Nutrition
Research and
Practice

Original Research

Check for updates
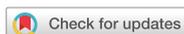
Disparities in dietary quantity and quality between the two different types of Korean family of older adults living with spouses and living alone: using data from the 6th Korea National Health and Nutrition Examination Survey

§**Corresponding Author:**
Young Suk Lim
Department of Food and Nutrition, Myongji
University, 116 Myongji-ro, Cheoin-gu,
Yongin 17058, Korea.
Tel. +82-31-330-6204
Fax. +82-31-335-7248
E-mail. victorylim@mju.ac.kr

*These two authors contributed equally to
this study.

ORCID iDs
Yu Rim Choi
https://orcid.org/0000-0002-9909-3600
Hae Ryun Park
https://orcid.org/0000-0003-2627-6518
Kyung Hee Song
https://orcid.org/0000-0001-9549-0716
Youngmi Lee
https://orcid.org/0000-0001-9965-0748
Young Suk Lim
https://orcid.org/0000-0002-6357-6512

Yu Rim Choi [iD] *, **Hae Ryun Park** [iD] *, **Kyung Hee Song** [iD], **Youngmi Lee** [iD], and **Young Suk Lim** [iD] §

Department of Food and Nutrition, Myongji University, Yongin 17058, Korea

ABSTRACT

BACKGROUND/OBJECTIVES: This study was conducted to examine disparities in food and nutrient intakes based on family types identified among 1,856 participants who were the Korean elderly people in the 6th Korea National Health and Nutrition Examination Survey (KNHNES) excluding those who were currently practicing the diet therapy.

SUBJECTS/METHODS: We separated the subjects into two groups: living alone (LA, n = 638) and living with a spouse (LS, n = 1,218). We also examined the disparities of dietary quantity and quality of those two groups using complex sampling design general linear regression analyses (CS GLM).

RESULTS: In the LA group, there was a higher percentage of females and average age in LA group was higher than the participants in the LS group. Household income and education level were significantly lower in LA compared to those of LS. The frequencies of skipping meals were higher in LA. LA's food and nutrient intakes showed lower consumption of vegetables, fruits, seaweeds, and of most nutrients. Even after adjusting for the confounding factors, the consumption of vegetables, seaweeds, carbohydrates, potassium, riboflavin, and vitamin C showed lower in LA than LS. Moreover, LA's nutrient intake ratios compared to the KDRIs were lower which turned out to be similar to their nutrient intakes.

CONCLUSIONS: These results show that dietary behavior and food intake of the elderly are associated with family types. Frequently skipping meals and less dietary variety are more common with elderly persons who were living alone. Therefore, it is necessary to integrate the supplementary food programs and nutrition education programs for the elderly living alone.

Keywords: Korean elderly; family types; dietary behavior; food intake; nutrient intake

Generated by xmlinkpress

Nutrition Research and Practice

INTRODUCTION

The proportion of the older adult population worldwide has increased consistently owing to the increased life expectancy, development of medical technology, and decrease in birthrates. In the United Nations' 2017 World Population Prospects Report [1], the proportion of older adults aged 60 years or older is expected to increase rapidly to about 15% of the entire population. Moreover, most countries, except those in Africa, can expect this cohort to account for more than 25% of their respective total population by 2050 [1]. According to Korea's National Statistical Office, the country became an aged society in 2017; a dramatic change in the types of older adult households [2] has occurred, which can be explained by the growth of nuclear families. The proportion of traditional extended households decreased from 24.5% in 1985 to 6.2% in 2015, whereas the ratio of older adults living alone increased from 16.9% to 32.9% at the same time [3]. Korean society is faced with various social problems, such as silver poor, high medical expenses, high prevalence rate of chronic diseases, and high incidence of suicide. Medical expenditures among older adults reached 39.1% of the total medical costs in 2016 [4]. The Korean government has implemented various medical and welfare policies to reduce the medical expenses of older adults and paid nationwide attention to the health problems of this population.

As their aging progresses, older people are more prone to chronic diseases, functional impairments, lack of physical activities, decrease in appetite, and difficulties in maintaining healthy nutritional diets [5-7]. Physical and mental ability as well as social networks are likely to collapse [8], which might lead to unbalanced eating. Older adults cope with higher risks of nutritional deficiencies compared with younger adults [5]. Moreover, more than half of the older adult population report clinical problems [9], such as diabetes and hypertension, which require dietary intervention for treatment. Therefore, serving customized meals is necessary, but these adults may not be consuming an adequate diet because of such factors as psychological alienation, physical weakness, and economic problems.

Cohabitation with a spouse or children plays a positive role in the physical and mental well-being of the older adult [7-13]. Older adults living alone have a higher risk of exposure and adverse effects on their prognosis of cardiovascular disease compared with those not living alone [7-9]. Older adults living alone also have fewer experiences of health-promoting activities, such as health checkups and oral examinations, and a higher smoking risk, compared with those living with their families [10]. Recent research [10,14,15] has reported that demographic and socioeconomic factors affect the food intake of older adults. Changes in household types can also affect the nutritional status of older adults [16-20]. Old age makes it difficult to be physically active, and to buy food and prepare meals.

This study aimed to provide baseline data for nutrition policy and program development for older adults in Korea by comparing dietary behavior and food and nutrients intake by family type.

SUBJECTS AND METHODS

Study participants and design
This study used the raw data of the 6th Korea National Health and Nutrition Examination Survey (KNHANES VI, 2013–2015) [21]. The KNHANES VI was a sample survey employing a

two-stage stratified cluster sampling method. The study participants included older adults aged 65 years and over who had participated in the health survey, health examination, and nutrition survey, but excluding those on the diet therapy. From such criteria, 1,856 older adults (858 men, 998 women) were selected for this study. The participants were categorized into two groups: living alone (LA) and living with a spouse (LS) based on the household survey questions. The study protocol was reviewed and approved by the Institutional Review Board of KNHANES VI (2013-07CON-03-04C, 2013-12EXP-03-5C, 2015-01-02-6C).

Assessment of dietary behavior and dietary intake

Trained interviewers collected food intake data by face-to-face interviews. Dietary behavior questions included the frequency of skipping meals and eating out. A food intake survey was conducted using the 24-hour recall method to examine the type and intake of food consumed one day before the survey date using tools such as 2D images, measuring cups, and thick slice. As the survey date influenced the amount of food intake, it was designed not to be based on a specific day. Food groups were analyzed into 17 categories based on the Standard Food Composition Table, 8th Revision in Korea [22]. The amount of nutrients intake was compared with the Dietary Reference Intakes for Koreans 2015 [23]. In the case of energy, the estimated energy requirements were used, and sodium and potassium were compared with the adequate intake.

Percentage of participants with insufficient nutrients intake

The percentage of the participants with insufficient nutrients intake in this study represented the proportion of people who consumed less than 75% of the estimated energy requirement and below of the average requirements for calcium, vitamin A, and riboflavin. We reported and then compared the percentage of the participants with insufficient nutrients intake with the statistics for the total older adults in KNHANES VI.

Demographic and socioeconomic variables

Demographic and socio-economic variables included sex, age, area of residence, household income level, and education level. The age distribution of the participants ranged from 65 to 74 years and 75 years and over, whereas the area of residence was categorized into urban and rural areas. Household income level was split into three groups according to the average household income of the designated year. Education level was classified as elementary school graduate or less, middle school graduate, high school graduate, and college graduate or more.

Statistical analyses

All of the statistical analyses were conducted using SPSS 24.0. We performed descriptive and analytic statistics using the generalized estimating equations approach through stratified and clustered design and weighting method.

For nominal variables, the χ^2 test was conducted, and for continuous variables, complex sample general linear models was undertaken to assess mean differences in food and nutrient intakes. All results of the study are presented as crude, and using two models. In the crude model, no adjustments were made for any variable, whereas sex and age variables were adjusted for in Model 1, and sex, age, energy consumption, household income, and education variables were adjusted for in Model 2.

RESULTS

Demographic characteristics and dietary behavior

Among the 1,856 participants, 638 older adults lived alone and 1,218 older adults lived with their spouse, as presented in **Table 1**. Significant differences were found in the distribution of sex, age, residence, household income, and education variables between the LA and LS groups. The percentage of female was higher in the LA group than in the LS group. The average age of the LA group was significantly higher than that of the LS group. Both education and household income levels in the LA group were lower compared with the LS group. The ratio of skipping breakfast, lunch, and dinner in the LA group was higher compared with the LS group. However, the frequency of eating out in the two groups was not significantly different.

Food group intakes

Table 2 presents the differences in food groups intake between the LA and LS groups. Most of the food intake, such as grains, saccharides, nuts, vegetables, fruits, seaweed, seasonings, vegetable oils, meats, eggs, seafood, beverages, and alcohol, showed a significant difference in the two different family types before adjusting for any variables (crude). Both Models 1 and 2 revealed that the LA group ate significantly lower amounts of vegetables and seaweed.

Table 1. Demographic characteristics and dietary behavior of the subjects

Variables	LA (n = 638)	LS (n = 1,218)	Total (n = 1,856)	*P*-value
Sex				< 0.001
Male	132 (17.9)	726 (60.0)	858 (45.6)	
Female	506 (82.1)	492 (40.0)	998 (54.4)	
Age (yrs)[1]				< 0.001
65–74	324 (45.1)	829 (66.1)	1,153 (58.9)	
≥ 75	314 (54.9)	389 (33.9)	703 (41.1)	
Mean age (yrs)[2]	74.5 ± 0.20	72.1 ± 0.18	73.3 ± 0.14	< 0.001
Residence				0.095
Urban	439 (68.5)	781 (63.8)	1,220 (65.4)	
Rural	199 (31.5)	437 (36.2)	636 (34.6)	
Household income level[3]				< 0.001
Low	502 (80.0)	588 (48.6)	1,090 (59.4)	
Middle	102 (15.3)	386 (31.2)	488 (25.7)	
High	34 (4.8)	244 (20.2)	278 (14.9)	
Attained education level				< 0.001
Elementary school	511 (80.9)	699 (59.0)	1,210 (66.5)	
Middle school	58 (9.5)	193 (15.2)	251 (13.2)	
High school	54 (7.6)	215 (17.5)	269 (14.1)	
College	15 (2.0)	111 (8.3)	126 (6.2)	
Skipping meals				
Breakfast				< 0.001
Yes	56 (9.3)	43 (3.5)	99 (5.6)	
No	582 (90.7)	1,175 (96.5)	1,757 (94.4)	
Lunch				< 0.01
Yes	73 (10.8)	79 (6.6)	152 (8.1)	
No	565 (89.2)	1,139 (93.4)	1,704 (91.9)	
Dinner				< 0.01
Yes	43 (6.7)	40 (3.2)	83 (4.4)	
No	595 (93.3)	1,178 (96.8)	1,773 (95.6)	
Frequency of eating out (times/week)[2]	1.4 ± 0.1	1.5 ± 0.1	1.4 ± 0.1	0.399

Values are number (%) or mean ± SE.
LA, living alone; LS, living with a spouse; SE, standard error.
[1]*P*-Value from complex sample χ^2-test.
[2]*P*-Value from complex sample t-test.
[3]Household income level; 'Low' = 1st quartile, 'Middle' = 2nd & 3rd quartile, 'High' = 4th quartile.

Table 2. Food group intakes of the subjects

Variables (g)	Crude[1]			Model 1[2]			Model 2[3]		
	LA (n = 638)	LS (n = 1,218)	P-value	LA (n = 638)	LS (n = 1,218)	P-value	LA (n = 638)	LS (n = 1,218)	P-value
Grains	276.9 ± 6.0	311.3 ± 5.9	< 0.001	298.2 ± 7.4	303.3 ± 5.9	0.591	293.5 ± 5.4	300.7 ± 3.7	0.298
Potatoes	38.9 ± 5.1	51.3 ± 5.6	0.078	39.6 ± 6.2	50.4 ± 6.0	0.249	38.3 ± 6.2	50.3 ± 5.9	0.206
Saccharides	7.9 ± 0.6	10.8 ± 0.7	< 0.01	9.0 ± 0.7	10.4 ± 0.7	0.192	9.2 ± 0.7	10.1 ± 0.7	0.394
Pulses	46.2 ± 3.9	49.2 ± 4.0	0.592	53.8 ± 4.4	46.8 ± 4.0	0.240	55.1 ± 4.5	45.5 ± 3.8	0.098
Nuts	5.8 ± 1.0	9.7 ± 1.4	< 0.05	7.4 ± 1.3	9.0 ± 1.2	0.297	6.8 ± 1.2	9.1 ± 1.3	0.193
Vegetables	274.9 ± 9.6	354.2 ± 8.7	< 0.001	308.5 ± 10.8	341.0 ± 8.4	< 0.05	310.1 ± 10.8	337.5 ± 7.8	< 0.05
Mushrooms	3.8 ± 1.1	5.6 ± 1.0	0.249	4.0 ± 1.2	5.5 ± 1.0	0.378	4.1 ± 1.2	5.3 ± 1.1	0.495
Fruits	170.4 ± 11.7	225.5 ± 11.6	< 0.001	182.4 ± 13.5	218.1 ± 11.4	< 0.05	191.2 ± 12.3	206.9 ± 9.9	0.319
Seaweed	17.4 ± 4.2	39.3 ± 5.6	< 0.01	17.6 ± 4.6	38.8 ± 5.7	< 0.01	18.2 ± 4.7	37.9 ± 5.6	< 0.05
Seasonings	23.9 ± 1.2	29.3 ± 1.3	< 0.01	28.3 ± 1.5	27.7 ± 1.3	0.788	28.1 ± 1.5	27.2 ± 1.2	0.702
Vegetable oils	4.1 ± 0.3	5.4 ± 0.3	< 0.01	5.2 ± 0.4	5.0 ± 0.3	0.610	5.2 ± 0.3	4.9 ± 0.3	0.430
Meats	55.9 ± 6.5	78.2 ± 6.2	< 0.01	62.1 ± 7.6	76.3 ± 6.7	0.197	61.2 ± 7.6	74.9 ± 6.8	0.242
Eggs	13.9 ± 1.3	17.7 ± 1.4	< 0.05	16.9 ± 1.6	16.5 ± 1.3	0.831	17.4 ± 1.6	15.8 ± 1.3	0.455
Seafood	69.3 ± 6.6	107.2 ± 9.3	< 0.001	78.9 ± 7.8	103.4 ± 9.7	0.066	80.8 ± 8.2	101.0 ± 9.7	0.145
Milk and dairy products	66.8 ± 6.2	66.4 ± 4.6	0.954	66.4 ± 6.9	65.9 ± 4.9	0.955	68.7 ± 6.5	62.5 ± 4.7	0.433
Beverage	40.8 ± 4.7	55.3 ± 4.5	< 0.05	49.9 ± 5.6	51.0 ± 4.4	0.875	53.0 ± 5.6	48.0 ± 3.9	0.470
Alcohol	39.9 ± 6.8	101.5 ± 13.1	< 0.001	92.8 ± 12.0	78.9 ± 10.1	0.236	88.9 ± 10.4	78.8 ± 9.8	0.403

Values are the mean ± SE, significant difference determined using CSGLM.
LA, living alone; LS, living with a spouse; CSGLM, complex sample general linear model.
[1]Crude: no adjustment.
[2]Model 1: adjusted for sex and age.
[3]Model 2: adjusted for sex, age, energy intake, household income level, and education level.

In Model 1, the LA group consumed about 36 g less fruit than the LS group. These results showed that the LA group had a relatively lower consumption of vegetables, fruits, and seaweeds compared with the LS group even after adjusting for socio-demographic variables.

Nutrient intakes and korean dietary reference intakes percentage

Table 3 shows the participants' nutrient intakes and the percentage of nutrient intakes compared with the Korean Dietary Reference Intakes (KDRIs 2015) [23] corresponding to

Table 3. Nutrient intakes and KDRI percentage of nutrient intakes of the subjects

Variables	Model 1[1]			Model 2[2]			KDRIs percentage		
	LA (n = 638)	LS (n = 1,218)	P-value	LA (n = 638)	LS (n = 1,218)	P-value	LA (n = 638)	LS (n = 1,218)	P-value
Energy (kcal)	1,726.8 ± 31.7	1,749.6 ± 25.8	0.548	1,863.3 ± 40.2[1]	1,843.0 ± 31.7	0.584	90.4 ± 1.5	99.1 ± 1.5	< 0.001
Protein (g)	54.4 ± 0.8	54.8 ± 0.6	0.699	57.6 ± 1.1	57.3 ± 0.9	0.749	99.2 ± 2.3	114.6 ± 2.2	< 0.001
Fat (g)	25.2 ± 0.9	24.3 ± 0.6	0.379	29.9 ± 1.1	27.9 ± 0.7	0.059	-	-	-
Saturated fatty acid (g)	7.0 ± 0.3	6.6 ± 0.2	0.181	8.1 ± 0.4	7.4 ± 0.2	< 0.05	-	-	-
Cholesterol (g)	130.6 ± 6.4	124.7 ± 5.2	0.473	165.1 ± 9.6	152.7 ± 8.3	0.152	-	-	-
Carbohydrates (g)	298.2 ± 2.9	305.9 ± 1.8	< 0.05	290.7 ± 3.5	300.7 ± 2.5	< 0.001	-	-	-
Calcium (mg)	396.7 ± 10.4	412.4 ± 8.9	0.253	422.3 ± 13.3	435.0 ± 11.5	0.374	44.7 ± 1.4	60.1 ± 1.4	< 0.001
Phosphorus (mg)	860.3 ± 12.0	884.1 ± 8.9	0.124	933.7 ± 15.8	942.8 ± 13.2	0.539	106.5 ± 2.4	134.9 ± 2.3	< 0.001
Iron (mg)	15.2 ± 0.3	16.3 ± 0.3	< 0.05	15.8 ± 0.6	16.7 ± 0.6	0.095	176.1 ± 4.9	201.8 ± 4.5	< 0.001
Sodium (mg)	3,199.0 ± 83.8	3,274.4 ± 64.9	0.479	3,161.4 ± 108.1	3,267.1 ± 97.4	0.322	234.8 ± 7.3	282.0 ± 6.5	< 0.001
Potassium (mg)	2,507.5 ± 50.2	2,776.6 ± 42.3	< 0.001	2,791.1 ± 66.3	3,002.7 ± 61.4	< 0.001	64.3 ± 1.6	83.7 ± 1.7	< 0.001
Vitamin A (μgRE)	603.7 ± 40.7	561.7 ± 24.4	0.400	642.1 ± 48.0	593.7 ± 29.6	0.332	91.0 ± 6.1	93.5 ± 3.7	0.732
Thiamine (mg)	1.70 ± 0.03	1.74 ± 0.02	0.236	1.73 ± 0.04	1.76 ± 0.02	0.411	134.2 ± 3.2	158.8 ± 2.7	< 0.001
Riboflavin (mg)	0.93 ± 0.02	1.02 ± 0.02	< 0.05	1.06 ± 0.03	1.12 ± 0.02	< 0.05	64.3 ± 2.0	78.6 ± 1.7	< 0.001
Niacin (mg)	12.2 ± 0.2	12.9 ± 0.2	< 0.05	13.2 ± 0.3	13.8 ± 0.2	0.117	72.8 ± 1.9	90.6 ± 2.0	< 0.001
Vitamin C (mg)	81.2 ± 4.5	102.6 ± 5.1	< 0.01	109.2 ± 7.1	124.4 ± 6.9	< 0.05	74.3 ± 3.9	107.9 ± 5.6	< 0.001

Values are the mean ± SE, significant difference determined using CSGLM.
LA, living alone; LS, living with a spouse; KDRIs, Dietary Reference Intakes for Koreans; EER, the specific estimated energy requirement for energy; RNI, recommended nutrient intakes for protein, calcium, phosphorus, iron, vitamin A, thiamine, riboflavin, niacin and vitamin C; AI, adequate intake for sodium and potassium; CSGLM, complex sample general linear model.
[1]Model 1: adjusted for sex and age.
[2]Model 2: adjusted for sex, age, energy intake, household income level, and education level.
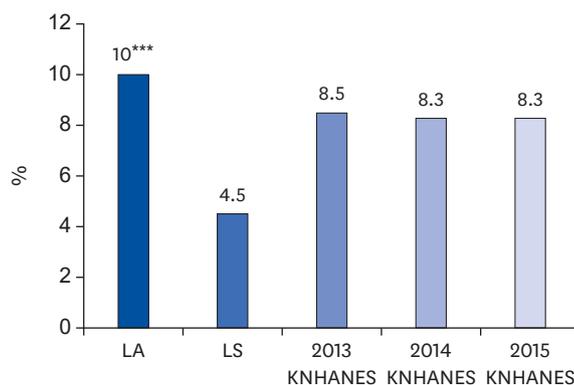
Fig. 1. Percentage of insufficient nutrient intakes of the subjects of aged 65 and over. Percentage of insufficient nutrient intakes: The percentage of people who consume less than 75% of the estimated energy requirement and consume below of the average requirement for calcium, iron, vitamin A, and riboflavin.
LA, living alone; LS, living with a spouse; 6th KNHANES (2013–2015), Korea National Health and Nutrition Examination Survey (2013–2015).
Values are the percentage, significant difference determined using complex sample χ^2-test, ***$P < 0.001$.

their sex and age; the estimated energy requirement for energy; adequate intake for sodium and potassium; and recommended nutrient intake (RNI) for other nutrients. In both Models 1 and 2, the LA group showed a significantly lower intake of potassium, riboflavin, and vitamin C compared with the LS group. Especially in Model 1, the LA group consumed a significantly smaller amount of iron and niacin compared with the LS group.

For the percentage analysis with respect to KDRIs, the LA group showed significantly lower percentages in all of the reported nutrients compared with the LS group. Although not significant, LA's vitamin A intake also tended to be lower. Moreover, the KDRIs percentage of calcium, potassium, riboflavin, niacin, and vitamin C of the LA group was lower than 75%, indicating the severity of their poor intake of essential nutrients.

Especially, the calcium intake level in the LA group was 44.7%, or lower than half of the RNIs. For sodium, intake levels in LA and LS were 234.8% and 282.0%, respectively, which were twice as high as the RNIs. Indeed, LA older adults consumed less than the RNIs of all of the essential nutrients excluding phosphorus, iron and riboflavin, indicating an unbalanced dietary intake compared with LS older adults. Thus, we found significant differences in the nutrient intakes level between the two family types, particularly LA indicated low dietary quality.

Percentage of insufficient nutrient intakes
Fig. 1 shows the percentage of participants in the two groups who consumed less than 75% of the estimated energy requirement and below the average needs for calcium, iron, vitamin A, and riboflavin. Percentages of participants with insufficient nutrient intakes were 10.0% in the LA group and 4.5% in the LS group.

DISCUSSION

As people age, they cope with both physical and mental debilitation; meanwhile, their social networks are likely to shrink. Researchers [7,24] have claimed that older women who live alone after experiencing the death of their spouse feel depressed, in turn affecting meal

frequency and variety. Living with a spouse or children is known to play a decisive role in physical and mental well-being.

Many studies [5-7,9,12,13] have reported that older adults living with family members, including spouses, benefit from positive effects on healthy eating, whereas older adults living alone show negative effects on their health, such as social isolation, drinking problems, and poor eating habits. In particular, health inequalities may be the most severe problems for older adults; age, severe socioeconomic deprivation, and family characteristics can affect the nutritional status of older adults.

The present results also showed significant differences in the dietary behavior and food and nutrients intake among Korean older adults when analyzed according to their family type, namely, living alone or with spouse. We found notable discrepancies between the two groups without and with adjustments for affecting factors on their diet, such as sex, age, energy intake, household income level, and education level.

Older adults living alone were more likely to skip meals and eat meals less regularly compared with those living with a spouse, which could result in a negative association with their food and nutrients intake. These findings are similar to other study results [25,26]. Tani *et al.* [25] revealed that men who exclusively ate alone are 3.74 times at higher risk of skipping meals compared with men who ate with others, and the combined effect of living alone is related to a higher ratio of unhealthy eating habits, obesity, and underweight. Moreover, men who live alone and eat alone are more likely to have an association with malnutrition compared with people living with others [25]. Wham [26] insisted that living with a spouse can have a positive effect on health behavior. In contrast, Feldblum *et al.* [27] claimed that family-type variables, such as marital life and deprivation, are not related to food intake and nutritional status.

Our study showed that food consumption of meat, eggs, seafood, grains, nuts, vegetables, fruits, seaweed, and even beverages and alcohol in the LA group was less compared with the LS group without adjusting for affecting factors, revealing the inferior diet of older adults living alone. After adjusting for age and sex variables in Model 1, the consumption differences in vegetables, fruits, and seaweed remained. After adjusting for age, sex, energy intake, household income, and education level in Model 2, we found a consumption difference in vegetables and seaweed. In particular, the vegetable consumption in the LA group was about 80 g less than that of the LS group. The difference in consumption of vegetables and seaweed is due to the complex cooking procedure and relative short preservation duration of these foods, which need a longer cooking duration and more effort for older adults. Alcohol consumption of the LA group was higher than that of the LS group after adjusting for sex and age, but not to a statistically significant degree.

These characteristics of inferior diet among the LA group are clearly outlined in **Table 3**. Nutrients intake of carbohydrates, iron, potassium, riboflavin, niacin, and vitamin C in the LA group were lower after adjusting for age and sex variables, and similar results of low intake of carbohydrates, potassium, riboflavin, and vitamin C but higher intake of saturated fat were found in the LA group after adjusting for five socio-demographic variables.

All of the KDRI percentages, except vitamin A, were lower in the LA group. Notably, the intake percentage of calcium, potassium, riboflavin, niacin, and vitamin C in the LA group,

compared with KDRIs, were 44.7%, 64.3%, 64.3%, 72.8%, and 74.3%, respectively. The calcium intake levels was 60.1% even in the LS group. Therefore, regardless of the family type, the optimum intake level of calcium in Korean older adults is necessary to reduce the risk of bone disease. The deficient intake of vitamins and minerals seems to be related to lower amounts of consumption of vegetables and fruits in the LA group, which may be attributed to a relatively monotonous and carbohydrate-based diet pattern.

The Insufficient Nutrients Intake Index of energy, calcium, iron, vitamin A, and riboflavin in the LA and LS groups were 10% and 4.5%, respectively, showing a difference of two times between the two groups. The percentage of the LA group with insufficient nutrients intake (10%) was even higher than that in the results of the 2013, 2014, and 2015 KNHANES statistics for all older adults of the designated survey years.

For these reasons, we inferred that older adults living alone consumed a simple meal of rice and pickled vegetables of kimchi to avoid the hassle and difficulty of preparing meals using various kinds of food. Other [16-19] researchers have also found that older adults living alone consume lower amount of fruits and fiber compared with those with spouses and have poor-quality diets. Family type has been recognized as one of the decisive indicators leading to high risks for poor health.

Overall, the diet of the older adults living alone in our study was inadequate both in quantity and quality, and we confirmed that these differences between the two groups resulted from their family type. If financial support or meal services and nutrition education are provided, this differences could be narrowed, demonstrating the serious need for comprehensive nutrition programs targeting older adults living alone.

The dietary intake and health of older people might be influenced not only by the family type but also by social and environmental factors. Holcomb *et al.* [28] reported that nutrition education, taking into account age, area of residence, and education level, has a positive effect on food and nutrient intake among older adults living alone. However, the ratios of Korean older adults who have experienced nutrition education from 2013 to 2015 are 5.1%, 4.5%, and 5.9%, respectively, by the 6th KNHANES [21]. In Japan, the figure is only 6% of older adults [25]. Considering these data, the participation rate in nutrition education programs among older adults is low at home and abroad [25].

Thomas *et al.* [29] reported that older men living alone have no problems maintaining their dietary balance and health through dinner club gatherings. Lim *et al.* [30] also reported that in Korea, the nutrition program of providing daily meals for rural older adults living alone has shown positive effects on the balanced diet, healthy eating, and social networking among the cohort.

We suggest that a customized nutrition intervention program composed of nutrition education and nutrition support be developed as a promising way to improve the diet of older adults, especially those living alone. Efforts in promoting social interests and delivering nutrition programs to unserved or underserved older adults should be prioritized.

This study has certain limitations. First, owing to privacy issues, we could not analyze the data according to various family types, such as living with their married child or grandchildren. Second, because the majority of older adults had chronic diseases, those

with chronic diseases were not excluded from the study sample; only those practicing diet therapy were excluded. Finally, food intake data for one day would be limited in representing usual diet. Despite these limitations, our study results are meaningful and representative for Korean older adults because of the use of KNHANES VI data, a large-scale survey conducted nationwide with a statistically optimal sample size.

The results showed the frequent skipping of meals and insufficient food and nutrients intake of older adults living alone compared with those of living with a spouse. In particular, there existed education and income disparities between these two groups. Our previous research [30] confirmed the effectiveness of a program providing daily lunch using village center facilities in rural areas. Such a nutrition program requires various physical facilities and contents. Social awareness and institutional support, together with the development of a nutrition program for underserved older adults, are urgently needed.

REFERENCES

1. Bacci ML. A Concise History of World Population. Hoboken: John Wiley & Sons; 2017.

2. Korean Statistical Information Service. Statistics DB [Internet]. Daejeon: Korean Statistical Information Service; 2018 [cited 2017 March 6]. Available from: http://kosis.kr/search/search.do

3. Kim CI, Lee HS. Living arrangements affect nutritional status of the elderly. J Community Nutr 2001;3:103-9.

4. Korean Statistical Information Service. Social indicators of Korea in 2016 [Internet]. Daejeon: Korean Statistical Information Service; 2017 [cited 2019 December 3]. Available from: http://kosis.kr/search/search.do

5. O'Shea JC, Wilcox RG, Skene AM, Stebbins AL, Granger CB, Armstrong PW, Bode C, Ardissino D, Emanuelsson H, Aylward PE, White HD, Sadowski Z, Topol EJ, Califf RM, Ohman EM. Comparison of outcomes of patients with myocardial infarction when living alone versus those not living alone. Am J Cardiol 2002;90:1374-7.
   PUBMED | **CROSSREF**

6. de Boer A, Ter Horst GJ, Lorist MM. Physiological and psychosocial age-related changes associated with reduced food intake in older persons. Ageing Res Rev 2013;12:316-28.
   PUBMED | **CROSSREF**

7. Kim SY, Sok SR. Factors influencing the life satisfaction in the older Korean women living alone. Contemp Nurse 2013;44:111-9.
   PUBMED | **CROSSREF**

8. Jennifer Yeh S, Lo SK. Living alone, social support, and feeling lonely among the elderly. Soc Behav Personal 2004;32:129-38.
   CROSSREF

9. Gliksman MD, Lazarus R, Wilson A, Leeder SR. Social support, marital status and living arrangement correlates of cardiovascular disease risk factors in the elderly. Soc Sci Med 1995;40:811-4.
   PUBMED | **CROSSREF**

10. Eskelinen K, Hartikainen S, Nykänen I. Is loneliness associated with malnutrition in older people? Int J Gerontol 2016;10:43-5.
    CROSSREF

11. Kooshiar H, Yahaya N, Hamid TA, Abu Samah A, Sedaghat Jou V. Living arrangement and life satisfaction in older Malaysians: the mediating role of social support function. PLoS One 2012;7:e43125.
    PUBMED | **CROSSREF**

12. Tabue Teguo M, Simo-Tabue N, Stoykova R, Meillon C, Cogne M, Amiéva H, Dartigues JF. Feelings of loneliness and living alone as predictors of mortality in the elderly: The PAQUID Study. Psychosom Med 2016;78:904-9.
    PUBMED | **CROSSREF**

13. Oh DH, Park JH, Lee HY, Kim SA, Choi BY, Nam JH. Association between living arrangements and depressive symptoms among older women and men in South Korea. Soc Psychiatry Psychiatr Epidemiol 2015;50:133-41.
    PUBMED | **CROSSREF**

14. Brownie S. Why are elderly individuals at risk of nutritional deficiency? Int J Nurs Pract 2006;12:110-8.
    PUBMED | CROSSREF

15. Shin SH, Sok SR. A comparison of the factors influencing life satisfaction between Korean older people living with family and living alone. Int Nurs Rev 2012;59:252-8.
    PUBMED | CROSSREF

16. Kwon SH, Park HR, Lee YM, Kwon SY, Kim OS, Kim HY, Lim YS. Difference in food and nutrient intakes in Korean elderly people according to chewing difficulty: using data from the Korea National Health and Nutrition Examination Survey 2013 (6th). Nutr Res Pract 2017;11:139-46.
    PUBMED | CROSSREF

17. Hanna KL, Collins PF. Relationship between living alone and food and nutrient intake. Nutr Rev 2015;73:594-611.
    PUBMED | CROSSREF

18. Jeong SS. · Kim JS. Comparison of health behaviors and health level between elders living alone and those living with a spouse. Glob Health Nurs 2014;4:27-36.

19. Kharicha K, Iliffe S, Harari D, Swift C, Gillmann G, Stuck AE. Health risk appraisal in older people 1: are older people living alone an "at-risk" group? Br J Gen Pract 2007;57:271-6.
    PUBMED

20. Quandt SA, McDonald J, Arcury TA, Bell RA, Vitolins MZ. Nutritional self-management of elderly widows in rural communities. Gerontologist 2000;40:86-96.
    PUBMED | CROSSREF

21. Korea Centers for Disease Control and Prevention. The Korean National Health and Nutritional Examination Survey 2013-2015 [Internet]. Cheongju: Korea Centers for Disease Control and Prevention; 2018 [cited 2018 December 1]. Available from: https://knhanes.cdc.go.kr/knhanes/sub03/sub03_02_02.do

22. Rural Development Administration (KR); National Institute of Agricultural Sciences (KR). Standard Food Composition Table 8th Revision. Seoul: Kyomunsa; 2012.

23. Korean Nutrition Society. Dietary Reference Intakes for Koreans 2015. Seoul: Korean Nutrition Society: 2015.

24. Oh SI, Kwak CS, Yon M, Lee MS. A study on the blood health status and nutrient intake in elderly women dwelling in longevity region in Jeonla province according to family arrangement. Korean J Food Nutr 2014;27:940-55.
    CROSSREF

25. Tani Y, Kondo N, Takagi D, Saito M, Hikichi H, Ojima T, Kondo K. Combined effects of eating alone and living alone on unhealthy dietary behaviors, obesity and underweight in older Japanese adults: results of the JAGES. Appetite 2015;95:1-8.
    PUBMED | CROSSREF

26. Wham C, Carr R, Heller F. Country of origin predicts nutrition risk among community living older people. J Nutr Health Aging 2011;15:253-8.
    PUBMED | CROSSREF

27. Feldblum I, German L, Castel H, Harman-Boehm I, Bilenko N, Eisinger M, Fraser D, Shahar DR. Characteristics of undernourished older medical patients and the identification of predictors for undernutrition status. Nutr J 2007;6:37.
    PUBMED | CROSSREF

28. Holcomb CA. Positive influence of age and education on food consumption and nutrient intakes of older women living alone. J Am Diet Assoc 1995;95:1381-6.
    PUBMED | CROSSREF

29. Thomas N, Emond R. Living alone but eating together: exploring lunch clubs as a dining out experience. Appetite 2017;119:34-40.
    PUBMED | CROSSREF

30. Bae JS, Seong SB, Jang SM, Yoo CH, Lim YS, Lee YM, Park HR, Lee KE. Operation and process evaluation of a community meal program for the elderly in rural areas during agricultural off-season perceived by cooking volunteers. Korean J Community Nutr 2019;24:277-89.