

Original Article



OPEN ACCESS

Received: Jun 5, 2024
Revised: Jul 5, 2024
Accepted: Jul 14, 2024
Published online: Jul 25, 2024

Correspondence to

Mi-Kyeong Choi

Department of Food and Nutrition, Kongju National University, 54 Daehak-ro, Yesan 32439, Korea.

Email: mkchoi67@kongju.ac.kr

Copyright © 2024. The Korean Society of Clinical Nutrition

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ORCID iDs

Yun-A Lee

<https://orcid.org/0000-0002-2516-1447>

Mi-Kyeong Choi

<https://orcid.org/0000-0002-6227-4053>

Conflict of Interest

The authors declare that they have no competing interests.

Author Contributions

Conceptualization: Choi MK; Formal analysis:

Lee YA, Choi MK; Investigation: Lee YA;

Methodology: Lee YA, Choi MK; Supervision:

Choi MK; Writing - original draft: Choi MK;

Writing - review & editing: Lee YA, Choi MK.

Nutritional Assessment of Protein and Sodium Contents in Commercial Senior-Friendly Foods

Yun-A Lee , Mi-Kyeong Choi

Department of Food and Nutrition, Kongju National University, Yesan 32439, Korea

ABSTRACT

The purpose of this study was to evaluate the nutritional adequacy of senior-friendly foods sold in Korea, focusing on protein and sodium. This study examined the nutritional content of 170 products with nutritional labels that were sold in online stores in Korea and categorized the products into 93 staple foods (cooked rice, porridge, and mousse) and 77 side-dish and snack foods (braized-steam-roast products, broth, sauces, and snacks). Then, the adequacy of the nutritional content of these foods, focusing on protein and sodium, was evaluated according to product type. The 93 staple products and 77 side-dish products had average serving sizes of 163.27 g and 127.92 g, prices of \$3.25 and \$2.72, and energy contents of 295.25 kcal and 141.95 kcal, respectively. For staple foods, the energy content was significantly greater in cooked rice, but the protein content and index of nutrition quality (INQ) were significantly greater in mousse. There were no significant differences in sodium content or contribution to adequate intake (AI) by product type, but the sodium INQ was significantly greater in the mousse and porridge. For side-dish foods and snack products, the protein content, contribution to the recommended intake, and INQ were all significantly greater for the braized-steam-roast products. Sauces and braized-steam-roast products were significantly higher in sodium content and contribution to the AI, while broth was significantly higher in sodium INQ. These findings can be used to guide proper product selection and nutritional management that considers the health characteristics of health-vulnerable and elderly people.

Keywords: Aged; Food; Protein; Sodium; Dietary reference intake

INTRODUCTION

The global elderly population is growing steadily due to economic and living environment improvements and medical advances. The United Nations estimates that the the world's population aged 65 and older is growing rapidly and that it will increase from 10% in 2022 to 16% by 2050 [1]. South Korea has already transitioned into being an aged society, with 14.2% of its population being aged 65 and over in 2017; this percentage is expected to exceed 20% by 2025, and South Korea will become a super-aged society by 2060, with this figure reaching 43.8% [2].

As societies age, the physical and mental health of elderly people, as well as their quality of life, is becoming an important issue at the national level. Older adults have difficulty eating due to physical problems with chewing and swallowing as well as degeneration of their sense of taste and smell. These conditions can lead to reduced food energy and nutrient intake, and consequently to the malnutrition. Previous studies have reported that older adults are at greater risk for malnutrition due to a combination of physiological changes as well as mental and socioeconomic factors [3,4].

Protein deficiency can lead to loss of muscle mass, decreased immune function, and delayed wound healing [5]. Recently, it has been reported that sarcopenia, a decline in physical function in old age due to loss of muscle mass and strength [6], is related to energy [7], protein [8], and antioxidant nutrients [9]. Therefore, proper nutrition has been emphasized for the prevention of sarcopenia in elderly people. In addition, it has been reported that the reduced gustatory function could lead to the preference for saltiness and large amount of sodium consumption [10]. Excess sodium intake has been reported to contribute to a variety of health problems, including cardiovascular and kidney disease [11,12], therefore, older adults should also pay attention to their sodium intake [13].

As the share of the elderly population increases, senior-friendly foods are being produced and marketed that cater to the physiological changes and preferences of elderly people, with the goal of making these foods easier for elderly people to swallow and digest. Senior-friendly food is defined as food that is processed by adjusting the physical properties, form, and ingredients of food to help elderly people eat, digest, absorb, and metabolize it [14,15]. As the demand for and market for senior-friendly foods increase, research is being conducted on product development [16-18]. However, there is limited research on the nutritional properties of products that are tailored to specific consumers groups such as elderly people.

We aimed to propose scientific guidelines that can be used by consumers, such as older adults who use age-friendly foods, to select products that are suitable for nutritious meal compositions. We hypothesized that the nutritional characteristics of senior-friendly foods would differ depending on the type and purpose of the product. Therefore, the nutrient content of Korean senior-friendly foods was examined by categorizing them into staple foods and side products, and the adequacy of nutrition was evaluated by focusing on protein and sodium, which are important for elderly people.

MATERIALS AND METHODS

Study targets and period

We examined products that were marked as senior-friendly foods (**Figure 1**), produced according to the definition provided by the Korean Ministry of Food and Drug Safety, or highlighted as excellent senior-friendly foods in online markets in Korea. A total of 178 products were collected and categorized into staple foods (14 cooked rice products, 64 porridge products, 15 mousses) and side-dish and snack foods (21 braized-steam-roast products, 13 broths, 14 sauces, 29 snacks). Eight products were excluded from the analysis because they were not included in any categories. Market research for senior-friendly foods was conducted between February 14 and September 25, 2023.



Figure 1. Senior-friendly food symbols used in South Korea. (A) Korean FoodPolis. (B) Korean Agency for Technology and Standards.

Collection of nutritional information for senior-friendly foods

For each product, the product name, brand name, price, total weight, and nutritional information were collected from the food labels and nutrition labels. For nutritional information, energy (kcal), carbohydrates (g), sugars (g), protein (g), fat (g), saturated fat (g), trans fat (g), cholesterol (mg), and sodium (mg) were recorded.

Nutritional assessment of senior-friendly foods

Nutritional assessment was conducted using the collected nutrient content of senior-friendly foods. The nutrient content according to product type was compared per serving and per 100 g of product because of the variation in total weight. The contribution of the product to the Korean Dietary Reference Intake (DRI) of male older adults aged 65–74 years, who have the highest nutritional requirements, was also evaluated. The nutritional adequacy of the product was assessed on male older adults aged 65–74 years to determine the satisfaction of all older adults. Since one serving of senior-friendly foods is used for a single meal, nutritional adequacy was evaluated by comparing it to one-third of the DRI. For protein and sodium, the index of nutrition quality (INQ = nutrient content per 1,000 kcal/DRI per 1,000 kcal for men aged 65–74 years) of each product was evaluated. The INQ was calculated using the estimated energy requirement (2,000 kcal for energy), recommended intake (RI, 60 g for protein), and adequate intake (AI, 1,300 mg for sodium) for men aged 65–74 years.

Statistical analysis

All data in this study were statistically analyzed using the SAS program (version 9.4; SAS Institute Inc., Cary, NC, USA). The means and standard deviations of all variables were calculated. Differences according to product type were tested using one-way ANOVA followed by Duncan's multiple range test. All significance tests were considered significant at $p < 0.05$.

RESULTS

General characteristics of staple senior-friendly foods

The general characteristics and nutrient contents of the staple food products are shown in **Table 1**. The average serving size of a staple food product was 163.27 g, the price was 3.25 US dollars (4,498.38 won), and the energy content per serving was 295.25 kcal. Cooked rice had the greatest serving size, price, energy, carbohydrate, and cholesterol content, but the trans fat content was significantly greater in mousse ($p < 0.05$).

Table 1. Price and nutritional values of staple senior-friendly foods

Variables	Total (n = 93)	Cooked rice (n = 14)	Porridge (n = 64)	Mousse (n = 15)	p value
Serving size (g)	163.27 ± 62.24	202.79 ± 60.16 ^a	166.64 ± 61.17 ^a	112.00 ± 28.83 ^b	< 0.001
Price (USD)	3.25 ± 3.09	5.85 ± 3.73 ^a	2.70 ± 2.98 ^b	3.17 ± 1.37 ^b	0.002
Energy (kcal)	295.25 ± 174.81	339.50 ± 133.47 ^a	315.63 ± 180.00 ^a	166.99 ± 130.28 ^b	0.006
Carbohydrate (g)	52.36 ± 35.35	61.29 ± 22.73 ^a	58.47 ± 36.03 ^a	18.00 ± 19.33 ^b	< 0.001
Sugars (g)	4.07 ± 5.01	2.48 ± 1.32	4.38 ± 5.81	4.22 ± 2.93	0.438
Fat (g)	5.26 ± 5.12	6.91 ± 3.89	4.99 ± 5.54	4.89 ± 4.10	0.432
Saturated fat (g)	1.38 ± 2.04	1.44 ± 1.15	1.23 ± 2.29	1.97 ± 1.48	0.455
Trans fat (g)	0.01 ± 0.06	0.02 ± 0.07 ^b	0.00 ± 0.01 ^b	0.07 ± 0.11 ^a	< 0.001
Cholesterol (mg)	12.33 ± 18.09	22.86 ± 24.83 ^a	7.84 ± 15.35 ^b	21.69 ± 14.85 ^a	0.001

Values are presented as mean ± standard deviation.

^{a,b}Values with different superscripts within a row are significantly different by Duncan's multiple range test (p < 0.05).

Protein and sodium content of staple senior-friendly foods

The protein and sodium contents of the staple food products are shown in **Table 2**. The protein content per serving and per 100 g was the highest in mousse, but the sodium content was not significantly different among staple foods. The percentages of energy, protein, and sodium content and the protein and sodium INQs to one-third of the DRIs for older men aged 65–74 years are shown in **Table 3**. The energy contribution was significantly greater for cooked rice than for other staple foods (p < 0.05). The protein content and the INQs of protein and sodium were significantly greater in mousse (p < 0.05).

Table 2. Protein and sodium values of staple senior-friendly foods

Variables	Protein (g)			Sodium (mg)		
	Mean ± SD	Median	IQR	Mean ± SD	Median	IQR
Per serving size						
Total (n = 93)	10.62 ± 8.04	9.00	5.00–14.00	525.70 ± 424.17	450.00	160.00–809.64
Cooked rice (n = 14)	13.64 ± 8.40 ^{ab}	11.50	6.00–22.00	394.21 ± 438.00	220.00	20.00–690.00
Porridge (n = 64)	9.01 ± 5.94 ^b	9.17	4.00–13.00	577.48 ± 432.06	540.00	160.00–848.64
Mousse (n = 15)	14.64 ± 12.75 ^a	9.00	7.00–31.50	427.48 ± 352.49	370.00	191.25–460.00
p value	0.014			0.214		
Per 100 g						
Total (n = 93)	7.66 ± 7.51	6.67	2.50–9.60	367.71 ± 334.80	210.00	115.39–616.60
Cooked rice (n = 14)	7.43 ± 5.62 ^b	5.42	3.00–12.40	230.51 ± 299.68	101.67	10.00–310.08
Porridge (n = 64)	6.20 ± 4.85 ^b	6.50	2.00–9.50	396.31 ± 350.22	196.88	115.19–652.80
Mousse (n = 15)	14.12 ± 13.44 ^a	7.33	6.00–34.17	373.70 ± 280.47	306.67	212.50–388.89
p value	< 0.001			0.246		

SD, standard deviation; IQR, interquartile range.

^{a,b}Values with different superscripts within a row are significantly different by Duncan's multiple range test (p < 0.05).

Table 3. Nutritional contribution of staple senior-friendly foods to 1/3 of dietary reference intake*

Variables	Total (n = 93)	Cooked rice (n = 14)	Porridge (n = 64)	Mousse (n = 15)	p value
%					
Energy	44.29 ± 26.22	50.93 ± 20.02 ^a	47.34 ± 27.00 ^a	25.05 ± 19.54 ^b	0.006
Protein	53.08 ± 40.21	68.21 ± 42.00 ^{ab}	45.05 ± 29.69 ^b	73.20 ± 63.74 ^a	0.014
Sodium	121.31 ± 97.88	90.97 ± 101.08	133.26 ± 99.71	98.65 ± 81.34	0.214
INQ					
Protein	1.32 ± 0.89	1.24 ± 0.42 ^b	0.99 ± 0.51 ^b	2.80 ± 0.98 ^a	< 0.001
Sodium	3.02 ± 1.90	1.36 ± 1.38 ^c	2.92 ± 1.41 ^b	5.03 ± 2.39 ^a	< 0.001

Values are presented as mean ± standard deviation.

INQ, index of nutrition quality.

*Dietary reference intakes for Korean men aged 65–74 years: estimated energy requirement 2,000 kcal, recommended intakes of protein 60 g, and adequate intake of sodium 1,300 mg.

^{a,b,c}Values with different superscripts within a row are significantly different by Duncan's multiple range test (p < 0.05).

General characteristics of side and snack senior-friendly foods

The general characteristics and nutrient contents of the side and snack senior-friendly foods are shown in **Table 4**. The average serving size of all products was 127.92 g, with a price of 2.72 US dollars and an energy content of 141.95 kcal. The energy, sugar, fat, saturated fat, trans fat, and cholesterol contents per serving were the highest in braized-steam-roast products, the price was highest in broth, and the serving size and carbohydrate content were highest in sauce products.

Protein and sodium content of side and snack senior-friendly foods

The protein and sodium contents of side and snack senior-friendly foods are shown in **Table 5**. The protein content per serving and per 100 g of product was significantly greater for braized-steam-roast products, and the sodium content was significantly greater for braized-steam-roast products and sauces. The percentages of energy, protein, and sodium contents and the protein and sodium INQs to one-third of the DRIs for older men aged 65–74 years are shown in **Table 6**. The energy and sodium contributions were significantly greater for braized-steam-roast products and sauces, while the protein contributions were significantly greater for braized-steam-roast products. The protein INQ was significantly greater for braized-steam-roast products and broths, and the sodium INQ was significantly greater for broths.

Table 4. Price and nutritional values of side and snack senior-friendly foods

Variables	Total (n = 77)	Braized-steam-roast (n = 21)	Broth (n = 13)	Sauce (n = 14)	Snack (n = 29)	p value
Serving size (g)	127.92 ± 66.90	161.19 ± 78.55 ^a	150.00 ± 0.00 ^a	180.00 ± 20.75 ^a	68.79 ± 38.81 ^b	< 0.001
Price (USD)	2.72 ± 1.73	3.22 ± 1.79 ^a	3.56 ± 0.28 ^a	2.70 ± 1.22 ^{ab}	1.99 ± 2.02 ^b	0.017
Energy (kcal)	141.95 ± 103.88	216.57 ± 101.53 ^a	23.54 ± 13.26 ^c	191.43 ± 53.08 ^a	117.10 ± 89.40 ^b	< 0.001
Carbohydrate (g)	16.41 ± 11.42	17.62 ± 11.00 ^b	3.32 ± 2.60 ^c	25.00 ± 3.90 ^a	17.24 ± 11.80 ^b	< 0.001
Sugars (g)	6.05 ± 5.40	8.08 ± 6.64 ^a	0.71 ± 0.42 ^b	7.86 ± 2.71 ^a	6.09 ± 5.12 ^a	< 0.001
Fat (g)	5.61 ± 6.46	9.37 ± 8.78 ^a	0.43 ± 0.53 ^c	6.74 ± 4.01 ^{ab}	4.52 ± 4.83 ^b	< 0.001
Saturated fat (g)	1.27 ± 1.91	2.53 ± 2.66 ^a	0.08 ± 0.15 ^c	1.39 ± 1.66 ^{ab}	0.75 ± 1.03 ^{bc}	< 0.001
Trans fat (g)	0.02 ± 0.07	0.07 ± 0.12 ^a	0.00 ± 0.00 ^b	0.02 ± 0.06 ^b	0.00 ± 0.00 ^b	0.004
Cholesterol (mg)	19.95 ± 29.01	45.71 ± 34.65 ^a	2.89 ± 3.74 ^c	24.29 ± 24.72 ^b	3.42 ± 10.68 ^c	< 0.001

Values are presented as mean ± standard deviation.

^{a,b,c}Values with different superscripts within a row are significantly different by Duncan's multiple range test ($p < 0.05$).

Table 5. Protein and sodium values of side and snack senior-friendly foods

Variables	Protein (g)			Sodium (mg)		
	Mean ± SD	Median	IQR	Mean ± SD	Median	IQR
Per serving size						
Total (n = 77)	9.01 ± 8.74	6.00	2.00–13.00	430.00 ± 409.29	362.00	88.00–580.00
Braized-steam-roast (n = 21)	16.52 ± 9.30 ^a	17.00	11.00–23.00	678.38 ± 404.72 ^a	780.00	320.00–1,000.00
Broth (n = 13)	1.60 ± 0.61 ^c	1.80	1.20–1.80	379.69 ± 26.06 ^b	378.00	368.00–394.00
Sauce (n = 14)	10.93 ± 3.79 ^b	11.50	9.00–13.00	832.14 ± 396.97 ^a	675.00	540.00–960.00
Snack (n = 29)	5.48 ± 7.40 ^c	3.30	1.65–6.00	78.54 ± 89.48 ^c	35.00	15.00–89.00
p value	< 0.001			< 0.001		
Per 100 g						
Total (n = 77)	7.62 ± 6.26	6.88	2.00–12.50	287.57 ± 200.57	266.14	100.00–368.75
Braized-steam-roast (n = 21)	10.90 ± 5.34 ^a	11.50	8.33–13.33	430.93 ± 185.67 ^a	434.78	320.00–512.50
Broth (n = 13)	1.07 ± 0.41 ^c	1.20	0.80–1.20	253.13 ± 17.37 ^b	252.00	245.33–262.67
Sauce (n = 14)	6.18 ± 2.15 ^b	6.88	5.50–7.50	449.02 ± 173.01 ^a	374.38	337.50–480.00
Snack (n = 29)	9.10 ± 7.42 ^{ab}	6.67	4.13–13.75	121.27 ± 113.58 ^c	71.43	27.00–220.00
p value	< 0.001			< 0.001		

SD, standard deviation; IQR, interquartile range.

^{a,b,c}Values with different superscripts within a row are significantly different by Duncan's multiple range test ($p < 0.05$).

Table 6. Nutritional contribution of side and snack senior-friendly foods to 1/3 of dietary reference intake*

Variables	Total (n = 77)	Braized-steam-roast (n = 21)	Broth (n = 13)	Sauce (n = 14)	Snack (n = 29)	p value
%						
Energy	21.29 ± 15.58	28.32 ± 12.13 ^a	3.53 ± 1.99 ^c	28.71 ± 7.96 ^a	17.57 ± 13.41 ^b	< 0.001
Protein	45.07 ± 43.68	66.00 ± 47.36 ^a	8.00 ± 3.06 ^c	54.64 ± 18.96 ^b	27.44 ± 36.99 ^c	< 0.001
Sodium	99.23 ± 94.45	159.37 ± 101.86 ^a	87.62 ± 6.01 ^b	192.03 ± 91.61 ^a	18.13 ± 20.65 ^c	< 0.001
INQ						
Protein	2.03 ± 1.26	2.62 ± 1.43 ^a	2.55 ± 1.04 ^a	1.96 ± 0.64 ^{ab}	1.30 ± 1.13 ^b	< 0.001
Sodium	8.35 ± 12.26	5.09 ± 3.04 ^{bc}	31.21 ± 14.52 ^a	6.53 ± 2.04 ^b	1.34 ± 2.41 ^c	< 0.001

Values are presented as mean ± standard deviation.

INQ, index of nutrition quality.

*Dietary reference intakes for Korean men aged 65–74 years: estimated energy requirement 2,000 kcal, recommended intakes of protein 60 g, and adequate intake of sodium 1,300 mg.

^{a,b,c}Values with different superscripts within a row are significantly different by Duncan's multiple range test ($p < 0.05$).

DISCUSSION

As the demand for senior-friendly foods is increasing with the growing elderly population, this study categorized senior-friendly foods into staple foods and side foods and evaluated their nutritional adequacy, focusing on protein and sodium. As older adults age, their physiological, physical, and mental functions decline, and they face a variety of problems, including decreased physical activity, poor nutrition, medication use, cognitive decline, and various diseases [19,20]. For older adults in particular, chewing and swallowing issues, as well as dysfunction in taste and smell, can lead to a decrease in food intake, which can lead to malnutrition [21]. According to the Korea National Health and Nutrition Examination Survey (KNHANES) [2], the proportion of nutrition-deficient people aged 65 and older was 14.7% in 2017, 23.8% in 2019, 22.8% in 2021, and 18.2% in 2022, with the figure for 2022 being more than 7 times greater than the proportion of energy and fat overnutrition of 2.6% for that year.

Inadequate protein intake can lead to loss of muscle mass, decreased immune function, and delayed wound healing, therefore it is important to ensure adequate energy intake and high-quality protein intake in older adults [5]. In recent years, there has been a growing interest in the prevention and management of sarcopenia, a condition characterized by a decline in physical function in old age due to loss of muscle mass and strength. Proper nutrition is an important factor in preventing sarcopenia, and energy, protein, and antioxidants have been reported to be associated with sarcopenia [22].

In the present study, among staple foods, the energy content was significantly higher in cooked rice than in porridge and mousse, but the protein content and INQ were significantly greater in mousse. These results show that rice is generally a good choice in terms of energy and protein nutrition when choosing a staple senior-friendly food, but mousse can be an alternative when dietary restrictions are present. These results suggest that cooked rice is appropriate as a staple senior-friendly food in terms of energy supply, but mousse can be an alternative for protein supplementation for people with dietary restrictions. Among side foods and snack products, the protein content, contribution to the DRI, and INQ were all significantly greater for the braized-steam-roast products. These findings can be used to make senior-friendly food choices, such as choosing mousses and steamed foods, when considering protein intake.

Excess sodium intake has been reported to contribute to a variety of health issues, including cardiovascular and kidney disease [11,12]. Declining physical functions can lead to changes in taste sensitivity, especially in elderly people, resulting in a decreased perception of tastes

such as salty, sweet, and bitter, and these changes can lead to loss of appetite, inappropriate dietary intake, and nutritional deficiencies [10]. In addition, sodium intake in elderly individuals should be carefully managed, as it has been reported that the preference for salty tastes increases with age due to changes in taste perception, leading to an increase in sodium intake [13]. According to the KNHANES [2], the prevalence of hypertension among elderly individuals aged 65 years and older was 62.3%, approximately 3 times higher than the prevalence of 21.4% among adults aged 19 years and older, and the proportion of elderly individuals who exceeded the goal intake (2,000 mg/d) of sodium was also reported to be high at 62.7%.

In this study, there were no significant differences in sodium content or contribution to DRI among staple senior-friendly foods by type, but the INQ of sodium was significantly greater in mousse and porridge than in rice. These findings suggest that rice is a good choice for reducing sodium intake when choosing staple foods for elderly people. In this study, the sodium content and contribution to DRI were significantly greater in sauces and braized-steam-roast products, while the sodium INQ was significantly greater in broth. Choi et al. [23] analyzed sodium intake by food and food type in 640 adults and older adults aged 19–69 years and reported the highest sodium intake (481.5 mg/d) from noodle soup. The DRI for Koreans (2020) also recommends reducing the consumption of liquid from noodle soups, soups, and stews as one of the ways to reduce sodium intake [14]. Considering that the sodium content of senior-friendly foods in this study greatly exceeded the DRI, except for that of snacks, and that elderly and health-vulnerable people prefer brothy foods that are easy to swallow, it is necessary to develop products with broth that have a reduced sodium content.

This study has following limitations. The study focused on senior-friendly foods in domestic markets, but as new products are constantly being produced worldwide, the limited research period and product group classification of this study did not allow for the examination and analysis of a wide range of senior-friendly foods. Therefore, the results of this study cannot be generalized to all senior-friendly foods. To compensate for these limitations of this study, research should be conducted to continually evaluate newly produced senior-friendly foods and to develop a standard model of meal composition using senior-friendly foods. It is also suggested that consumers check nutritional labels when selecting senior-friendly foods because there is wide variation in nutritional content, including protein and sodium content, among products. Despite some limitations, this study analyzed the nutritional characteristics of products at a time when the demand for and market for senior-friendly foods are expanding, and it provided information that is necessary for selecting appropriate products according to consumers' health characteristics. The findings can be used for nutritional management of elderly and health-vulnerable people.

CONCLUSION

This study categorized senior-friendly foods into staple and side dishes, examining their nutritional adequacy with a focus on protein and sodium. For staple foods, the energy content was significantly greater in cooked rice, but the protein content and INQ were significantly greater in mousse. There were no significant differences in the sodium content or contribution to the AI by product type, but the sodium INQ was significantly greater in mousse and porridge. For side-dish foods and snack products, the protein content, contribution to the RI, and INQ were all significantly greater for the braized-steam-roast

products. Sauces and braized-steam-roast products were significantly higher in sodium content and contribution to AI, while broth was significantly higher in sodium INQ. These results can be used for proper product selection and nutrition management for health-vulnerable and elderly people.

REFERENCES

1. United Nations. World population prospects 2022. New York (NY): United Nations; 2022.
2. Korea Centers for Disease Control and Prevention. Korea health statistics 2021: Korea National Health and Nutrition Examination Survey (KNHANES IX-1). Cheongju: Korea Centers for Disease Control and Prevention; 2023.
3. Kim JH, Chon YH, Chang HJ. A study on the food security for low-income older adults: a case study on meals on wheels project in Seoul. *J Korean Gerontol Soc* 2020;40:617-38. [CROSSREF](#)
4. Na W, Kim J, Kim H, Lee Y, Sohn C, et al. The relationship between nutrition status and risk of frailty in cognitive impaired elderly in Daycare Center (DC Center). *J Korean Soc Food Sci Nutr* 2021;50:88-94. [CROSSREF](#)
5. Kim BK, Chun YG, Lee SH, Park DJ. Emerging technology and institution of foods for the elderly. *Food Sci Ind* 2015;48:28-36.
6. Rosenberg IH. Sarcopenia: origins and clinical relevance. *J Nutr* 1997;127:990S-1S. [PUBMED](#) | [CROSSREF](#)
7. Landi F, Calvani R, Cesari M, Tosato M, Martone AM, et al. Sarcopenia: an overview on current definitions, diagnosis and treatment. *Curr Protein Pept Sci* 2018;19:633-8. [PUBMED](#) | [CROSSREF](#)
8. Sahni S, Mangano KM, Hannan MT, Kiel DP, McLean RR. Higher protein intake is associated with higher lean mass and quadriceps muscle strength in adult men and women. *J Nutr* 2015;145:1569-75. [PUBMED](#) | [CROSSREF](#)
9. Ter Borg S, de Groot LC, Mijnders DM, de Vries JH, Verlaan S, et al. Differences in nutrient intake and biochemical nutrient status between sarcopenic and nonsarcopenic older adults-results from the Maastricht Sarcopenia Study. *J Am Med Dir Assoc* 2016;17:393-401. [PUBMED](#) | [CROSSREF](#)
10. Jeon S, Kim Y, Min S, Song M, Son S, et al. Taste sensitivity of elderly people is associated with quality of life and inadequate dietary intake. *Nutrients* 2021;13:1693. [PUBMED](#) | [CROSSREF](#)
11. Malta D, Petersen KS, Johnson C, Trieu K, Rae S, et al. High sodium intake increases blood pressure and risk of kidney disease. From the science of salt: a regularly updated systematic review of salt and health outcomes (August 2016 to March 2017). *J Clin Hypertens (Greenwich)* 2018;20:1654-65. [PUBMED](#) | [CROSSREF](#)
12. Nan X, Lu H, Wu J, Xue M, Qian Y, et al. The interactive association between sodium intake, alcohol consumption and hypertension among elderly in northern China: a cross-sectional study. *BMC Geriatr* 2021;21:135. [PUBMED](#) | [CROSSREF](#)
13. Shin EK, Lee HJ, Ahn MY, Lee YK. Study on the development and evaluation of validity of salty taste assessment tool. *Korean J Nutr* 2008;41:184-91.
14. Ministry of Health and Welfare (KR); The Korean Nutrition Society. Dietary reference intakes for Koreans 2020. Sejong: Ministry of Health and Welfare; 2020.
15. Lee HS, Nam YJ, Kim YE, Kim JC, Shin Y, et al. Policies and industrial technology trends for senior-friendly foods. *Food Sci Ind* 2020;53:435-43.
16. Noda R, Sano J. Ingestion-assisting oleaginous composition for person having difficulty in swallowing/masticating and food for person having difficulty in swallowing/masticating. Japan patent JP 5938161. 2016.
17. Boo KW, Kim BG, Lee SJ. Physicochemical and sensory characteristics of enzymatically treated and texture modified elderly foods. *Korean J Food Sci Technol* 2020;5:495-502.
18. Shin KE, Jun KW. A study on the manufacturing of Jerusalem artichoke (*Helianthus tuberosus* L.) mook for development of care food. *Culin Sci Hosp Res* 2020;26:51-61.
19. Shin SJ, Hwang EH. Gender differences in the cognitive function and nutritional status in older age: a representative nationwide data of Korean elders. *J Korean Public Health Nurs* 2017;31:209-19.
20. Zarei M, Qorbani M, Djalalinia S, Sulaiman N, Subashini T, et al. Food insecurity and dietary intake among elderly population: a systematic review. *Int J Prev Med* 2021;12:8. [PUBMED](#) | [CROSSREF](#)
21. Choi MI, Mun SJ. Relationship among dietary intake ability, oral health status, and nutritional status in the elderly. *Korean J Clin Dent Hyg* 2018;6:29-40.

22. Robinson SM, Reginster JY, Rizzoli R, Shaw SC, Kanis JA, et al. Does nutrition play a role in the prevention and management of sarcopenia? *Clin Nutr* 2018;37:1121-32. [PUBMED](#) | [CROSSREF](#)
23. Choi MK, Kim NY, Lee YK, Heo YR, Hyun T, et al. Contribution of food groups to sodium and potassium intakes by their ratio in Korean adults. *Prog Nutr* 2019;21:285-93. [CROSSREF](#)