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Nutritional Intake and Biochemical Status in Blood and Urine of Elderly Women : Comparisons Among Subgroups Divided by Residence Type

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ABSTRACT

The present paper presents information on the dietary intake and biochemical status of elderly who are living in different types of residence. On hundred and sixty five women(age 65－80 years old) were divided into three groups : those who are living alone (LA), living with family (LF), and living in institutions (LI) within the same general community. Nutrient intake, body fat content, and biochemical measurements in blood and urine were examined statistically and potential environment-related influence are discussed. Elderly women living alone had significantly lower intake of nutrients than elderly women were not living alone LF group showed significantly higher fat consumption than LA and LI groups. Body fat content, plasma albumin and calcium levels in elderly women who lived with other people were significantly higher than those in elderly women living alone, but fat weights and lean body mass between groups were not different. None of the plasma lipid fractions were significantly different among the three groups except LDL-cholesterol (LDL-C) concentration. In the LI group, LDL-C was lower than that of LF and LA groups.

From the above results, serious nutritional deficiency has been shown in elderly women that live alone. Therefore, nutritional education and social help should be carried out to improve these situations for elderly people. (*Korean J Nutrition* 30(9) : 1095~1101, 1997)

KEY WORDS : dietary intake · elderly women · residence types · lipid fractions.

Introduction

It has been reported that the percentage of elderly (over 65 years old) in the total Korean population was 5.5% in the year 1994 and is expected to be 6.8% in the year 2000 due to increased life expectancy[1]. The increasing elderly population has resulted in social and economical problems similar to those in Western conturies. In addition, there are 20,169 elderly people living alone (which is thirty times higher than the number of elderly people who are live in institutions) in Chonbuk province[2]. However, institutions for old people are insufficient, and can accommodate only destitute elderly people or elderly people without a provider.

There are three different resident types among elderly people in Korea : living in institutions (LI) as a destitute person or elderly without a provider, living alone (LA) when they have no family or live far away from their family, or living with their family (LF) and spending their time with other older people at community centers.

Many factors may contribute to nutrition related health problems in the elderly. Lack of mobility may

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make it difficult for the elderly to obtain and prepare food and poor dental health may making eating difficult even when food is available[3]. It is strongly recommended that elderly people have a well-designed diet plan including balanced dietary intake and appropriate micro nutrient intake[4]. There have been many recent surveys of dietary intake and life style in the elderly living in either rural or urban areas. However most of this research[5][6][7][8] has been conducted in Western countries. The surveys of dietary intake and nutritional supplemental studies[9][10] in developed conturies suggest that the establishment of social welfare systems for the elderly can improve their quality of life. Since the 1970's, there has been increasing concern for the nutritional care of the elderly in Korea. Researchers have tried to suggest appropriate dietary recommendations for the prevention of age-related diseases, and have conducted regular surveys of dietary intake and biochemical parameters in both blood and urine[11][12][13].

The present study investigates the effects of the types of residence on dietary intake and biochemical status in elderly women by analyzing their blood and urine, and evaluates type of residence in relation to potential environment-related influences.

Subjects and Methods

1. Subjects

165 elderly women were recruited and divided into three groups : those who live alone (LA) live with their families (LF), and those who live in institutions (LI) within the same general community. During the study period(January 4, 1996 - March 18, 1996), all subjects were visited and interviewed three times by the well-trained research team.

2. Servey of dietary intake

The diet survey was conducted by 24-hour recall method for three successive days excluding weekends [14][15]. All dietary intake was surveyed by the same researcher that conducted the initial survey. Direct interview for each subject was carried out by using measuring instruments and book for eye meassurement[16]. Intake levels of energy, carbohydrate, protein, fat and other nutrients were calculated using recorded nutrient contents of Korean foods[17]. For each subject, an average value of three days for a particular nutrient was used as the mean daily intake for that nutrient and compared with Korean RDA.

3. Anthropometry

Body weight and height were measured with the subjects wearing light clothing in the morning before blood sampling. Mid-upper-arm-circumference (MUAC) was assessed three times and the mean values were used[18]. Body mass index(BMI) was calculated as weight(kg)/height(m^2).

4. Assessment of body composition

Total body fat(fat%), fat free body weight(Lean body weight), and total body water contents were measured by bioelectric impedance analysis. Whole body impedance was measured with a portable, Bioelectric Impedance Fatness Analyzer(GIF-891, Gil Woo Trading Co., Seoul, Korea).

5. Collection of blood and urine

Immediately after physical assessment, 12 hours fasting blood samples were drawn from each subject in heparinzed vaccum tubes. Blood samples were centrifuged at 5,000rpm for 10 minutes at 4℃ and the plasma samples were kept frozen at −20℃ until samples were analyzed. Urine from each subject was collected every 24 hours into a tared plastic container fitted with a plastic funnel. Thymol was used as a preservative for urine. After determination of total urine volume, aliquots were frozen in polyethylene bottles at −20℃ until analyzed.

6. Measurement of plasma and urine parameters

Plasma total cholesterol and glucose were analyzed with commercial kit based on enzymatic methods (Youngdong pharmaceutical Co., Korea). HDL-cholesterol was analyzed with the same analytical method as total cholesterol, after the precipitation of LDL and VLDL with dextran sulfate-Mg^{++}(Kyoto Pharmaceutical Co., Japan). LDL-cholesterol was analyzed from the difference between the total cholesterol in the plasma and the cholesterol determined in the supernatant after precipitation(VLDL & HDL) the LDL-cholesterol is to be calculated(Quantolip Co., Germany). Triglyceride(TG) was analyzed with commercial kit based on Trinder method(Youngdong Pharmaceutical Co., Korea). Urinary creatinine was determined by the alkaline-picrate method[19]. Calcium was analyzed with Auto blood chemistry Analyer(Hitachi 7150, Japan).

7. Statistical analysis

The data is expressed as mean values with their standard errors. Statistical significance among groups was analyzed by Duncan's multiple range test using GraphPad Software version 2.0(San Diego, CA, USA). A p value <0.05 was considered to be significant.

Results and Discussion

The average age, height, weight, BMI, and MUAC were similar among the three groups (Table 1). Body fat(%) was in the normal range (below 30%) in all subjects, but the LA group had significantly lower body fat than those of both LI and LF groups (Table 2). Fat weight(kg) and lean body mass(kg) were not different among the groups, but total body water(%) in the LA group was significantly higher than in the LI and LF groups. When body fat is calculated from total body water, it is usually assumed that free fat tissue's water content is 67 – 77.5%[20]. Errors may have been introduced due to such assumptions, but any errors should have been equally distributed between groups. Weight to height ratio and skinfold method[18] have been long used to estimate the degree of obesity. However, obesity is the accumulation of either abdominal or subcutaneous body fat. Some people who are normal weight and appear lean can have a high body fat content due to subcutaneous fat. Therefore, we conducted this experiment by using a bioelectric impedance fatness analysis that can detect not only subcutaneous fat, but also abdominal fat. Previous studies of middle-school students[21] and middle aged women[22] showed that BMI positively correlated with their body fat content, however our data did not. The lack of correlation may be because all subjects in this study were normal body weight and group differences in body fat % were a result of differences in total body water contents.

The mean daily intake of energy, total fat, carbohydrate, protein, and other nutrients is shown in Table 3. Daily energy, carbohydrate, protein, calcium, potassium, and vitamin B_1 intake of LA group was significantly lower than in LF and LI groups. Total dietary fat was significantly higher in the LF group than in the LI and LA groups. The daily energy intake of the LA group was 73.1% of Korean RDA, significantly lower than that of the LF and LI groups. Daily protein intake of the LI group was 91% of RDA, which is similar to other data for elderly

Table 1. Anthropometric parameters of subjects

Variable	Groups		
	LA[1)](n=55)	LF[2)](n=55)	LI[3)](n=55)
Age(year)	74.32 ± 1.58[4)]	76.19 ± 1.39	76.71 ± 1.51
Weight(kg)	46.47 ± 1.76	51.00 ± 2.58	46.36 ± 2.03
Height(cm)	146.41 ± 1.70	147.81 ± 1.53	144.54 ± 1.09
BMI[5)](kg/m^2)	21.84 ± 0.79	23.19 ± 0.86	22.35 ± 0.96
MUAC[6)](Cm)	23.70 ± 0.57	23.95 ± 0.49	23.51 ± 0.71

1) Living alone 2) Living with family 3) Living in institution
4) Mean±SE 5) Body mass index 6) Mid-upper-arm-circumference

Table 2. Body fat content of the subjects by using Fatness Analyzer

Variable	Groups		
	L[1)](n=55)	LF[2)](n=55)	LI[3)](n=55)
Body fat (%)	24.15 ± 1.05[a4)5)]	28.55 ± 1.35[b)]	28.07 ± 1.13[b]
Fat weight(kg)	11.37 ± 0.73	13.49 ± 1.23	12.79 ± 0.89
Lean body Mass(kg)	35.24 ± 1.19	33.41 ± 2.14	33.11 ± 1.25
Total body water(%)	57.42 ± 0.67[a]	54.81 ± 0.94[b]	54.90 ± 0.79[b]

1) Living alone 2) Living with family 3) Living in institution 4) Mean±SE
5) Different superscripts in the same row indicate significant differences($p<0.05$) between groups by Duncan's multiple comparison test

Table 3. Average nutrient intake per subject per day

Variable	Groups					
	LA[1)](n=55)		LF[2)](n=55)		LI[3)](n=55)	
Energy(Kcal)	1242.39 ± 139.14^{a} [4)5)]	(73.1)[6)]	1872.99 ± 140.75^{b}	(110.2)	1939.85 ± 124.60^{b}	(114.1)
Protein(g)	36.43 ± 3.69^{a}	(60.7)	51.39 ± 5.14^{b}	(84.6)	55.30 ± 30.8^{b}	(91.0)
Total fat(g)	8.83 ± 1.87^{a}		20.96 ± 2.82^{b}		9.80 ± 0.85^{a}	
CHO(g)	238.16 ± 26.89^{a}		367.20 ± 27.04^{b}		402.17 ± 27.29^{b}	
Fiber(g)	4.95 ± 0.69^{abc}		5.70 ± 0.54^{b}		3.57 ± 0.30^{c}	
Ash(mg)	8.90 ± 1.18^{ac}		13.36 ± 1.31^{b}		8.74 ± 0.74^{c}	
Ca(mg)	216.33 ± 31.68^{a}	(30.9)	446.45 ± 58.64^{b}	(63.8)	603.56 ± 71.11^{b}	(86.2)
P(mg)	484.34 ± 126.17^{a}	(69.2)	817.20 ± 64.07^{bc}	(116.7)	923.96 ± 76.67^{c}	(131.9)
Fe(mg)	12.85 ± 2.15^{ac}	(107.1)	18.90 ± 0.88^{b}	(157.5)	14.51 ± 1.64^{c}	(120.9)
Na(mg)	632.40 ± 182.14		371.21 ± 83.83		483.68 ± 73.80	
K(mg)	829.66 ± 143.43^{a}	(118.5)	1726.20 ± 140.14^{b}	(246.6)	1281.43 ± 83.44^{c}	(183.1)
V.A(R.E.)	233.92 ± 54.02^{abc}	(33.4)	452.81 ± 97.49^{b}	(64.7)	118.59 ± 17.08^{c}	(16.94)
$V.B_1$(mg)	0.57 ± 0.071^{a}	(57.0)	1.65 ± 9.55^{bc}	(165)	6.56 ± 3.30^{c}	(156.1)
$V.B_2$(mg)	0.56 ± 0.09^{a}	(46.7)	0.80 ± 0.07^{b}	(66.7)	1.19 ± 0.15^{c}	(99.2)
Niacin(mg)	11.39 ± 1.51	(87.6)	15.05 ± 3.05	(115.8)	11.19 ± 0.63	(86.1)
Vit. C(mg)	24.92 ± 7.62^{ac}	(45.3)	131.34 ± 34.19^{b}	(138.8)	69.29 ± 24.99^{c}	(125.9)

1) Living alone 2) Living with family 3) Living in institution 4) Mean±SE

5) Different superscripts in the same row indicate significant differences($p<0.05$)between groups by Duncan's multiple comparison test

6) Values in parenthesis indicate percent intake with reference to the Korean RDA

people[13]. Daily protein intake of the LA group was 60.7% of the RDA, which was significantly lower than the LI and LF groups. These protein intake levels were lower than in subjects of other studies from a similar population[23]. Daily lipid intake levels of the LA and LI groups were also lower than in previous studies[23,24]. The % energy from carbohydrate : protein : lipid ratio were 77.8, 13.96, and 8.26, respectively, for the LA group. The same % energy were 78.64, 11.07, and 10.07 respectively for the LF group, and 82.96, 11.4 and 5.75 respectively for the LI group. These % energy ratios indicated that the carbohydrate intake was much higher and lipid intake lower than in the Korean Nutritional Survey of 1993[25]. This survey showed average notritional energy percentages of 65.9, 15.9, and 18.2 for carbohydrate, protein, and lipid. The LI group varied the greatest from the normal Korean population with 83% of calories from carbohydrate as compared to 66% of RDA. Daily calcium intake of the LA group was 30% of the RDA, which is significantly lower than the 63% in the LF and 86% in LI group. However, Fe and K intake of all subject groups was higher than the RDA. Absorption rates of Fe are different depending on the type of Fe in the food, with absorption of Fe are plant origin 3－5times lower than that of animal origin[26,27]. Therefore, it is reasonable to assume that the Fe absorption rate was low in our subject group because plants were the major Fe sources.

The daily vitamin intake data suggests that there may also be serious vitamin deficiencies in all 3 groups. Daily vitamin A intakes were 16.9%, 33.4%, and 64.7% of the Korean RDA in the LI, LA, and LF groups, respectively. The daily vitamin B_1 intake of LF and LI groups were higher than Korean RDA, but, that of the LA group was 57% of RDA. Daily vitamin B_2 and vitamin C intake of the LA group were 46% and 45% of RDA, significantly lower than LI and LF. In our study, daily energy and protein intake conditions of LF and LI groups were better than those of similar groups in other studies[11-13]. However, serious nutritional deficiencies were shown in the LA group because the intake levels of most nutrients were very low. Table 4 summarizes the biochemical parameters in blood. Fasting blood glucose was not significantly different among the three groups, but blood albumin and calcium levels of the LA group were significantly lower than those of LF and LI groups. Serum albumin level has been shown

Table 4. Biochemical parameters in blood

Variable	Groups		
	LA[1)](n=55)	LF[2)](n=55)	LI[3)](n=55)
Fasting blood sugar(mg/dl)	83.32 ± 2.97[4)5)]	90.36 ± 4.10	92.57 ± 4.12
Plasma albumin(g/dL)	3.99 ± 0.05[a]	4.70 ± 0.06[b]	4.80 ± 0.09[b]
Plasma calcium(mg/dL)	7.67 ± 0.73[ab]	9.05 ± 0.06[bc]	9.95 ± 0.15[c]
Triglyceride(mg/dl)	133.09 ±18.39	169.90 ±14.79	181.84 ±18.15
Total cholesterol(mg/dl)	190.81 ± 8.25	207.45 ± 8.28	187.94 ± 7.41
HDL-cholesterol(mg/dl)	43.95 ± 2.77	39.11 ± 3.42	40.41 ± 2.63
LDL-cholesterol(mg/dl)	124.31 ± 6.64[a]	129.93 ± 5.30[a]	103.94 ± 4.50[b]

1) Living alone 2) Living with family 3) Living in institution 4) Mean±SE
5) Different superscripts in the same row indicate significant differences($p<0.05$) between groups by Duncan's multiple comparison test

Table 5. Biochemical parameters in urine

Variable	Groups		
	LA[1)] (n=55)	LF[2)] (n=55)	LI[3)] (n=55)
Total urine(ml/day)	1450.86 ±112.76[a4)5)]	1101.11 ± 74.08[b]	1282.00 ±107.45[b]
Glucose(g/day)	0.022± 0.05	0.042± 0.04	0.33 ± 0.02
Creatinine(g/day)	0.77 ± 0.03[ab]	0.83 ± 0.07[bc]	0.95 ± 0.06[c]
Protein(mg/g.cr)	156.08 ± 27.66	144.33 ± 17.75	164.34 ± 17.30

1) Living alone 2) Living with family 3) Living in institution 4) Mean±SE
5) Different superscripts in the same row indicate significant differences($p<0.05$) between groups by Duncan's multiple comparison test

to be an indicator of depleted protein status and decreased dietary protein intake[28)]. Several studies also have shown that low concentrations of serum albumin are associated with increased morbidity and mortality in hospitalized patients[29)30)]. The lower blood albumin content of LA group can be a result of a lower protein intake than those of other groups in our study. Therefore, nutritional education and social help have to be provided for elderly people living alone to increase their protein intake.

At this time, there are no appropriate biochemical indicators for assessing calcium status. This is due in large part to the biologic mechanisms that tightly control serum calcium levels despite wide variations in dietary intake[31)]. According to the previous research[31)32)], serum calcium exists in three fractions : protein bound, ionized, and complexed. The protein-bound calcium is considered physiologically inactive, whereas the ionized fraction is considered physiologically active, and complexed calcium's biologic role is uncertain. Low serum calcium($<$9mg/dl) can result from a variety of conditions including hypoparathyroidism, renal disease, and acute pancreatitis. High serum calcium concentration($>$11mg/dl) can be due to increased intestinal absorption, bone resorption, or renal tubular reabsorption resulting from such conditions as hyperparathyroidism, hyperthyroidism, and hypervitaminosis D[31)]. Subjects of LF and LI groups showed normal serum calcium status. However, the LA group showed lower serum calcium concentration, possibly resulting from low dietary calcium intake and metabolic diseases.

All blood lipid fractions were similar except for the LDL-cholesterol level of LI group, which was lower than that of LA and LF groups. Generally, it has been considered that analysis of blood lipid fractions is the first method to diagnosis of coronary heart disease and atherosclerosis. Previous studies[33)] have shown that reducing the ratio of LDL-choesterol/HDL-choesterol rather than total choesterol in blood is the most effective way to prevent atherosclerosis and coronary heart diseases. Therefore, the LDL-choesterol content is the main concern for lipoprotein metabolism because it has shown positive correlation to those diseases[34)]. In our study, the LDL-cholesterol concentration of the LI group showed significantly lower value than those of LF and LA group. This result maybe due to the LI subjects had a regular exercise program conducted by institution.

Biochemical parameters in 24 hour urinary excretion of creatinine was significantly lower in the LA group than in the LI group, although urinary volume was higher in the LA group. A biochemical test sometimes used for estimating body muscle mass is 24-hour urinary creatinine excretion, because creatinine is excreted in a relatively constant proportion to the mass of muscle in the body.

Dietary intake and biochemical parameters of both blood and urine were investigated on LA, LF, and LI elderly women within the same general community. In conclusion, serious nutritional deficiencies were observed in LA group. Various factors such as difficulties in food purchasing and preparation, poverty, physical disability, and social isolation of subjects in LA group may be related to the nutritional deficiency. Social help and continuous nutritional education for elderly people who live alone must be practically performed to improve their quality of life.

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