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Nutritional Assessment of the Oldest-Old Population Aged 85 Over: Based on 2009 Korea National Health and Nutrition Examination Survey

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ABSTRACT: As Korea is expected to become super high aged society in 2026, nutrition is important elements of health in the elderly and affects their life. In epidemiological surveys, anthropometric and biochemical measurements represent important components of nutritional assessment in elderly. In the present study, we investigated anthropometric index, biochemical markers, and nutrient intake for elderly aged over 85 by using data on 71 elderly (24 men, 47 women) over 85 years which was obtained from Korea National Health and Nutrition Examination Survey in 2009. According to BMI values, the prevalence of underweight and obesity was 9.7% and 34.5% in men, and 7.9% and 26.4% in women. The prevalence of sarcopenia was 70.7% in men and 25.0% in women. However, plasma biochemical data are normal range in the older population. In nutrients intake, daily Intake of energy, protein, dietary fiber, water, thiamin, riboflavin, niacin, calcium, and potassium was inadequate considering the Dietary Reference Intakes for Koreans(KDRIs). In conclusion, elderly need to be educated nutrition and their health dietary life to prevent malnutrition, and standard of nutrition intake should be rearranged in elderly aged 85 over considering their antrhopometric index.

Keywords: nutritional assessment, anthropemetric index, nutrient intake, elderly, KNHANES

INTRODUCTION

Though Korea has gone through a more rapid population aging process, various structures of society and cultural changes cannot catch that situation. So many problems for unprepared for aging population have been happened. Especially, elderly undergoes malnutrition and unsuitable dietary life as well as problems of economical poor and social psychological adaptation by loss of income. Social countermeasures about social, medical problems were required to improve life quality[1,2,3].

Aging is accompanied by physiologic changes including reduced lean body mass that can negatively impact nutritional diet that is poor in quality, all of which increase the prevalence and effects of malnutrition in the elderly.

Malnutrition results from limited food availability in elderly who eats less due to difficulty chewing, swallowing, and/or preparing and unable to absorb the nutrients properly[4]. Recently, ministry of health and welfare have shown that elderly over 65 years old have suffered from poor nutrition. As a result, malnutrition is fairly common in the elderly, with low calorie and protein intakes, as well as many deficiencies of important vitamins and minerals[5]. Furthemore, a higher insufficient intake of nutrients tend to be associated with low incomes. Improving

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the health and nutritional status of elderly can help lower their disease caused by malnutrition such as anemia in the short term and also cause to elderly realized that they care themselves to keep healthy lifestyle in the long term[6].

Most of elderly experienced changes in body composition that occur during aging. By Villareal DT et al(2005), body weight and body mass index increase with age until roughly 60's, after which they both decline[7]. There are many reason that appetite declines, food consumption declines, less feel hungry, and loss of body muscle mass[4]. One of characteristics in elderly changed body composition is loss of muscle called sarcopenia[7]. In Oh C et al[8] study, nutritional intervention is needed to elderly to help body composition changes which lead to sarcopenia.

There's research that health status, dietary patterns, and nutritional intake in elderly focused on 60's and 70's and also narrow study area. Few studies have reported data on very old subjects aged over 85 years. This study aimed to provide fundamental and well-established scientific principles for improving the health and nutritional status of elderly by analyzing KNHANES 2009 which has representability of Korea and Koreans.

LITERATURE REVIEW

Nutritional Assessment

1) Nutritional Intake of Elderly

Nutrition is a significance factor of health in the elderly and affects the aging process[4]. Therefore, malnutrition lead to worsen the quality of life, sarcopenia, physical and cognitive decline, and chronic disease, and an increase in costs to the National Health Service[9]. Proper nutrition helps to ensure that elderly stay in good health, keep self-sufficient and maintain a high quality of life.

Studies related to nutritional intake are actively discussed all over the world. Chen SH et al(2014) was compared to health-related characteristics, nutrition-related factors and nutritional status of elderly so as to develop strategies, programmes and policies[10]. Oehlschlaeger et al[11] assessed and compared nutritional status and functional capacity of elderly in Brazil. Fernández-Barrés et al[12] assessed food consumption to prepare the plan for Spain elderly. Bates CJ et al[13] and Chorong Oh et al[14] found that there were gender difference in food choice so it lead to change nutrient intake and nutritional blood status indices. Also, there were huge selection choice from food to restaurants and favorite food to elderly[15,16,17].

Choi HJ et al[18] examined nutritional intake and food preference elderly aged over 85 years residing in Namhae-gun Kyungnam. Kim MW et al[19] indicated that elderly who lived in Ganhwa-gun area had worse nutrients intakes. Kwak CS et al[20] estimated anthropometric index, dietary habits and nutrient intake of the oldest-old population aged 95 over in Seoul. Kang NE et al[21] noted that there relation between nutritional habit and functional health status with mobility. Likewise, studies about superaged elderly had narrow study area in Korea.

2) Anthropometric and Biochemical Indicators of Elderly

Anthropometrics including body weight and weight history and biochemical indicators are initial indicator for screening nutritional risk, disability and severe diseases in the elderly[20,23]. Body composition is closely related with nutrition intake[24,25]. Blood biochemical indicators represent chronic disease factors such as metabolic syndrome. By Kwak CS et al[20], height is inappropriate measurement because of lessening the height and stooping by aging. Girth of the upper arm circumference and recent weight change are more useful to predict to mortality and prevalence[26]. Also, body mass index is simple measurement to predict disease risk in those termed obese, but it is unreliable for elderly like same reason with height. In addition, BMI is not included fat mass and muscle mass which can diagnose sarcopenia[4]. Overall, a significant age by gender interaction effects was clarified anthropometric measurements, thus new standard is necessary for measuring anthropmetric index in the elderly because of occurring body composition changes during aging[27].

METHODS

Subjects

This study was based on data from the Fourth KNHANES in 2009. The KNHANES is a cross-sectional and nationally representative survey carried out by the Korea Centers for Disease Control and Prevention using the stratified, multistage probability sampling design. It consists of three survey sections, including the health interview survey, the health examination survey, and the nutrition survey. Among 1,788 eligible subjects who had participated in on biochemical test, and DXA data. A total 71 elderly (24 men and 47 women) were included in the final data analyses.

Measurements

Subjects were selected 85 and over elderly based on US Senate Special Committee on Aging which classify 3 groups of elderly as the young-old(65-74 years old), the old-old(75～84 years old), and the oldest old(over 85 years old)[27].

BMI was calculated as weight (kg) divided square height(m^2). Blood pressure was measured using a sphygmomanometer with the subject in a sitting position. First, three consecutive blood pressure measurements were performed on all subjects at 5 minutes intervals, and then the average of the second and third measurements was used in the analysis. Blood samples were collected in the morning after the subjects had fasted for at least 8 hour. Total cholesterol, TAG and HDL-cholesterol concentrations were analyzed in a central, certified laboratory using a Hitachi Automatic Analyzer 7600. A dual-energy X-ray absorptiometry (DXA) scan was performed to measure total body fat mass and total muscle mass. Sarcopenia is defined as two ways; an appendicular skeletal muscle mass divided by weight or square of height(m^2) of less than 1SD below the sex-specific mean for young adults. A general questionnaire was administered to collect basic demographic and health-related information. Family income was categorized quarter. The educational level was categorized as: elementary school or less; middle school; high school; college. Marital status was divided into three categories: married; widowed/ divorced; single. Dietary intake was measured using the single 24 hour dietary recall method. A trained staff instructed the respondents to recall and describe all foods.

Statistical Analysis

All statistical analyses were conducted using SPSS 20.0 version for Windows (SPSS, Inc.). The associations between socioeconomic characteristics and gender were assessed. General linear models were constructed to assess the associations between gender and nutrient intakes. An association was considered statistically significant if the *P* value was <0.05.

RESULTS

General characteristics were summarized in Table 1. Mean age of participants (n=71) were 87.21(0.40), 87.12(0.47) years old by men and women respectively. More than half of subjects resided in city. Men had higher education level than women but there were no significant. While more than 80% of men live with their spouses, roughly the same percentage of women do not significantly(p<0.001). Men tended to have higher self-assessment of health than women.

Anthropometric and biochemical data were summarized and adjusted by marriage status in Table 2. Men were taller and heavier than women (158.59 vs 141.83/ 58.14 vs 44.82) significantly(p<0.001). Body mass index, waist circumference, systolic blood pressure, diastolic blood, serum total cholesterol, serum triglyceride, serum HDL-cholesterol, and fasting glucose were close to normal range in both genders. Women were higher body fat mass, body fat percentage than men significantly. On the other way, women were lower body muscle mass, body muscle percentage than men significantly. Prevalence of sarcopenia of men was higher than women significantly by calculated height(m^2). Using weight, there was no significant but prevalence rates of sarcopenia in men were higher than in women commonly.

Energy and nutritional intake values are summarized in Table 3. Nutritional intake of women was poorer than men. Especially, dietary fiber, water, thiamin, riboflavin, niacin, calcium, potassium were below KDRIs in both gender. Average daily energy intake of men and women was 1,480.81kcal, 947.65 kcal respectively. However, sodium intake was about double of KDRIs in subjects. Carbohydrates provided 68.97%, protein provided 13.81%, and fat provided 13.93% in men, and carbohydrates provided 75.26%,

Table 1. General characteristics of subjects

		Male(N=24)		Female(N=47)		p^a
		N	%	N	%	
Age		87.21±0.4[b]		87.12±0.47		0.874
Residential area	Metropolitan	7	26.2	12	36	0.291
	Urban	7	51.7	13	32.7	
	Rural	8	22.1	14	31.3	
Income	Low	12	51.9	15	49.8	0.096
	Mid-low	6	41.1	12	25.0	
	Mid-high	1	2.6			
	High	2	4.3	10	25.2	
Education level	Primary school	16	76.4	33	96.6	0.122
	Middle school	3	14.5	1	3.4	
	High school	1	6.2			
	College	2	2.9			
Marital status	Single			1	5.7	<0.001
	With spouse	17	83.1	3	7.6	
	Without spouse	5	16.9	35	86.7	
Self assessment of health	Very good	3	10.9	2	2.3	0.294
	Good	12	46.5	12	37.5	
	Normal	4	20.5	5	12.4	
	Bad	2	17.4	12	29.8	
	Very bad	1	4.7	3	18.1	
Smoking status		2	8.7	5	14.3	0.848
Exercise		2	3.5	2	2.8	0.566
Drinking stauts		5	19.9	5	10.0	0.252

[a] p values were obtained χ^2 test.
[b] Mean±standard error.

protein provided 13.12%, and fat provided 13.93% in women. Carbohydrates ratio of women was higher than recommended. Fat ratio of subjects was lower than recommended.

DISCUSSION AND CONCLUSIONS

Since South Korea's life expectancy stood beyond the average life expectancy of OECD in 2006 (OECD 2015), people desire to live long and healthy lives.

In this study, by measuring anthropometric, biochemical indicators, and nutritional intake of the oldest-old elderly, we propose the new fundamental and well-established scientific principles for improving the health and nutritional status of elderly. We observed malnourished conditions on aging in whi-

Table 2. Anthropometric and biochemical measurement

	Male(N=24)		Female(N=47)		p^b
	Mean	SE[a]	Mean	SE	
Height (cm)	158.59	1.24	141.83	0.47	<0.001
Weight (kg)	58.14	1.89	44.82	1.17	<0.001
Body mass index(kg/m^2)	23.03	0.79	22.26	0.52	0.517
Underweight (<18.5)	3(9.7)[c]		5(7.9)		0.705
Normal or overweight (18.5~25)	12(55.8)		22(65.7)		
Obese (≧25)	12(34.5)		9(26.4)		
Waist circumference (cm)	80.1	2.5	72.77	1.66	0.045
Systolic blood pressure (mmHg)	131.79	5.01	134.11	3.24	0.750
Diatolic blood pressure (mmHg)	73.81	2.12	76	1.34	0.376
Serum total cholesterol (mg/dL)	172.62	6.41	194.14	9.77	0.05
Serum triglyceride (mg/dL)	131.04	28.45	120.57	29.5	0.756
Serum HDL-cholesterol (mg/dL)	45.32	5.18	57.59	4.54	0.138
Fasting glucose (mg/dL)	102.47	5.14	112.75	10.64	0.361
Body fat mass (g)	12,920.87	1,008.26	14,856.54	1,449.61	0.348
Body muscle mass (g)	40,755.07	1,408.86	27,833.09	859.37	<0.001
Body fat (%/body weight)	23.55	1.42	33.71	2.04	0.001
Body muscle (%/body weight)	76.44	1.42	66.28	2.04	0.001
Sarcopenia(weight)	12	73.1	10	45.1	0.079
Sarcopenia(height)	13	70.7	9	25.0	0.008

[a] Standard error.
[b] Differences were tested using generalized linear model.
[c] Number(%).
All models were adjusted for marriage status.

ch a lack of protein, energy and other nutrients by eating habits.

According to study of Kwak CS et al[20], the body height and weight was 156.5 cm, 54.0 kg in men and 140.8 cm, 41.3 kg in women with over 95 years old living in Seoul. Also, the height and weight of over 85 years old living in Kyungnam were 160.2cm, 52.6 kg in men and 147.0 cm, 44.9 kg in women[12]. Similarly, this study showed 158.5 cm 58.1 kg in men and 141.8 cm, 44.8 kg in women. As aging, showing average height loss is common and it decreases 0.3 cm every year in both gender by Perissinotto E (2002)[20]. Despite distinct changing height/weight in elderly, their nutrition criteria didn't exist for over 85 years old Koreans by ministry of health and welfare.

Understanding the pattern of weight and body-composition change in aging process, sarcopenia and increasing body fat are both hallmarks with decline in skeletal muscle mass[24]. Likewise, underweight is fatal for elderly due to decreasing muscle mass and bone mass[28], which increasse risk of chronic diseases, such as heart disease and risk of cancers. In Table 2, although body mass index was

Table 3. The average daily nutrient intake of subjects

	DRIs[a] (Male/Female)	Male(N=24)		Female(N=47)		p[c]
		Mean	SE[b]	Mean	SE	
Energy (kcal)	2,000/1,600[d]	1,480.81	105.76	947.65	53.78	<0.001
Energy (kcal/kg)		28.46	1.63	24.90	1.57	<0.001
Carbohydrates (g)		279.44	16.57	191.00	7.85	<0.001
Protein (g)	50/45	46.71	6.35	28.84	2.87	0.027
Protein (g/kg)		0.96	0.04	0.80	0.04	<0.001
Fat (g)		19.98	3.32	8.26	1.80	0.010
Dietary fiber (g)	25/205	6.73	1.03	4.34	0.40	0.069
Water (g)	2,100/1,800[e]	853.95	56.76	639.95	51.46	<0.001
Vitamin A (gNE)	700/600	741.72	72.45	660.09	74.20	0.056
Thiamin (mg)	1.2/1.1	1.18	0.07	0.88	0.06	<0.001
Riboflavin (mg)	1.5/1.2	1.00	0.06	0.77	0.05	<0.001
Niacin (mg)	16/14	14.78	0.83	10.45	0.70	<0.001
Vitamin C (mg)	100/100	104.82	11.90	93.77	12.22	0.019
Calcium (mg)	700/650	351.70	53.89	205.03	33.74	0.032
Phosphorus (mg)	700/700	912.57	106.35	553.96	56.20	0.013
Iron (mg)	9/8	10.56	1.518	6.44	0.98	0.052
Sodium (mg)	2,000/2,000[g]	4,262.19	231.81	3,022.89	206.38	<0.001
Potassuim (mg)	3,500/3,500[f]	2,766.07	152.79	2,249.54	148.46	<0.001
CPF ratio						
Carbohydrates (%)	50~70%	68.97	0.94	75.26	0.81	<0.001
Protein (%)	7~20%	13.81	0.81	13.12	0.82	<0.001
Fat (%)	15~25%	13.93	0.5	12.31	0.44	<0.001

[a] Dietary reference intakes; DRIs.
[b] Standard error.
[c] Differences were tested using generalized linear model.
[d] Estimated energy requirement; EER.
[e] Adequate intake; AI.
[f] Goal intake.
[g] Acceptable macronutrient distribution ranges; AMDR.
All models were adjusted for marriage status.

normal, men are overweight and women are obesity when it was diagnosed by ratio in body fat. However, 70.7% of men and 25.0% of women were sarcopenia that takes part in functional impairment, disabilities, and frailty syndrome. In addition, elderly who were underweight (BMI<20) showed poorer nutritional quality than those who were normal weight (BMI 20~25) and overweight(BMI≧25)[29]. So, elderly have to keep their weight with consistent body composition by optimizing diet and nutrition[30].

The consequences of poor nutritional health are consistent with other studies[13,14,15,16]. Nutritional quality declines with age, especially in older elderly (over 75) in both sex, but older males had better nutritional quality than elderly woman[28]. Especially, dietary fiber, water, and calcium are less than half of KDRIs, which give many health benefits to elderly. Especially dietary fiber has various functions; lower risk of colon cancer, constipation, treatment for cardiovascular disease and type 2 diabetes[31]. Therefore malnutrition has an effect on a decline in functional, decreased bone mass, immune dysfunction, anemia, reduced cognitive function, poor wound healing, and delayed recovering form surgery in elderly[32]. So oral supplements need to be considered in elderly unable to meet daily requirements.

Carbohydrates, protein, and fat ratio from energy was inadequate in our study subjects. Similar with our study, Oh C, No JK[23] noted that the percentage of energy from carbohydrate caused chronic disease like metabolic syndrome in women were higher than in men. Fat that can dissolve vitamin and nourish our body is essential to your health. However, in our result, percentage of energy from fat was lack. With intake of proper fat portion, balanced ratio of n-6 and n-3 is needed to intake through the food and supplement.

In conclusion, we developed the first set of anthropmetric, biochemical indicators, and nutritional intakes in over 85 years old elderly by using KNHANES which has representability of Korean population. Nutrients which including energy, protein, dietary fiber, water, thiamin, riboflavin, niacin, calcium, and potassium were lacked for over 85 years elderly. Elderly need to be educated nutrition and their health life to prevent malnutrition. It was inappropriate to combine over 75 years and over 85 years in same group in nutrition standard for Koreans because of their different anthropemetric status at different age groups. So, it is need to rearrange nutrition intake standard for over 85 elderly.

This study has some limitations. First of all, it was a cross-sectional study and we can't exclude survival or birth-cohort bias or discount temporal or cohort effects. Second, it showed nutritional intake but it can't explain quality of nutrition and their dietary habits. In future study, we will research with study's sub-grouping such as young-old(65 to 74), the old-old(75 to 84), and the oldest old(over 85) in order to assess nutrition and health status which can be the database of an aging study of the Korean population.

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