweighted numbers and weighted percentages were calculated for the categorical variables. Differences by sex and age group (35–49 and 50–64 yrs) were analyzed using Student's *t*-test for continuous variables and χ^2 test for categorical variables.

The relationships between dietary competencies, cooking skills, and NQ scores (for balance, moderation, practice, as well as total scores) were determined using logistic regression analysis. This analysis was adjusted for relevant variables that showed significant differences among the participants, by calculating the adjusted odds ratios (ORs) and 95% confidence intervals (95% CIs). All significance testing was performed with an α -level of 0.05. NQ scores for balance, moderation, practice, and total scores were divided into quartiles to facilitate the analysis.

RESULTS

General characteristics of the respondents

The general characteristics of the middle-aged adults living alone according to sex and age group are presented in **Table 1**. The average age of the respondents was 48.83 yrs, and 74.40% had college degrees or higher educational levels. Among the respondents, 61.40% were single and 25.60% were widowed or divorced. Based on the age group, adults aged 35–49 yrs had significantly higher proportions of respondents who had a college degree or higher educational levels ($P = 0.001$), who were engaged in economic activities ($P < 0.001$), and who were single ($P < 0.001$), compared with those aged 50–64 yrs.

The average duration of living alone was 124.55 mon. While no significant difference was observed by sex, this duration was significantly longer in the 50–64 yrs age group (138.34 mon) compared with in the 35–49 yrs age group (112.22 mon; $P = 0.002$). Regarding alcohol consumption, the proportion of respondents who reported no alcohol consumption at all over the preceding year was higher among female (40.40%) than that among male (21.20%), and higher among the 50–64 yrs age group (38.98%) than that among the 35–49 yrs age group (23.48%).

Dietary status

The eating habits of the respondents according to sex and age group are presented in **Table 2**. Our analysis of meal frequency showed mean frequencies of 3.01 times/wk, 5.92 times/wk, and 5.85 times/week for breakfast, lunch, and dinner, respectively. For dinner, male exhibited a significantly higher meal frequency (6.10 times/wk) than female (5.59 times/wk; $P < 0.001$).

The most common reason for skipping meals when eating alone was “because it is a hassle to prepare meals” (80.20%). Male had a higher response rate of “because I don't know how to cook” (10.80%) than female (1.60%), whereas female were more likely to respond that they

Table 1. General characteristics of the middle-aged adults living alone according to sex and age

Variable	Sex			Age			Total (n = 500)
	Male (n = 250)	Female (n = 250)	P-value ¹⁾	35–49 yrs (n = 264)	50–64 yrs (n = 236)	P-value ¹⁾	
Age (yrs)	48.77 ± 8.27	48.88 ± 8.34	0.885	42.17 ± 4.43	56.28 ± 4.33	< 0.001	48.83 ± 8.30
Sex						1.000	
Male	-	-	-	132 (50.00)	118 (50.00)		250 (50.00)
Female	-	-	-	132 (50.00)	118 (50.00)		250 (50.00)
Residential area			1.000			1.000	
Metropolitan	125 (50.00)	125 (50.00)		132 (50.00)	118 (50.00)		250 (50.00)
Non-metropolitan	125 (50.00)	125 (50.00)		132 (50.00)	118 (50.00)		250 (50.00)
Educational level			0.554			0.001	
≤ High school	69 (27.60)	59 (23.60)		49 (18.56)	79 (33.47)		128 (25.60)
College	155 (62.00)	161 (64.40)		181 (68.56)	135 (57.20)		316 (63.20)
≥ Graduate school	26 (10.40)	30 (12.00)		34 (12.88)	22 (9.32)		56 (11.20)
Economic activity			0.464			< 0.001	
Yes	207 (82.80)	213 (85.20)		248 (93.94)	172 (72.88)		420 (84.00)
No	43 (17.20)	37 (14.80)		16 (6.06)	64 (27.12)		80 (16.00)
Marital status			0.796			< 0.001	
Single	157 (62.80)	150 (60.00)		215 (81.44)	92 (38.98)		307 (61.40)
Married	32 (12.80)	33 (13.20)		17 (6.44)	48 (20.34)		65 (13.00)
Widowed/divorce/other	61 (24.40)	67 (26.80)		32 (12.12)	96 (40.68)		128 (25.60)
Duration of living alone (mon)	125.05 ± 90.78	124.05 ± 93.73	0.904	112.22 ± 80.02	138.34 ± 102.53	0.002	124.55 ± 92.18
Body mass index (kg/m ²)	24.61 ± 3.52	22.69 ± 3.76	< 0.001	23.79 ± 4.08	23.49 ± 3.38	0.370	23.65 ± 3.77
Smoking status			< 0.001			0.112	
Yes	136 (54.40)	30 (12.00)		96 (36.36)	70 (29.66)		166 (33.20)
No	114 (45.60)	220 (88.00)		168 (63.64)	166 (70.34)		334 (66.80)
Frequency of alcohol consumption			< 0.001			0.004	
None	53 (21.20)	101 (40.40)		62 (23.48)	92 (38.98)		154 (30.80)
< 1 time/mo	36 (14.40)	74 (29.60)		59 (22.35)	51 (21.61)		110 (22.00)
1 time/mo	28 (11.20)	28 (11.20)		33 (12.50)	23 (9.75)		56 (11.20)
2–4 times/mo	47 (18.80)	24 (9.60)		48 (18.18)	23 (9.75)		71 (14.20)
2–3 times/wk	56 (22.40)	15 (6.00)		40 (15.15)	31 (13.14)		71 (14.20)
≥ 4 times/wk	30 (12.00)	8 (3.20)		22 (8.33)	16 (6.78)		38 (7.60)
Regular exercise			0.720			0.251	
Yes	134 (53.60)	130 (52.00)		133 (50.38)	131 (55.51)		264 (52.80)
No	116 (46.40)	120 (48.00)		131 (49.62)	105 (44.49)		236 (47.20)

Values are presented as mean ± SD or number (%).

¹⁾P-value by Student's t-test or the χ^2 test.

skipped meals when eating alone “for diet reasons” (38.40%) compared with male (18.80%; $P < 0.001$). The respondents’ levels of satisfaction with their diet and awareness of their own healthy diet were 3.07 and 2.77 out of 5.0 points, respectively, with no significant differences according to sex and age.

Table 3 presents the participants’ frequencies of consuming vegetable, fruit, and milk and dairy products consumption, and the reasons for not consuming them. The proportion of participants who consumed vegetables once per day was the highest, at 28.60%, with significant differences observed according to age ($P = 0.011$). The most common reason for not consuming vegetables was “because the quantity for sale is too large to eat alone” (64.79%). In the case of male, the proportion of the respondents who responded that they do not eat vegetables “because it is difficult to prepare or cook” was significantly higher than that of female ($P = 0.003$). The proportion of respondents in the 35–49 yrs age group who responded, “because it is difficult to dispose of the resultant food waste” was significantly higher than that in the 50–64 yrs age group ($P = 0.035$).

For fruit consumption, the proportion of the participants who responded that they consumed fruit less than once every 2 weeks was the highest, at 34.20%, with significant differences

Table 2. Eating habits of the middle-aged adults living alone according to sex and age

Variable	Sex			Age			Total (n = 500)
	Male (n = 250)	Female (n = 250)	P-value ¹⁾	35–49 yrs (n = 264)	50–64 yrs (n = 236)	P-value ¹⁾	
Frequency of meals (/wk)							
Breakfast	2.68 ± 2.98	3.34 ± 3.07	0.854 ⁵⁾	2.50 ± 2.83	3.59 ± 3.16	0.061 ⁶⁾	3.01 ± 3.04
Lunch	5.89 ± 2.01	5.94 ± 1.81	0.720 ⁵⁾	6.05 ± 1.73	5.77 ± 2.09	0.448 ⁶⁾	5.92 ± 1.91
Dinner	6.10 ± 1.68	5.59 ± 1.87	< 0.001 ⁵⁾	5.80 ± 1.75	5.89 ± 1.84	0.707 ⁶⁾	5.85 ± 1.79
Reasons for skipping meals when eating alone ²⁾							
Because it is a hassle to prepare meals	197 (78.80)	204 (81.60)	0.432	223 (84.47)	178 (75.42)	0.011	401 (80.20)
Because I don't want to deal with the cleanup	118 (47.20)	95 (38.00)	0.038	119 (45.08)	94 (39.83)	0.236	213 (42.60)
Because I have no appetite	103 (41.20)	106 (42.40)	0.786	99 (37.50)	110 (46.61)	0.039	209 (41.80)
Because it is a hassle to do the grocery shopping	74 (29.60)	76 (30.40)	0.845	87 (32.95)	63 (26.69)	0.127	150 (30.00)
For diet reasons	47 (18.80)	96 (38.40)	< 0.001	79 (29.92)	64 (27.12)	0.488	143 (28.60)
Because I don't want to eat alone	62 (24.80)	53 (21.20)	0.339	50 (18.94)	65 (27.54)	0.023	115 (23.00)
Because I don't have time to eat	40 (16.00)	44 (17.60)	0.632	49 (18.56)	35 (14.83)	0.265	84 (16.80)
I have never skipped a meal	36 (14.40)	44 (17.60)	0.329	33 (12.50)	47 (19.92)	0.024	80 (16.00)
For financial reasons	33 (13.20)	17 (6.80)	0.017	27 (10.23)	23 (9.75)	0.858	50 (10.00)
Because I don't know how to cook	27 (10.80)	4 (1.60)	< 0.001	15 (5.68)	16 (6.78)	0.611	31 (6.20)
Other	13 (5.20)	11 (4.40)	0.676	11 (4.17)	13 (5.51)	0.484	24 (4.80)
Dietary satisfaction ³⁾	3.01 ± 0.82	3.13 ± 0.78	0.562 ⁵⁾	3.11 ± 0.83	3.03 ± 0.77	0.314 ⁶⁾	3.07 ± 0.80
Awareness of their own healthy diet ⁴⁾	2.75 ± 0.87	2.80 ± 0.91	0.223 ⁵⁾	2.69 ± 0.88	2.86 ± 0.89	0.276 ⁶⁾	2.77 ± 0.89

Values are presented as mean ± SD or number (%).

¹⁾P-value by Student's t-test or the χ^2 test.

²⁾Multiple response.

³⁾Very dissatisfied (1)–very satisfied (5).

⁴⁾Strongly disagree (1)–strongly agree (5).

⁵⁾Adjusted for smoking status and frequency of alcohol consumption.

⁶⁾Adjusted for educational level, economic activity, marital status, duration of living alone and frequency of alcohol consumption.

according to sex and age. Female consumed fruits significantly more frequently than male did ($P < 0.001$). The most common reason for not consuming fruits was “because it is expensive” (54.17%). The proportion of the participants who responded that they consumed milk 1–3 times per week was the highest, at 36.00%. The major reason for not consuming milk or dairy products was “because I do not like them” (53.56%). The number of male not consuming milk or dairy products “because it is expensive” was significantly higher than that of female ($P < 0.001$). The proportion of respondents in the 35–49 yrs age range who reported not consuming milk or dairy products “because the quantity for sale is too large to eat alone” ($P = 0.023$), “due to a lack of storage space” ($P = 0.0290$), and “because I do not like them” ($P < 0.001$) was significantly higher than that in the 50–64 yrs age group.

Dietary competencies and cooking skills

The results for the cooking and food purchase environments of the respondents are presented in **Table 4**. Sufficiency of cooking equipment had the highest score, at 3.91 points out of 5.0, followed by sufficiency of cooking utensils (3.83 points), sufficiency of food storage space (3.69 points), sufficiency of cooking space (3.46 points), and sufficiency of seasonings needed for cooking (3.30 points). All items in the cooking environment section differed significantly according to sex. Female scored higher than male in all these items.

Regarding the food purchase environment of the residential area, “There are grocery stores near my house where I can purchase variety of healthy foods” had the highest score, at 3.71 points, followed by “There is a grocery store close to my house where I can purchase variety of healthy foods” (3.58 points), “The foods sold at the grocery stores near my house are fresh and of good quality” (3.47 points), “The services of a grocery store near my house are

Table 3. Frequencies of vegetable, fruit, and milk and dairy products consumption, and the reasons for not consuming of the middle-aged adults living alone according to sex and age

Variable	Sex			Age			Total (n = 500)
	Male (n = 250)	Female (n = 250)	P-value ¹⁾	35–49 yrs (n = 264)	50–64 yrs (n = 236)	P-value ¹⁾	
Frequencies of vegetable consumption			0.156			0.011	
≥ 2 times/d	48 (19.20)	60 (24.00)		42 (15.91)	66 (27.97)		108 (21.60)
1 time/d	72 (28.80)	71 (28.40)		76 (28.79)	67 (28.39)		143 (28.60)
4–6 times/wk	58 (23.20)	49 (19.60)		62 (23.48)	45 (19.07)		107 (21.40)
1–3 times/wk	65 (26.00)	54 (21.60)		68 (25.76)	51 (21.61)		119 (23.80)
≤ 1 time/2 wk	7 (2.80)	16 (6.40)		16 (6.06)	7 (2.97)		23 (4.60)
Reasons for not consuming vegetables ²⁾ (n = 142)							
Because the quantity for sale is too large to eat alone	45 (62.50)	47 (67.14)	0.563	58 (69.05)	34 (58.62)	0.201	92 (64.79)
Because it is difficult to prepare or cook	45 (62.50)	26 (37.14)	0.003	43 (51.19)	28 (48.28)	0.733	71 (50.00)
Because it is difficult to dispose of the resultant food waste	34 (47.22)	25 (35.71)	0.164	41 (48.81)	18 (31.03)	0.035	59 (41.55)
Due to a lack of storage space	18 (25.00)	16 (22.86)	0.765	22 (26.19)	12 (20.69)	0.450	34 (23.94)
Because it is expensive	15 (20.83)	7 (10.00)	0.075	14 (16.67)	8 (13.79)	0.642	22 (15.49)
Because it is not easily purchasable nearby	11 (15.28)	8 (11.43)	0.501	12 (14.29)	7 (12.07)	0.703	19 (13.38)
Because I do not like them	5 (6.94)	12 (17.14)	0.061	6 (7.14)	11 (18.97)	0.033	17 (11.97)
Frequencies of fruit consumption			< 0.001			< 0.001	
≥ 2 times/d	1 (0.40)	14 (5.60)		3 (1.14)	12 (5.08)		15 (3.00)
1 time/d	27 (10.80)	67 (26.80)		37 (14.02)	57 (24.15)		94 (18.80)
4–6 times/wk	14 (5.60)	41 (16.40)		22 (8.33)	33 (13.98)		55 (11.00)
1–3 times/wk	89 (35.60)	76 (30.40)		94 (35.61)	71 (30.08)		165 (33.00)
≤ 1 time/2 wk	119 (47.60)	52 (20.80)		108 (40.91)	63 (26.69)		171 (34.20)
Reasons for not consuming fruits ²⁾ (n = 336)							
Because it is expensive	108 (51.92)	74 (57.81)	0.293	117 (57.92)	65 (48.51)	0.090	182 (54.17)
Because the quantity for sale is too large to eat alone	103 (49.52)	73 (57.03)	0.181	112 (55.45)	64 (47.76)	0.167	176 (52.38)
Because it is difficult to dispose of the resultant food waste	70 (33.65)	41 (32.03)	0.759	78 (38.61)	33 (24.63)	0.008	111 (33.04)
Because I do not like them	39 (18.75)	23 (17.97)	0.858	33 (16.34)	29 (21.64)	0.220	62 (18.45)
Due to a lack of storage space	39 (18.75)	17 (13.28)	0.192	32 (15.84)	24 (17.91)	0.618	56 (16.67)
Because it is difficult to prepare or cook	30 (14.42)	11 (8.59)	0.113	34 (16.83)	7 (5.22)	0.002	41 (12.20)
Because it is not easily purchasable nearby	17 (8.17)	8 (6.25)	0.514	14 (6.93)	11 (8.21)	0.662	25 (7.44)
Frequencies of milk and dairy products consumption			0.021			0.308	
≥ 2 times/d	8 (3.20)	6 (2.40)		8 (3.03)	6 (2.54)		14 (2.80)
1 time/d	35 (14.00)	52 (20.80)		43 (16.29)	44 (18.64)		87 (17.40)
4–6 times/wk	21 (8.40)	27 (10.80)		25 (9.47)	23 (9.75)		48 (9.60)
1–3 times/wk	84 (33.60)	96 (38.40)		106 (40.15)	74 (31.36)		180 (36.00)
≤ 1 time/2 wk	102 (40.80)	69 (27.60)		82 (31.06)	89 (37.71)		171 (34.20)
Reasons for not consuming milk and dairy products ²⁾ (n = 351)							
Because I do not like them	96 (51.61)	92 (55.76)	0.437	80 (42.55)	108 (66.26)	< 0.001	188 (53.56)
Because the quantity for sale is too large to eat alone	46 (24.73)	52 (31.52)	0.157	62 (32.98)	36 (22.09)	0.023	98 (27.92)
Because it is expensive	68 (36.56)	27 (16.36)	< 0.001	58 (30.85)	37 (22.70)	0.087	95 (27.37)
Due to a lack of storage space	20 (10.75)	12 (7.27)	0.258	23 (12.23)	9 (5.52)	0.029	32 (9.12)
Because it is not easily purchasable nearby	8 (4.30)	4 (2.42)	0.334	8 (4.26)	4 (2.45)	0.354	12 (3.42)

Values are presented as number (%).

¹⁾P-value by χ^2 test.

²⁾Multiple response; participants who responded with a consumption frequency of 3 times per week or less.

convenient to use” (3.33 points), and “The foods sold at the grocery stores near my house are reasonably priced for me to purchase” (3.30 points). Female had higher scores than male for most of the items related to cooking and purchasing environments in residential areas.

Table 5 presents the results for dietary competencies and cooking skills. Among all of the respondents, the score for the “I know about the impact of food choices on health” was the highest, at 3.36 points. In the case of cooking skills, “I can handle simple cooking appliances and cooking utensils” had the highest score, at 3.95 points. Female scored significantly higher than male in dietary competency ($P = 0.003$) and cooking capability ($P = 0.001$).

Dietary status of middle-aged adults living alone

Table 4. Cooking environment and food purchase environment of the middle-aged adults living alone according to sex and age

Variable	Sex			Age			Total (n = 500)
	Male (n = 250)	Female (n = 250)	<i>P</i> -value ^{2,3)}	35–49 yrs (n = 264)	50–64 yrs (n = 236)	<i>P</i> -value ^{2,4)}	
Cooking environment ¹⁾							
There is enough cooking equipment.	3.70 ± 0.97	4.11 ± 0.81	< 0.001	3.94 ± 0.95	3.87 ± 0.88	0.206	3.91 ± 0.92
There are enough cooking utensils.	3.59 ± 1.03	4.06 ± 0.88	< 0.001	3.82 ± 1.04	3.83 ± 0.93	0.696	3.83 ± 0.98
There is enough food storage space.	3.53 ± 1.02	3.85 ± 1.07	0.024	3.65 ± 1.11	3.74 ± 0.99	0.532	3.69 ± 1.06
There is enough cooking space.	3.27 ± 1.13	3.65 ± 1.06	0.039	3.45 ± 1.18	3.47 ± 1.02	0.768	3.46 ± 1.11
There are enough seasonings needed for cooking.	2.95 ± 1.09	3.64 ± 1.11	< 0.001	3.17 ± 1.15	3.44 ± 1.14	0.306	3.30 ± 1.15
Mean of cooking environment score	3.41 ± 0.85	3.86 ± 0.82	< 0.001	3.61 ± 0.89	3.67 ± 0.84	0.753	3.64 ± 0.87
Food purchase environment ¹⁾							
There are grocery stores near my house where I can purchase variety of healthy foods.	3.57 ± 0.92	3.84 ± 0.92	0.021	3.71 ± 0.95	3.71 ± 0.91	0.593	3.71 ± 0.93
There are grocery stores close to my house where I can purchase variety of healthy foods.	3.44 ± 1.00	3.72 ± 0.94	0.061	3.55 ± 0.99	3.61 ± 0.98	0.915	3.58 ± 0.98
The foods sold at the grocery stores near my house are fresh and of good quality.	3.37 ± 0.79	3.57 ± 0.87	0.207	3.50 ± 0.83	3.44 ± 0.85	0.233	3.47 ± 0.84
The services of grocery stores near my house are convenient to use.	3.17 ± 0.98	3.49 ± 1.03	0.043	3.31 ± 1.04	3.35 ± 1.00	0.883	3.33 ± 1.02
The foods sold at the grocery stores near my house are reasonably priced for me to purchase.	3.12 ± 0.96	3.48 ± 0.97	0.011	3.27 ± 1.00	3.33 ± 0.96	0.432	3.30 ± 0.98
Mean of food purchase environment score	3.33 ± 0.77	3.62 ± 0.80	0.016	3.47 ± 0.81	3.49 ± 0.79	0.848	3.48 ± 0.80

Values are presented as mean ± SD.

¹⁾Strongly disagree (1)–strongly agree (5).

²⁾P-value by Student's t-test.

³⁾Adjusted for smoking status and frequency of alcohol consumption.

⁴⁾Adjusted for educational level, economic activity, marital status, duration of living alone and frequency of alcohol consumption.

Table 5. Dietary competencies and cooking skills of the middle-aged adults living alone according to sex and age

Variable	Sex			Age			Total (n = 500)
	Male (n = 250)	Female (n = 250)	<i>P</i> -value ^{2,3)}	35–49 yrs (n = 264)	50–64 yrs (n = 236)	<i>P</i> -value ^{2,4)}	
Dietary competency ¹⁾							
I know about the impact of food choices on health.	3.16 ± 0.96	3.57 ± 0.89	0.009	3.42 ± 0.96	3.31 ± 0.93	0.253	3.36 ± 0.95
I know about the various food groups that make up a healthy diet.	3.01 ± 0.90	3.37 ± 0.94	0.149	3.18 ± 0.98	3.21 ± 0.89	0.692	3.19 ± 0.93
I know how to cook hygienically according on the type of food.	2.92 ± 0.88	3.40 ± 0.94	< 0.001	3.18 ± 0.95	3.15 ± 0.94	0.769	3.16 ± 0.94
I know how to store food hygienically according to its type.	2.94 ± 0.94	3.36 ± 0.93	0.006	3.11 ± 1.00	3.20 ± 0.90	0.563	3.15 ± 0.96
I know about the energy and nutrients required for my age.	2.64 ± 0.98	3.00 ± 0.97	0.083	2.73 ± 1.00	2.92 ± 0.97	0.143	2.82 ± 0.99
Mean of dietary competency score	2.94 ± 0.78	3.34 ± 0.80	0.003	3.12 ± 0.83	3.16 ± 0.80	0.806	3.14 ± 0.81
Cooking skill ¹⁾							
I can handle simple cooking appliances and cooking utensils.	3.56 ± 0.88	3.86 ± 0.91	< 0.001	3.96 ± 0.79	3.94 ± 0.69	0.599	3.95 ± 0.74
I understand and can follow simple cooking recipes.	3.62 ± 0.63	3.93 ± 0.65	< 0.001	3.95 ± 0.79	3.92 ± 0.70	0.715	3.94 ± 0.75
I can easily prepare a meal.	3.77 ± 0.75	4.11 ± 0.71	0.009	3.72 ± 0.92	3.69 ± 0.89	0.421	3.71 ± 0.91
I can understand food labels on processed foods.	3.77 ± 0.75	4.14 ± 0.70	0.241	3.60 ± 0.90	3.72 ± 0.81	0.556	3.65 ± 0.86
I can choose healthier ingredients within my economic status.	3.53 ± 0.85	3.78 ± 0.85	0.027	3.60 ± 0.90	3.63 ± 0.87	0.672	3.62 ± 0.88
Mean of cooking capability score	3.62 ± 0.63	3.93 ± 0.65	0.001	3.77 ± 0.69	3.78 ± 0.63	0.875	3.77 ± 0.66

Values are presented as mean ± SD.

¹⁾Strongly disagree (1)–strongly agree (5).

²⁾P-value by Student's t-test.

³⁾Adjusted for smoking status and frequency of alcohol consumption.

⁴⁾Adjusted for educational level, economic activity, marital status, duration of living alone and frequency of alcohol consumption.

Table 6. NQ of the middle-aged adults living alone according to sex and age

Variable	Sex			Age			Total (n = 500)
	Male (n = 250)	Female (n = 250)	P-value ^{1,2)}	35–49 yrs (n = 264)	50–64 yrs (n = 236)	P-value ^{1,3)}	
Balance	28.54 ± 16.05	36.97 ± 19.17	0.032	29.18 ± 15.99	36.75 ± 19.59	0.003	32.75 ± 18.16
Moderation	65.58 ± 15.52	69.09 ± 16.52	0.530	60.94 ± 15.44	74.48 ± 13.67	< 0.001	67.33 ± 16.10
Practice	55.66 ± 15.63	64.05 ± 15.96	0.986	58.27 ± 16.09	61.63 ± 16.46	0.864	59.85 ± 16.33
Total NQ score	50.5 ± 11.54	57.44 ± 13.72	0.470	50.34 ± 12.06	58.02 ± 13.13	0.001	53.97 ± 13.13
Distribution ⁴⁾			< 0.001			< 0.001	
Low	150 (60.00)	97 (38.80)		161 (60.98)	86 (36.44)		247 (49.40)
Middle	83 (33.20)	98 (39.20)		86 (32.58)	95 (40.25)		181 (36.20)
High	17 (6.80)	55 (22.00)		17 (6.44)	55 (23.31)		72 (14.40)

Values are presented as mean ± SD.

NQ, nutrition quotient.

¹⁾P-value by Student's t-test or the χ^2 test.

²⁾Adjusted for smoking status and frequency of alcohol consumption.

³⁾Adjusted for educational level, economic activity, marital status, duration of living alone and frequency of alcohol consumption.

⁴⁾Low: 0–52.737 points, middle: 52.738–68.482 points, high: 68.483–100 points.

Relationship with nutrient quotient

The NQ score of all the participants was 53.97 points (**Table 6**). The mean scores for balance, moderation, and practice were 32.75, 67.33, and 59.85 points, respectively. No significant differences were found according to sex; however, significant differences were observed according to age. Balance ($P = 0.003$), moderation ($P < 0.001$), and total NQ scores ($P = 0.001$) were significantly higher in those aged 50–64 yrs than in those aged 35–49 yrs. The distribution of the NQ scores showed significant differences according to sex and age. In particular, the low scoring group had a significantly higher proportion of male (60.00%) than of female (38.80%).

Analyzing the impact of dietary competency on NQ score (**Table 7**), we found that higher dietary competency scores in balance, practice, and total NQ scores, excluding moderation, correlated with significantly higher scores on each item (P for trend < 0.001). In the case of the total NQ scores, it was 1.67 in Q2, 2.71 in Q3, and 3.75 in Q4, indicating that this score increased significantly as the dietary competency score increased. In particular, in the case of adults aged 35–49 yrs living alone, higher dietary competency scores correlated significantly with higher NQ scores (P for trend < 0.001).

Our analysis of the NQ scores according to the level of cooking capability (**Table 8**) showed that the adjusted OR increased significantly as the cooking capability score increased for all of the items, as well as the total NQ score. In the case of the NQ, compared with the Q1 group with the lowest cooking capability score, the OR for the Q2, Q3, and Q4 groups were 1.95, 2.34, and 3.99, respectively. Therefore, the group with the highest cooking capability score also had a higher NQ score (P for trend < 0.001).

DISCUSSION

In this study, an online survey was conducted targeting 500 middle-aged adults (aged 35–64 yrs) living alone, to determine their eating habits, food-related environments (i.e., cooking and purchasing environment), dietary competencies, and cooking skills, as well as their relationships with the NQ score. The survey results revealed that middle-aged adults living alone cited difficulties related to meal preparation and cleaning up after meals as the main reasons for skipping meals when eating alone. In addition, the consumption of vegetables,

Table 7. Adjusted ORs and 95% CIs of high nutrition quotient score by dietary competency in middle-aged adults living alone

Variable	Balance	Moderation	Practice	Total
Male¹⁾				
Q1	1.00	1.00	1.00	1.00
Q2	1.32 (0.58–2.99)	0.72 (0.36–1.45)	1.19 (0.56–2.54)	1.13 (0.49–2.59)
Q3	1.42 (0.66–3.06)	0.61 (0.31–1.21)	1.66 (0.80–3.41)	1.04 (0.48–2.26)
Q4	3.14 (1.43–6.89)	0.49 (0.24–1.01)	3.93 (1.83–8.45)	2.75 (1.25–6.05)
P for trend ⁶⁾	0.005	0.049	< 0.001	0.016
Female²⁾				
Q1	1.00	1.00	1.00	1.00
Q2	1.47 (0.72–2.99)	1.52 (0.75–3.08)	3.24 (1.55–6.75)	2.52 (1.21–5.25)
Q3	1.62 (0.80–3.28)	1.55 (0.77–3.12)	4.83 (2.30–10.15)	2.77 (1.34–5.73)
Q4	2.18 (1.08–4.40)	1.95 (0.97–3.92)	11.70 (5.39–25.39)	3.95 (1.91–8.19)
P for trend ⁶⁾	0.032	0.081	< 0.001	0.001
35–49 yrs³⁾				
Q1	1.00	1.00	1.00	1.00
Q2	1.25 (0.55–2.81)	1.30 (0.60–2.83)	2.99 (1.44–6.22)	2.05 (0.82–5.11)
Q3	4.15 (1.94–8.88)	1.08 (0.50–2.35)	4.92 (2.39–10.12)	4.93 (2.10–11.57)
Q4	3.28 (1.53–7.05)	1.82 (0.85–3.88)	9.63 (4.51–20.55)	6.95 (2.95–16.36)
P for trend ⁶⁾	< 0.001	0.162	< 0.001	< 0.001
50–64 yrs⁴⁾				
Q1	1.00	1.00	1.00	1.00
Q2	0.87 (0.42–1.79)	0.81 (0.40–1.63)	1.31 (0.64–2.67)	0.96 (0.47–1.96)
Q3	1.95 (0.44–2.03)	0.47 (0.22–0.99)	2.36 (1.10–5.05)	1.23 (0.58–2.61)
Q4	1.98 (0.94–4.16)	0.83 (0.40–1.73)	3.87 (1.81–8.28)	2.16 (1.03–4.52)
P for trend ⁶⁾	0.046	0.406	< 0.001	0.020
Total⁵⁾				
Q1	1.00	1.00	1.00	1.00
Q2	1.32 (0.77–2.28)	1.18 (0.72–1.94)	2.20 (1.31–3.71)	1.67 (0.95–2.94)
Q3	2.26 (1.31–3.88)	0.84 (0.50–1.41)	3.69 (2.15–6.32)	2.71 (1.54–4.77)
Q4	2.84 (1.66–4.85)	1.26 (0.76–2.08)	6.30 (3.66–10.85)	3.75 (2.15–6.55)
P for trend ⁶⁾	< 0.001	0.612	< 0.001	< 0.001

OR, odds ratio; CI, confidence interval.

¹⁾Adjusted for educational level and regular exercise.²⁾Adjusted for smoking status.³⁾Adjusted for age, sex, educational level and smoking status.⁴⁾Adjusted for sex and smoking status.⁵⁾Adjusted for sex, educational level, marital status, smoking status and regular exercise.⁶⁾P for trend by logistic regression analysis.

fruits, and milk among middle-aged adults living alone was lower than the recommended level. An analysis of the NQ score—a comprehensive indicator that can be used to evaluate the quality of an individual's diet—revealed that the mean score was 53.97 points. The dietary competencies of middle-aged adults living alone were lower than their cooking skills, and higher dietary competencies and cooking skills were significantly associated with increased NQ scores in this population. These results are expected to be useful for developing targeted nutrition education interventions for single-person households.

Individuals living alone prepare their own meals and are responsible for their own dietary intake. These characteristics affect their eating habits, such as increased consumption of processed foods or convenience foods, decreased intake of fruits and vegetables, and skipping meals. Adults living alone also seek convenience, rely heavily on eating out, skip meals frequently, have irregular meal times, and often eat alone [37,38]. Hong and Kim [10] used raw data from the Food Consumption Behavior Survey to report that adults in their 40s and 50s who lived alone had a significantly higher rate of skipping breakfast than those who were a part of multi-person households and those who responded that they eat regularly. In

Table 8. Adjusted ORs and 95% CIs of high nutrition quotient score by cooking skill in middle-aged adults living alone

Variable	Balance	Moderation	Practice	Total
Male¹⁾				
Q1	1.00	1.00	1.00	1.00
Q2	2.58 (1.15–5.80)	1.19 (0.59–2.39)	0.78 (0.38–1.62)	1.82 (0.78–4.20)
Q3	1.80 (0.82–3.95)	1.19 (0.61–2.35)	1.74 (0.86–3.49)	2.06 (0.92–4.59)
Q4	5.82 (2.46–13.75)	1.20 (0.56–2.56)	3.47 (1.57–7.69)	5.21 (2.19–12.39)
P for trend ⁴⁾	0.001	0.645	< 0.001	< 0.001
Female²⁾				
Q1	1.00	1.00	1.00	1.00
Q2	0.98 (0.47–2.07)	3.32 (1.54–7.18)	2.33 (1.10–4.95)	1.84 (0.86–3.97)
Q3	1.58 (0.80–3.10)	4.13 (2.03–8.40)	2.97 (1.49–5.93)	2.83 (1.40–5.72)
Q4	0.83 (0.40–1.72)	3.48 (1.65–7.34)	3.70 (1.76–7.75)	2.24 (1.07–4.70)
P for trend ⁴⁾	0.984	0.002	0.001	0.020
35–49 yrs³⁾				
Q1	1.00	1.00	1.00	1.00
Q2	2.36 (1.11–5.04)	2.34 (1.05–5.21)	1.89 (0.95–3.74)	3.63 (1.42–9.26)
Q3	2.70 (1.13–6.44)	2.88 (1.17–7.09)	2.34 (1.05–5.25)	3.83 (1.36–10.75)
Q4	2.57 (1.17–5.62)	3.63 (1.60–8.25)	3.96 (1.92–8.18)	6.22 (2.41–16.07)
P for trend ⁴⁾	0.042	0.003	< 0.001	< 0.001
50–64 yrs³⁾				
Q1	1.00	1.00	1.00	1.00
Q2	0.95 (0.46–1.97)	1.58 (0.80–3.11)	1.81 (0.89–3.70)	1.66 (0.80–3.44)
Q3	1.15 (0.51–2.59)	1.22 (0.56–2.65)	2.53 (1.12–5.73)	1.80 (0.79–4.08)
Q4	2.00 (0.93–4.29)	1.88 (0.90–3.94)	4.36 (1.99–9.55)	4.34 (1.98–9.53)
P for trend ⁴⁾	0.049	0.176	< 0.001	< 0.001
Total³⁾				
Q1	1.00	1.00	1.00	1.00
Q2	1.39 (0.83–2.33)	1.62 (1.00–2.62)	1.79 (1.09–2.92)	1.95 (1.13–3.37)
Q3	1.69 (0.94–3.03)	1.78 (1.02–3.10)	2.40 (1.36–4.25)	2.34 (1.27–4.31)
Q4	2.00 (1.17–3.42)	2.05 (1.23–3.41)	3.99 (2.35–6.78)	3.99 (2.27–7.02)
P for trend ⁴⁾	0.009	0.010	< 0.001	< 0.001

OR, odds ratio; CI, confidence interval.

¹⁾Adjusted for regular exercise.²⁾Adjusted for duration of living alone and regular exercise.³⁾Adjusted for sex, smoking status and regular exercise.⁴⁾P for trend by logistic regression analysis.

the present study, the consumption frequencies of breakfast, lunch, and dinner per week for middle-aged adults (aged 35–64 yrs) living alone were 3.01, 5.92, and 5.85, respectively, indicating that they skipped breakfast ≤ 4 times per week, and skipped lunch and dinner more than once per week. Compared with female, more middle-aged male in single-person households skipped meals when eating alone because they did not know how to cook food or had to clean up themselves. The rate at which male aged 50–64 yrs living alone skipped meals was significantly higher than that among female in that demographic group.

In the case of middle-aged female living alone, the frequency of eating dinner was significantly lower than that in male, which may be related to the high desire to control weight as a reason for skipping meals when eating alone. Skipping meals can result in an insufficient supply of nutrients needed for the day, or cause overeating during the next meal. In addition, considering previous studies which reported that meal skipping is closely related to an inappropriate cardiometabolic profile or metabolic syndrome [39,40], it is necessary to suggest various methods to stop meal skipping in middle-aged single-person households and especially single-male households. In addition, customized intervention measures based on the reasons for skipping meals when eating alone, such as cooking education or increasing opportunities to eat together, are necessary.

This study found that the proportion of middle-aged adults living alone who consumed vegetables and fruits more than once per day were 50.20% and 21.80%, respectively, which was not high. The importance of vegetable and fruit intake in the diet is increasing. Particularly in South Korea, dietary habits are shifting toward a Western style. Among adults living alone, vegetable and fruit intake is becoming increasingly low [8,41]. In a study that analyzed raw data from the 2017–2021 National Health and Nutrition Examination Survey, adults aged ≥ 19 yrs living alone showed significantly lower ORs for consuming > 500 g/day of fruits and vegetables compared with adults living in multi-person households. A stratification analysis showed the same results, regardless of household type, only for those aged ≥ 65 yrs [42].

As this study was conducted only on middle-aged adults living alone, it is difficult to clearly present the differences between single-person and multi-person households. However, in this study, a high proportion of middle-aged male (aged 35–49 yrs) among the adults living alone responded that they did not consume vegetables and fruits because they found it difficult to clean or dispose of the resultant food waste. This result is similar to that of previous studies showing that adults living alone lack the time to cook vegetables or do not have the skills to prepare vegetable-based dishes, thereby resulting in low vegetable intake [31,32]. Reduced vegetable and fruit intake is a common phenomenon among adults living alone [8,41,42]; the rich micronutrients and bioactive substances contained in vegetables and fruits help to prevent various chronic diseases. Considering that it is very helpful for health [43,44], it is necessary to consider various ways of increasing vegetable and fruit intake in middle-aged adults living alone. In particular, changes in the food environment that can increase the intake of vegetables and fruits, such as selling vegetables in smaller quantities or providing spaces to store food, would likely be beneficial. When conducting educational programs for middle-aged adults living alone, it is necessary to prioritize topics, such as how to care for vegetables and fruits and the importance of eating them to prevent chronic diseases.

The mean balance, moderation, and practice scores among our participants were 32.75, 67.33, and 59.85 points, respectively, and the mean total NQ score was 53.97 points. When compared with the average total NQ score of adults nationwide (60.8 points) [36], the NQ score in our participant group was very low. In particular, those aged 35–49 yrs showed significantly lower scores. Previous studies have also shown that the nutritional statuses of individuals living alone are generally lower than those of individuals living in multi-person households. According to a previous study targeting middle-aged male of 40–60 yrs, the dietary evaluation index of single-person households was significantly lower than that of multiple-person ones, particularly for breakfast. Single-person households have also reported lower dietary, grain, and fruit intake scores than multi-person ones [45].

In a survey of Spanish adults aged 18–45 yrs, single-person households had significantly lower healthy eating indexes than multi-person ones, and the frequency of consumption of fast, fried, and ultra-processed foods was high, whereas that of fish was low [46]. The present study, as well as several previous studies, have reported that the nutritional statuses of middle-aged adults living alone tend to be worse than those of adults living in multi-person households. Therefore, it is important to uncover the underlying factors related to the nutritional statuses of middle-aged adults living alone, and improve their nutritional statuses through interventional programs.

Cooking skills play a crucial role in meal preparation, particularly when using raw ingredients. Food skills include meal planning, conceptualizing food, meal preparation,

cooking techniques, food awareness, and knowledge of nutritious and hygienic foods [47]. Cooking and food skills are closely related to food selection and health outcomes. Adults with higher cooking skills are less likely to choose convenience or processed foods, and are more likely to consume more vegetables [23-26]. Additionally, cooking and food skills differed depending on sex and age, with older adults and female tending to have better cooking and food skills [30].

Self-efficacy related to these cooking skills is associated with healthier food consumption [27,28]. In a study conducted in Australia, when groups were classified according to their levels of confidence in food technology and nutritional knowledge, the importance of consuming fresh food and vegetables and the rate of reading and choosing based on product information (e.g., ingredients and nutritional labels) increased when confidence was high [29]. The present study investigated the dietary competencies and cooking skills of middle-aged adults living alone, and found that female had higher dietary competencies and cooking skills than male. Although the dietary competencies and cooking skills in this study differed from those investigated in previous studies [26,29,30], female generally appeared to have higher competencies than male. Therefore, various methods should be implemented to improve dietary competencies and cooking skills in middle-aged and older male living alone, including conducting cooking classes and providing recipes.

Analyzing the relationships between dietary competencies, cooking skills, and the NQ score showed that higher dietary competencies and cooking skills correlated significantly with higher NQ score. These results are similar to those of a previous study [30], which showed that adults with high diet quality scores had higher levels of confidence in their cooking and food skills, and lower levels of consumption of takeaway foods. Adults with lower cooking skills have higher risk of death; however, this was only observed among those who were living alone [33]. Therefore, customized education is warranted to improve the dietary competencies and cooking skills of middle-aged adults and single-person households.

This study had several limitations. First, the participants were limited to middle-aged adults living alone; therefore, characteristics could not be compared between single- and multi-person households. However, the dietary characteristics of single- and multi-person households have been thoroughly examined in other previous studies [8,10,41,45]. The purpose of this study was to analyze the dietary habits, cooking behaviors, and purchasing environments of single-person households and to systematically analyze the relationship between these factors and nutritional status. Second, despite the fact that socioeconomic factors such as income and education level have an impact on nutrition and health, no comparative analysis was conducted with regard to the nutritional status of adults living alone according to their socioeconomic level. Third, although eating habits, dietary competencies, cooking skills, and NQ scores of middle-aged adults living alone were analyzed, the relationship between these factors and health outcomes was not. A previous study analyzing adults aged ≥ 19 yrs found that adults living alone had more inappropriate eating habits, such as skipping breakfast and eating meals irregularly, and significantly higher prevalence of metabolic syndrome than those living in multi-person households [48].

In addition, a 3-yr cohort study targeting older adults showed that lower cooking skills correlated with higher risk of death; however, this was only found in adults who lived alone [33]. Considering these results, detailed research regarding the relationship between dietary habits and nutritional statuses of middle-aged adults living alone and health indicators is

warranted. Finally, because this was a cross-sectional study, the results were derived only for correlations, and causal relationships could not be revealed. Therefore, longitudinal studies are warranted to determine specifically how the dietary characteristics of adults living alone affect their nutritional statuses and future health indicators.

This study also had several notable strengths. First, when recruiting participants for this study, samples were extracted using proportional allocation by age group, sex, and residential area. This ensured a representative sampling of adults living alone from across the country, thereby making the results of this study more generalizable. Second, this study derived the dietary characteristics and intervention factors of middle-aged adults living alone, and subdivided them by age group and sex. Therefore, the results of this study may be useful as fundamental data for developing customized education programs for adults living alone based on age group and sex in dedicated centers for people living alone or health centers in the community.

REFERENCES

1. Statistics Korea. 2022 Social Trends in Korea. Daejeon: Statistics Korea; 2022.
2. Statistics Korea. 2022 Statistics on One-Person Households. Daejeon: Statistics Korea; 2022.
3. Kandler U, Meisinger C, Baumert J, Löwel H; KORA Study Group. Living alone is a risk factor for mortality in men but not women from the general population: a prospective cohort study. *BMC Public Health* 2007;7:335. [PUBMED](#) | [CROSSREF](#)
4. Meisinger C, Kandler U, Ladwig KH. Living alone is associated with an increased risk of type 2 diabetes mellitus in men but not women from the general population: the MONICA/KORA Augsburg Cohort Study. *Psychosom Med* 2009;71:784-8. [PUBMED](#) | [CROSSREF](#)
5. Chae HJ, Kim M. Health behavior, health service use, and health related quality of life of adult women in one-person and multi-person households. *Korean J Women Health Nurs* 2019;25:299-314. [PUBMED](#) | [CROSSREF](#)
6. Kullberg K, Aberg AC, Bjorklund A, Ekblad J, Sidenvall B. Daily eating events among co-living and single-living, diseased older men. *J Nutr Health Aging* 2008;12:176-82. [PUBMED](#) | [CROSSREF](#)
7. Heo YK, Sim KH. Dietary attitude of single households in metropolitan areas. *Korean J Food Nutr* 2016;29:735-45. [CROSSREF](#)
8. Hanna KL, Collins PF. Relationship between living alone and food and nutrient intake. *Nutr Rev* 2015;73:594-611. [PUBMED](#) | [CROSSREF](#)
9. Kwak JH, Choi S, Ju DJ, Lee M, Paik JK. An analysis of the association between chronic disease risk factors according to household type for the middle-aged: the Korea national health and nutrition examination survey (2013–2015). *Korean J Food Nutr* 2021;34:88-95.
10. Hong SH, Kim JM. Relationship between eating behavior and healthy eating competency of single-person and multi-person households by age group. *Korean J Community Nutr* 2021;26:337-49. [CROSSREF](#)
11. Lee SJ. A study on dietary intake and health status between single- and multi-person households: using cross-sectional and longitudinal data [dissertation]. Seoul: Ewha Womans Univrsity; 2022.
12. Korea Rural Economic Institute. 2018 Food Consumption Behavior Survey. Naju: Korea Rural Economic Institute; 2018.
13. KB Financial Group Management Research Institute. 2020 Korean Single-Person Household Report. Seoul: KB Financial Group Management Research Institute; 2020.
14. Lee H, Cho YT. Comparison of health behaviors, disease prevalence between middle aged one-person households and multi-member households in South Korea. *Pogon Sahoe Yongu* 2019;39:380-407. [CROSSREF](#)
15. Jang M, Her E, Lee K. Metabolic syndrome risk by intake ratio and intake pattern of protein in middle-aged men based on the 2012–2013 Korean National Health and Nutrition Examination Survey Data. *Korean J Community Nutr* 2016;21:366-77. [CROSSREF](#)
16. Passi SJ. Prevention of non-communicable diseases by balanced nutrition: population- specific effective public health approaches in developing countries. *Curr Diabetes Rev* 2017;13:461-76. [PUBMED](#) | [CROSSREF](#)

17. Malik S, Dineen EH. Integrative approaches for cardiovascular disease prevention. In: Wong ND, Amsterdam EA, Toth PP, editors. *ASPC Manual of Preventive Cardiology*. Cham: Springer Cham; 2021. p.705-32.
18. Güzel S, Keser A. Relationship between the risk of coronary heart disease and nutritional status of adult. *Acta Nat Sci* 2022;3:189-202. [CROSSREF](#)
19. Garcia AL, Reardon R, McDonald M, Vargas-Garcia EJ. Community interventions to improve cooking skills and their effects on confidence and eating behaviour. *Curr Nutr Rep* 2016;5:315-22. [PUBMED](#) | [CROSSREF](#)
20. Foley W, Spurr S, Lenoy L, De Jong M, Fichera R. Cooking skills are important competencies for promoting healthy eating in an urban indigenous health service. *Nutr Diet* 2011;68:291-6. [CROSSREF](#)
21. Bernardo GL, Rodrigues VM, Bastos BS, Uggioni PL, Hauschild DB, Fernandes AC, Martinelli SS, Cavalli SB, Bray J, Hartwell H, et al. Association of personal characteristics and cooking skills with vegetable consumption frequency among university students. *Appetite* 2021;166:105432. [PUBMED](#) | [CROSSREF](#)
22. Moreau M, Plourde H, Hendrickson-Nelson M, Martin J. Efficacy of nutrition education-based cooking workshops in community-dwelling adults aged 50 years and older. *J Nutr Gerontol Geriatr* 2015;34:369-87. [PUBMED](#) | [CROSSREF](#)
23. van der Horst K, Brunner TA, Siegrist M. Ready-meal consumption: associations with weight status and cooking skills. *Public Health Nutr* 2011;14:239-45. [PUBMED](#) | [CROSSREF](#)
24. Hartmann C, Dohle S, Siegrist M. Importance of cooking skills for balanced food choices. *Appetite* 2013;65:125-31. [PUBMED](#) | [CROSSREF](#)
25. Lam MCL, Adams J. Association between home food preparation skills and behaviour, and consumption of ultra-processed foods: cross-sectional analysis of the UK National Diet and nutrition survey (2008–2009). *Int J Behav Nutr Phys Act* 2017;14:68. [PUBMED](#) | [CROSSREF](#)
26. Tani Y, Fujiwara T, Kondo K. Cooking skills related to potential benefits for dietary behaviors and weight status among older Japanese men and women: a cross-sectional study from the JAGES. *Int J Behav Nutr Phys Act* 2020;17:82. [PUBMED](#) | [CROSSREF](#)
27. Cannuscio CC, Hillier A, Karpyn A, Glanz K. The social dynamics of healthy food shopping and store choice in an urban environment. *Soc Sci Med* 2014;122:13-20. [PUBMED](#) | [CROSSREF](#)
28. Kreausukon P, Gellert P, Lippke S, Schwarzer R. Planning and self-efficacy can increase fruit and vegetable consumption: a randomized controlled trial. *J Behav Med* 2012;35:443-51. [PUBMED](#) | [CROSSREF](#)
29. Burton M, Reid M, Worsley A, Mavondo F. Food skills confidence and household gatekeepers' dietary practices. *Appetite* 2017;108:183-90. [PUBMED](#) | [CROSSREF](#)
30. Lavelle F, Bucher T, Dean M, Brown HM, Rollo ME, Collins CE. Diet quality is more strongly related to food skills rather than cooking skills confidence: results from a national cross-sectional survey. *Nutr Diet* 2020;77:112-20. [PUBMED](#) | [CROSSREF](#)
31. Papadaki A, Scott JA. The impact on eating habits of temporary translocation from a Mediterranean to a Northern European environment. *Eur J Clin Nutr* 2002;56:455-61. [PUBMED](#) | [CROSSREF](#)
32. Larson NI, Perry CL, Story M, Neumark-Sztainer D. Food preparation by young adults is associated with better diet quality. *J Am Diet Assoc* 2006;106:2001-7. [PUBMED](#) | [CROSSREF](#)
33. Tani Y, Fujiwara T, Anzai T, Kondo K. Cooking skills, living alone, and mortality: JAGES cohort study. *Int J Behav Nutr Phys Act* 2023;20:131. [PUBMED](#) | [CROSSREF](#)
34. Choi MK, Park ES, Kim MH. Home meal replacement use and eating habits of adults in one-person households. *Korean J Community Nutr* 2019;24:476-84. [CROSSREF](#)
35. Seoul Metropolitan Government. 2022 Seoul Food Statistics Survey Report. Seoul: Seoul Metropolitan Government; 2022. p.637-56.
36. Yook SM, Lim YS, Lee JS, Lim KN, Hwang HJ, Kwon S, Hwang JY, Kim HY. Revision of nutrition quotient for Korean adults: NQ-2021. *J Nutr Health* 2022;55:278-95. [CROSSREF](#)
37. Lee SL, Lee SJ. The effects of eating habit and food consumption lifestyles on dietary life satisfaction of one-person households. *J Consum Cult* 2016;19:115-33. [CROSSREF](#)
38. Lee SL, Choi IS, Kim JH. Healthy eating capability of one: person households-the effects of eating alone, meal types, and dietary lifestyles. *Fam Environ Res* 2020;58:483-96. [CROSSREF](#)
39. Sierra-Johnson J, Undén AL, Lineström M, Rosell M, Sjogren P, Kolak M, De Faire U, Fisher RM, Hellénus ML. Eating meals irregularly: a novel environmental risk factor for the metabolic syndrome. *Obesity (Silver Spring)* 2008;16:1302-7. [PUBMED](#) | [CROSSREF](#)
40. St-Onge MP, Ard J, Baskin ML, Chiuve SE, Johnson HM, Kris-Etherton P, Varady K, et al.; American Heart Association Obesity Committee of the Council on Lifestyle and Cardiometabolic Health; Council on Cardiovascular Disease in the Young; Council on Clinical Cardiology Meal timing and frequency:

- implications for cardiovascular disease prevention: a scientific statement from the American Heart Association. *Circulation* 2017;135:e96-121. [PUBMED](#) | [CROSSREF](#)
41. Nakashima T, Katayama N, Saji N, Teranishi M, Yoshida T, Suzuki H, Sone M, Hamajima N. Dietary habits and medical examination findings in Japanese adults middle-aged or older who live alone. *Nutrition* 2021;89:111268. [PUBMED](#) | [CROSSREF](#)
 42. Na Y, Lee KW. Association of household types with healthy dietary practices in Korean adults: findings from the 2017–2021 Korea National Health and Nutrition Examination Survey. *J Korean Soc Food Cult* 2023;38:293-303.
 43. Aune D, Giovannucci E, Boffetta P, Fadnes LT, Keum N, Norat T, Greenwood DC, Riboli E, Vatten LJ, Tonstad S. Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality-a systematic review and dose-response meta-analysis of prospective studies. *Int J Epidemiol* 2017;46:1029-56. [PUBMED](#) | [CROSSREF](#)
 44. Zin CAJCM, Mohamed WMIW, Khan NAK, Ishak WRW. Effects of fruit and vegetable polyphenols on the glycemic control and metabolic parameters in type 2 diabetes mellitus: a review. *Prev Nutr Food Sci* 2022;27:257-64. [PUBMED](#) | [CROSSREF](#)
 45. Kim JM, Lee E. Association between healthy eating index and mental health in middle-aged adults based on household size in Korea. *Int J Environ Res Public Health* 2022;19:4692. [PUBMED](#) | [CROSSREF](#)
 46. Sandri E, Pérez-Bermejo M, Cabo A, Cerdá-Olmedo G. Living alone: associations with diet and health in the Spanish young adult population. *Nutrients* 2023;15:2516. [PUBMED](#) | [CROSSREF](#)
 47. Region of Waterloo Public Health. Food skills of Waterloo region adults [Internet]. Waterloo: Region of Waterloo Public Health; 2010 [cited 2024 July 7]. Available from: <http://chd.region.waterloo.on.ca/en/researchResourcesPublications/resources/FoodSkills.pdf>.
 48. Lee KW, Shin D. Comparison of dietary behaviors and the prevalence of metabolic syndrome in single- and multi-person households among Korean adults. *Healthcare (Basel)* 2021;9:1116. [PUBMED](#) | [CROSSREF](#)