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Nutrient Intake Status of Koreans by Income Level and Age Group Analyzed from 2001 National Health and Nutrition Survey Data

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ABSTRACT

In order to investigate the differences of nutrient intakes by the economic status and different age groups and to identify the nutritional risk group and its specific nutrition problem, 2001 Korean National Health and Nutrition Survey were analyzed. The subject's numbers of 9,391 were classified into four classes such as low (14.2%), medium (37.2%), high (26.0%), and high above (22.6%) on the basis of the family monthly income and the 2001 Korean minimum cost of living according to the family size. Mean intakes of energy and all nutrients assessed by the RDAs, lipid-energy %, and MAR were increased as the economic status were going up. Na intake expressed per 1,000kcal was in reverse. Nearly a half (45.5%) of the low-income people seemed to take nutritionally inadequate diet in consideration with MAR values. Deficiencies of iron and even energy in the toddlers (1 to 2 years) of low-income class were of great concern. Adolescent age group has been observed that their calcium and iron intakes, and possibly energy, were appeared to be the most deficient among all the age groups regardless of the economic status. For the elderly in all the economic status except high-above class, calcium, vitamin A, and riboflavin were commonly deficient nutrients. Calcium deficiency was appeared throughout nearly all the ages except toddlers and all the economic classes. Even in the high-above class 57.3% took insufficient amount of calcium. (*J Community Nutrition* 6(2) : 67~77, 2004)

KEY WORDS : nutrient intake · economic status · different age group · 2001 KNHNS.

Introduction

Various socioeconomic factors, as well as demographic condition such as age and gender, have direct influences on the nutritional status of an individual or the population. Factors such as income, economy, education, family, and housing impact upon the food purchasing power and the variety of food choice, and hence nutritional outcomes. Especially family income is the major determinant of the diet and health status (Mo et al. 2001 ; Blaylock et al. 1999 ; Frankle, Owen 1993).

In recent years, numerous socioeconomic problems have emerged during and after the 1997 economic crisis in Korea. These problems include the widened gap between the rich and the poor, employment instability, the increasing number of homeless people, and the rising number of poor households Therefore problems of nutritional deficiency may become more spread in the low-income people, while nutrition problems of over-intake and imbalance is existed on the other economic class people.

There have been studies about nutritional status in terms of the economic levels in Korea (Kang, Kim 2002 ; Kim 1996 ; Lee et al. 1998 ; Nam et al. 1998 ; Son et al. 1996). Most of these studies reported the tendency that as the family income increased they took less cereal and more foods of animal origin and more fruits and vegetables. This tendency was shown regardless of the age groups studied. In other developed countries similar situations were reported that the nutrition behavior of low income families differed from that families with higher income (Koehler et al. 2004). The clear impact of social class and income on the nutrition can be seen in the results of the Health Behavior in School Aged

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Children study which was coordinated by World Health Organization and in which 35 countries were engaged. The lower the socioeconomic class, the lower the quality of nutrition and the less favorable the nutrition behavior was (Klocke 1997).

In Korea, however, nationwide information about nutritional pattern concerned with the economic condition is not still enough to use for the national nutrition policy establishment. Most preceding survey studies associated with the income level were carried out in a small-scale sample of specific age groups in limited regions. For the nation-wide data there are no studies regarding the economic level except the report of in-depth analysis using 1998 Korean National Health and Nutrition Survey (KNHNS) (Korea Health and Welfare Ministry 2000).

Therefore in the present study, using the latest nationwide survey data of 2001 KNHNS, the differences in nutrient intakes by the economic status and different age groups were investigated, and thus nutritional risk groups and their specific nutrition problems were identified. A part of the data presented in this study were cited from the reports of in-depth analysis of 2001 Korean National Health and Nutrition Survey (Korea Health and Welfare Ministry 2003) in which the authors of this study were participated for the analysis. Outcomes of the study may be used as a suggestion for establishing national nutrition policies and for developing the practical programs.

Subjects and Methods

1. Study subjects

The present study used the nutrition survey data of the 2001 Korean National Health and Nutrition Survey (KNHNS) conducted by the Korea Ministry of Health and Welfare, during November and December 2001. The nutrition survey sample comprised of 10,500 persons representing Korean population age one year and older. As the non-responses on the item of monthly family income were deleted, data of 9,391 numbers of the subjects (89.4%, 3,115 households) were analyzed.

2. Data collection and processing

1) Data collection

Nutrition survey was carried out by specially trained dietitians and members of each household were interviewed at home. One-day food intake was surveyed by 24-hour recall method. Food portions were converted into weight according to the standard estimators. The daily nutrient intake was estimated on the basis of food composition table of Korean Office of Rural Development (2000).

2) Classification of economic class

Economic status was classified into four classes using the poverty income guideline defined as 2001 Korean minimum cost of living considering family size. "Low" class meant the subjects' monthly family income was below the poverty income guideline. As such, "middle", "high", and "high-above" meant from 100% to 199.9% of the poverty income guideline, from 200% to 299.9% of the poverty income guideline, and from 300% of the poverty income guideline or more, respectively. Subjects of 1331 (14.2%) belonged to the low economic class, 3495 (37.2%) the middle, 2441 (26.0%) the high, and 2124 (22.6%) high above. Numbers of households belonged to each economic class were 639 (20.5%), 1038 (33.3%), 716 (23.0%), and 722 (23.2%), respectively. Monthly incomes (10,000Won) per household were 33.1 ± 28.4 for the low, 125.2 ± 41.3 for the middle, 196.3 ± 60.4 for the high, and 321.5 ± 130.9 for the high above.

3) Nutrient intake evaluation

Energy and nutrient intake were evaluated on the basis of 2000 Korean recommended dietary allowances (RDA). The percentages against RDAs (RDA%) for all nutrients were calculated and lipid intake multiplied by 9kcal was expressed as the percent of energy intake (lipid-energy%). Mean adequacy ratios (MAR) of energy, protein, Ca, P, Fe, vitamin A, thiamin, riboflavin, niacin, and vitamin C were calculated. MAR is the mean value of the nutrient adequacy ratios (NARs) of energy and above 9 nutrients. The following formula is to estimate the NARs.

NAR = Amount of nutrient in a diet/RDA of nutrient
(If NAR > 1, NAR is regarded as 1)

For the above 9 nutrients, indices of nutritional quality (INQ) were estimated and the number of nutrient with its INQ lower than 1. INQ is calculated using the following formula :

INQ = Amount of nutrient in 1000kcal of diet/Allowance of nutrient per 1000kcal

For the allowances of nutrient per 1000kcal, RDAs of each

age and sex group according to the 2000 revisions of Korean RDA was used because the INQ in the present study was for evaluating the daily diet quality of each subject (Lee, Nieman 1995).

3. Statistical analysis

All the values were expressed as group mean and standard deviation (SD) or frequency distribution and the percentage. Group differences of means were examined by t-test, ANOVA, ANCOVA or MANCOVA. The statistical analyses were carried out using SPSS program (ver 11.0).

Results and Discussion

1. Nutrient intakes by economic status

1) Total subjects

Nutrient intake pattern of the total subjects by the economic status was shown in Table 1. As age, gender, education level as well as economic status are variables that affect the nutrient intake most significantly, age, gender and education level were adjusted during the statistical comparative

Table 1. Daily nutrient intakes and nutritional indices by the economic status*

Nutrient	Low (n = 1330)	Middle (n = 3495)	High (n = 2441)	High-above (n = 2124)	Total (n = 9390)	p-value[2)]
Energy (kcal)	1737.7 ± 766.2[1)]	1941.5 ± 871.8	2014.3 ± 890.1	2123.7 ± 886.3	1973 ± 874	0.000
RDA%	86.8 ± 35.1	93.8 ± 37.9	95.9 ± 38.9	100.4 ± 39.3	94.8 ± 38.3	0.000
Protein (g)	61.8 ± 50.7	69.4 ± 40.8	74.0 ± 42.3	81.2 ± 45.1	72.2 ± 44.1	0.000
RDA%	104.6 ± 57.1	124.0 ± 66.2	132 ± 76.8	142.2 ± 75.4	127 ± 71.0	0.000
Lipid (g)	30.2 ± 36.0	40.2 ± 33.0	44.0 ± 34.6	48.7 ± 35.5	41.7 ± 34.9	0.000
Energy%	14.6 ± 8.6	18.4 ± 9.5	19.4 ± 9.3	20.3 ± 9.3	18.5 ± 9.4	0.000
Carbohydrate (g)	295.9 ± 126.2	312.9 ± 138.2	31 ± 135.1	326.9 ± 131.0	314.5 ± 134.4	0.000
Ca (mg)	460.3 ± 340.6	476.8 ± 319.4	512.5 ± 341.8	550.2 ± 334.3	500.4 ± 333.3	0.000
RDA%	66.2 ± 48.8	68.9 ± 48.1	73.2 ± 51.6	78.4 ± 49.0	71.8 ± 49.5	0.000
P (mg)	1008.0 ± 492.7	1134.1 ± 545.7	1194.8 ± 564.7	1295.2 ± 597.9	1168.4 ± 562.8	0.000
RDA%	143.0 ± 69.5	161.7 ± 77.0	169.0 ± 80.6	183.6 ± 85.0	165.9 ± 79.8	0.000
Fe (mg)	13.0 ± 43.7	12.0 ± 16.1	12.3 ± 8.5	13.6 ± 15.0	12.6 ± 20.9	0.307
RDA%	92.2 ± 79.7	92.6 ± 73.7	95.2 ± 68.8	103.5 ± 69.5	95.7 ± 72.6	0.000
Na (mg)	4801 ± 3254	4843 ± 3399	4882 ± 3075	5153 ± 3201	4917 ± 3254	0.002
/1000kcal	2849.2 ± 1737.6	2534.2 ± 1507.4	2507.3 ± 1427.1	2468.6 ± 1219.1	2557.0 ± 1467.3	0.000
K (mg)	2485 ± 1317	2777 ± 1711	2864 ± 1353	3130 ± 1462	2838 ± 1527	0.000
Vitamin A (μgRE)	518.4 ± 518.1	610.7 ± 755.2	624.2 ± 608.9	699.2 ± 641.7	625.6 ± 790.8	0.000
RDA%	76.8 ± 72.81	94.7 ± 112.1	96.5 ± 92.0	106.4 ± 93.3	95.9 ± 115.7	0.000
Thiamin (mg)	2.60 ± 49.12	1.26 ± 0.88	1.35 ± 0.86	1.41 ± 0.82	1.51 ± 18.51	0.139
RDA%	96.87 ± 60.09	118.06 ± 77.02	125.93 ± 79.22	129.53 ± 73.30	119.70 ± 75.31	0.000
Riboflavin (mg)	0.95 ± 2.03	1.12 ± 0.73	1.19 ± 0.64	1.31 ± 0.70	1.15 ± 1.00	0.000
RDA%	72.13 ± 42.73	89.93 ± 57.46	94.32 ± 51.88	102.53 ± 53.90	91.40 ± 54.10	0.000
Niacin (mg)	13.9 ± 14.8	16.3 ± 11.4	17.3 ± 11.2	19.0 ± 11.8	16.8 ± 12.1	0.000
RDA%	98.8 ± 60.0	116.4 ± 76.5	122.3 ± 78.6	132.9 ± 76.8	119.2 ± 75.7	0.000
Vitamin C (mg)	112.2 ± 109.3	131.5 ± 120.3	138.0 ± 119.7	140.9 ± 112.4	132.6 ± 117.2	0.000
RDA%	164.5 ± 156.5	197.1 ± 177.1	206.1 ± 178.2	208.8 ± 164.8	197.5 ± 172.4	0.000
Drinking water (ml)	838.8 ± 505.5	830.7 ± 468.6	843.4 ± 469.7	838.0 ± 456.8	836.8 ± 471.6	0.777
Alcohol beverage (g)	6.1 ± 26.2	5.3 ± 21.9	5.9 ± 27.3	5.8 ± 23.0	5.7 ± 24.3	0.660
MAR	0.74 ± 0.20	0.79 ± 0.18	0.82 ± 0.16	0.85 ± 0.15	0.80 ± 0.18	0.000
Nutrient's number of INQ < 1	4.52 ± 2.14	3.93 ± 2.02	3.29 ± 1.93	3.39 ± 1.95	3.78 ± 2.05	0.000

*adjusted with age, gender, and education level
[1)]*Mean ± SD*, [2)]*ANCOVA*
Multivariate test by Pillai's Trace : p = 0.000 (for the RDA% of 10 nutrients, lipid-energy%, Na/1000kcal, drinking water, alcohol beverage, MAR, and Nutrient's number of INQ < 1)

analysis.

The intake amounts of energy and most nutrients except iron and thiamin were increased as the economic status were going up. Consequently the percentages of RDAs for all nutrients, lipid-energy%, and MAR became higher and the numbers of nutrient with INQ lower than 1 (INQ < 1) became less as the economic status were elevated. These results corresponded with the results of previous studies on the nutritional status in terms of the economic levels in Korea (Kim, Kang 2000 ; Kim 1996 ; Lee et al. 1998 ; Lee et al. 1986 ; Nam et al. 1998). In other developed countries similar situations were reported that the nutrition behavior of low income families differed from that families with higher income (Koehler et al. 2004).

Of the nutrients Ca intake was the lowest. The mean RDA% of the total subjects was 71.8%, which was below the cutoff point of inadequacy, 75% of RDA. The Ca intake of the low and middle economic groups was poorer. Sodium intake was also increased from 4,801mg to 5153mg as the economic class became higher. These amounts were equivalent to 12.1g and 13.0g of salt, respectively, which were similar to many previous reports (Son, Heo 2002). However when Na intake was examined per 1,000kcal of energy intake because Na intake from salts depended much on the meal amount, the sodium intake tendency by economic level was reversed. Low-income group took the highest and high-above group took the lowest. It suggests that the low economic class people took diet saltier than the higher economic class did. If the energy intakes of all the economic class were supposed to be same as the average energy intake of the whole subjects, 1973kcal, daily salt intakes were assumed as 14.2g in low economic class and as 12.2g in the high-above class. These values are higher than the Korean dietary goal of salt intake less than 10 grams per day (Korea Health and Welfare Ministry 2002). Major sources of sodium intake are reported to be as kimchi, seasonings such as soybean paste, soy sauce, ets., and ramyon (Korea Health and Welfare Ministry 2000). The dietary guideline 'avoid salty foods and eat slightly salted' should be more emphasized at nutrition education to bring down the salt intake and hence sodium intake.

Intake amounts of drinking water and alcohol beverage did

Table 2. Distributions of the intake levels of some nutrients by the economic status

Intake levels of nutrient		Low (n = 1330)	Middle (n = 3495)	High (n = 2441)	High-above (n = 2124)	Total (n = 9390)	p-value[3]
Energy%[1]	< 75	40.3[2]	33.4	31.2	25.4	32.0	0.000
	75 – 125	46.7	49.6	50.3	53.6	50.3	
	≥ 125	13.0	17.1	18.5	21.0	17.7	
Protein%	< 75	32.5	21.8	16.3	12.9	19.9	0.000
	75 – 125	39.2	38.8	38.3	35.1	37.9	
	≥ 125	28.3	39.4	45.4	51.9	42.2	
Ca%	< 75	69.9	66.3	63.0	57.3	63.9	0.000
	75 – 125	20.2	24.9	26.7	30.7	26.0	
	≥ 125	9.9	8.8	10.4	12.1	10.1	
Fe%	< 75	55.1	49.1	46.3	38.8	46.9	0.000
	75 – 125	25.6	29.9	32.2	36.5	31.4	
	≥ 125	19.3	21.0	21.5	24.7	21.7	
Vitamin A%	< 75	62.7	53.5	49.2	42.9	51.3	0.000
	75 – 125	21.8	24.8	28.3	28.9	26.2	
	≥ 125	15.5	21.7	22.4	28.2	22.5	
Riboflavin%	< 75	60.0	45.7	39.8	32.9	43.3	0.000
	75 – 125	28.7	35.1	39.8	41.2	36.8	
	≥ 125	11.3	19.2	20.4	25.9	19.9	
MAR	< 0.5	14.7	8.1	5.4	3.5	7.3	0.000
	0.5 – 0.75	30.9	26.1	22.9	18.6	24.2	
	≥ 0.75	54.5	65.9	71.7	77.9	68.5	
Energy-lipid overintake[4]	Yes	1.5	3.8	4.5	5.7	4.1	0.000
	No	98.5	96.2	95.5	94.3	95.9	

[1]RDA%, [2]%, [3]Chi-square test, [4]Energy% ≥ 125 and lipid-energy% ≥ 30

not show any significant differences among the economic status groups.

When we looked at the low-income group closely, the average intake of energy was less than 90% of RDA, lipid-energy % was 14.6%, Ca was 66.2%, vitamin A was 76.8%, and riboflavin was 72.1% of RDAs. These are much lower than the other three groups, especially than high or high-above groups. In case of MAR reflecting the overall nutrient intake adequacy of an individual diet, the low income group showed 0.74 of average, whereas the rest 3 groups showed from 0.79 to 0.85. The average numbers of nutrient with INQ < 1 of the low-income group was 4.52 in average out of 9 nutrients, in comparison with from 3.29 to 3.39 in the high or high-above groups.

The MAR of less than 0.75 could be regarded as inadequate diet since the RDA% of 75 is usually used as a cutoff point in determining inadequacy of a nutrient intake in Korea. INQ is used an index of nutrient density that allows the quality of a nutrient per 1,000kcal in a diet. A daily diet with overall INQs greater than 1 is generally considered to be of good quality, which means the diet provides important nutrients in excess of calories. On the contrary, a diet supplying calories in excess of nutrients would have an INQ less than 1. Therefore above results suggested that the low-income group in average took the diets insufficient in both nutritional adequacy and quality and saltier diet than the other three groups of better economic conditions.

In order to determine the prevalence of nutrient deficiency the RDA% of each nutrient was classified into 3 categories, below 75, 75 up to 125, and 125 or more, which was translated into deficient, adequate, and excess intakes, respectively. Table 2 shows the distributions of three RDA% categories of important nutrients by economic status. Although the mean values of energy, protein, vitamin A, iron and riboflavin intakes of total subjects were over 90% of RDA as seen in Table 1, the proportions belonged to the deficient category were from 19.9% to 51.3% depending on the nutrients. In case of Ca, the deficiency ratio was 63.9%.

All the proportions of deficient category for energy, protein, Ca, Fe, vitamin A, and riboflavin became higher as the economic status decreased, whereas the proportions of the excess were going up as the economic level increased. Particularly in low economic status people, the prevalence of the deficient were 40.3% for energy, 32.5% for protein, 69.9% for Ca, 55.1% for Fe, 62.7% for vitamin A, and 60.0% for riboflavin. Table 2 also showed MAR distributions. Nearly a half (45.5%) of the low income people fell into the inadequate category (MAR < 0.75). Of 45.5%, 14.7% showed MAR less than 0.5, 30.9% showed MAR from 0.5 up to 0.75. In the other three economic classes one-fourth up to one-third of the subjects belonged to the inadequate category.

On the other hand, the prevalence of the excess intake of energy was quite high, particularly in the high (18.5%) or high-above (21.0%) classes. Moreover, the excess intake prevalence of both energy and lipid was 4.5% and 5.7% in the high and the high-above group, respectively. These results suggested that obesity and related metabolic degenerative diseases were of great concern in the high or high-above eco-

Table 3. The male subjects' daily intakes of some nutrients by the economic status*

Nutrient	Low (n = 568)	Middle (n = 1674)	High (n = 1183)	High-above (n = 1058)	Total (n = 4483)	p-value[3]
Energy %[1]	88.4 ± 36.2[2]	96.5 ± 38.0	97.6 ± 39.2	102.0 ± 39.1	97.1 ± 38.5	0.000
Protein %	108.1 ± 57.8	129.8 ± 67.2	134.7 ± 65.0	148.4 ± 80.1	132.7 ± 69.8	0.000
Lipid-energy%	15.9 ± 9.0	19.1 ± 9.3	19.9 ± 9.3	21.0 ± 9.6	19.3 ± 9.5	0.000
Ca %	68.4 ± 47.8	74.2 ± 49.4	77.5 ± 50.7	83.9 ± 54.3	76.6 ± 51.0	0.000
Fe %	99.6 ± 78.8	107.4 ± 74.5	109.9 ± 68.3	124.0 ± 79.0	111.0 ± 75.0	0.000
Na/1000kcal	2708.8 ± 1674.2	2450.2 ± 1329.0	2461.2 ± 1287.5	2433.8 ± 1158.2	2482.0 ± 1332.3	0.011
Vitamin A %	91.7 ± 256.8	105.8 ± 128.6	104.2 ± 93.9	113.3 ± 94.4	105.3 ± 137.8	0.174
Riboflavin %	75.8 ± 45.0	94.1 ± 60.8	95.6 ± 51.7	105.0 ± 56.5	94.8 ± 56.2	0.000
Drinking water (ml)	957.0 ± 574.3	930.7 ± 516.3	910.1 ± 484.9	913.2 ± 490.1	924.5 ± 510.0	0.000
Alcohol beverage (g)	9.0 ± 28.2	9.2 ± 29.2	10.1 ± 36.3	9.3 ± 9.4	9.4 ± 31.1	0.454
MAR	0.76 ± 0.19	0.82 ± 0.17	0.84 ± 0.15	0.87 ± 0.14	0.83 ± 0.17	0.000
Nutrient's number of INQ < 1	4.20 ± 2.10	3.62 ± 2.07	3.39 ± 1.97	3.07 ± 1.97	3.50 ± 2.05	0.000

*adjusted with age and education level
[1]RDA%, [2]Mean ± SD, [3]ANCOVA, Multivariate test by Pillai's Trace : p = 0.000

nomic classes.

Above results confirmed that family income was an important determinant of the nutrients intake. As family income increases, food choices becomes various and of high quality resulting in better nutritional outcome (Mo et al. 2001 ; Blaylock et al. 1999 ; Terry 1993). However, excess intake of energy and lipid is another nutrition problem of higher income class that should be cared.

2) By gender

In Table 3 and 4 nutrient intakes of the four economic classes are shown by gender. Both male and female nutrient intake patterns by the economic status were similar to that of the whole subject of Table 1. The more the family incomes, the better the nutrient intake patterns were. However, comparing with the male subjects, all the nutrients intakes of the female were lower regardless of the economic classes. Sodium intake per 1000kcal was higher in the female than in the male, especially for the female with low-income the intake amount of alcohol beverage was much more than the other three economic classes. And Ca intake of the female in middle economic class was as low as that in the low economic class, which needs a careful consideration.

Table 4. The female subjects' daily intakes of some nutrients by the economic status*

Nutrient	Low (n = 762)	Middle (n = 1821)	High (n = 1258)	High-above (n = 1066)	Total (n = 4907)	p-value[3]
Energy %[1]	85.5 ± 34.4[2]	91.4 ± 37.7	94.2 ± 38.6	98.7 ± 39.5	92.8 ± 38.0	0.000
Protein %	102.0 ± 56.4	118.7 ± 64.8	129.8 ± 86.5	136.0 ± 69.9	122.7 ± 71.7	0.000
Lipid-energy%	13.7 ± 8.1	17.7 ± 9.6	18.9 ± 9.4	19.6 ± 9.0	17.8 ± 9.4	0.000
Ca %	64.5 ± 49.4	64.0 ± 46.3	69.1 ± 52.1	72.9 ± 42.4	67.3 ± 47.7	0.000
Fe %	86.7 ± 80.0	78.9 ± 70.4	81.3 ± 66.3	83.1 ± 51.1	81.7 ± 67.3	0.050
Na/1000kcal	2953.8 ± 2611.4	2611 ± 1651.2	2550.6 ± 1546.2	2503.0 ± 1276.3	2625.4 ± 1577.7	0.003
Vitamin A %	73.4 ± 78.4	84.5 ± 93.4	89.3 ± 89.5	99.6 ± 91.6	87.2 ± 90.2	0.000
Riboflavin %	69.4 ± 40.8	86.1 ± 54.0	93.1 ± 52.1	100.1 ± 51.1	88.3 ± 51.9	0.000
Drinking water(ml)	750.7 ± 427.1	738.8 ± 398.5	780.8 ± 446.1	763.4 ± 407.8	756.8 ± 417.8	0.047
Alcohol beverage(g)	3.9 ± 24.4	1.7 ± 10.6	2.0 ± 13.4	2.4 ± 13.5	2.3 ± 14.9	0.006
MAR	0.72 ± 0.21	0.77 ± 0.18	0.80 ± 0.17	0.83 ± 0.16	0.78 ± 0.18	0.000
Nutrient's number of INQ < 1	4.69 ± 2.21	4.13 ± 2.00	3.79 ± 1.90	3.67 ± 1.91	4.03 ± 2.02	0.000

*adjusted with age and education level
[1]RDA%, [2]Mean ± SD, [3]ANCOVA, Multivariate test by Pillai's Trace : p = 0.000

Table 5. Daily nutrient intake status by age groups of the low income class

Nutrient	Age group(years)								p-value[3]
	1 – 2 (n = 22)	3 – 6 (n = 67)	7 – 12 (n = 121)	13 – 19 (n = 92)	20 – 29 (n = 115)	30 – 49 (n = 262)	50 – 64 (n = 270)	65+ (n = 382)	
Energy %[1]	75.5 ± 31.2[2]	83.2 ± 34.4	91.1 ± 30.0	82.2 ± 38.0	86.2 ± 38.5	90.2 ± 34.1	87.1 ± 33.1	85.4 ± 37.3	0.224
Protein %	108.1 ± 48.1	135.2 ± 62.9	131.9 ± 54.7	91.7 ± 42.1	107.8 ± 62.1	113.8 ± 55.4	100.9 ± 53.0	88.8 ± 56.4	0.000
Lipid-energy%	22.1 ± 10.7	18.2 ± 7.7	19.8 ± 6.8	19.5 ± 8.3	18.2 ± 9.3	15.5 ± 8.4	11.6 ± 7.3	11.2 ± 7.4	0.000
Ca %	86.1 ± 60.0	54.6 ± 35.5	63.6 ± 35.7	51.0 ± 32.5	69.1 ± 44.0	72.3 ± 50.1	74.0 ± 56.8	60.8 ± 49.6	0.000
Fe %	68.3 ± 60.5	63.8 ± 33.6	76.0 ± 47.0	57.7 ± 34.8	83.4 ± 60.7	99.1 ± 77.2	115.9 ± 102.8	93.2 ± 84.6	0.021
Na/1000kcal	1782 ± 1219	1956 ± 1116	2106 ± 912	2303 ± 979	2827 ± 1977	2920 ± 1379	3234 ± 1784	3121 ± 2097	0.000
Vitamin A %	84.3 ± 75.1	68.5 ± 49.8	87.0 ± 60.5	72.1 ± 48.8	91.5 ± 80.3	92.6 ± 67.0	85.0 ± 100.3	54.5 ± 55.7	0.000
Riboflavin %	110.5 ± 54.9	75.9 ± 41.7	86.5 ± 33.8	76.1 ± 39.6	80.9 ± 45.8	79.2 ± 39.0	69.0 ± 47.2	58.5 ± 39.1	0.000
Drinking water(ml)	518 ± 444	677 ± 432	865 ± 476	998 ± 678	925 ± 537	967 ± 609	824 ± 422	735 ± 400	0.000
Alcohol beverage(g)	0	0	0.1 ± 0.4	3.2 ± 23.5	5.7 ± 21.9	7.5 ± 26.3	8.6 ± 31.5	7.5 ± 30.3	0.019
MAR	0.70 ± 0.19	0.71 ± 0.20	0.79 ± 0.16	0.71 ± 0.20	0.75 ± 0.19	0.79 ± 0.18	0.75 ± 0.20	0.68 ± 0.22	0.000
Nutrient's number of INQ < 1	3.82 ± 2.82	4.64 ± 1.90	4.26 ± 1.87	4.65 ± 2.01	3.83 ± 1.99	3.71 ± 1.93	4.33 ± 2.19	5.45 ± 2.11	0.000

[1]RDA%, [2]Mean ± SD, [3]ANOVA

2. Nutrient intakes of each economic class by the age group

Tables 5 to 8 shows some nutrients intake status by age groups of each economic class, which could suggest the nutritionally vulnerable age groups and their nutritional problems in a specific economic class. Age groups were classified into years of 1 to 2(1 − 2), 3 to 6(3 − 6), 7 to 12(7 − 12), 13 to 19(13 − 19), 20 to 29(20 − 29), 30 to 49(30 − 49), 50 to 64(50 − 64), and 65 and older(65+) on the bases of Korean RDA and the previous reports of 1999 and 2001 KNHNS.

In the low economic class(Table 5), age groups of 1 − 2, 3 − 6, 13 − 19, and 65+ showed MAR values below 0.75, and age groups of 3 − 6, 13 − 19, and 65+ showed the numbers of nutrient with INQ < 1 over a half(4.5) of 9 nutrients. The low intakes of Ca, Fe, and vitamin A for 3 − 6 and 13 − 19 age groups seemed to be main causes of low MAR and high numbers of nutrients with INQ < 1. For the 65+ age group Ca, vitamin A, and riboflavin intakes were very poor since the mean percentages of RDAs were only 60.8%, 54.5%, and 58.5%, respectively.

Ca intakes of both 3 − 6 and 13 − 19 age groups were as low as around 50% of RDA, 54.6% and 51.0%, respectively. Iron intake was 57.7% of RDA suggesting another nutrient being significantly deficient in the 13 − 19 age group. Lipid intake of the elderly, 65+ group, also seemed to be inadequate since mean value of lipid-energy% was only 11.2% which was far less than the recommended level of 20% and was much lower than those of other age groups.

It also should be paid attention to that the RDA% of energy and iron and MAR of the 1 to 2 age group were only 75.5% and 68.3% and 0.70. Such deficiencies of the toddlers(1 to 2 years) might disturb their normal growth rate.

The age groups of 7 − 12, 20 − 29, 30 − 49, and 50 − 64 showed relatively good nutrient intakes in average. Especially for the group of 7 − 12, it is partially owing to the school feeding program. As the school feeding program has recently been extended to the middle and high school, nutrient intake status of 13 − 19 group will be expected to become better.

In focus of individual nutrient, the energy intakes of most age groups in low income class was less than or around 90% of RDA. This levels of energy intake particularly for the age group of growing period and maybe for the elderly may not be enough for the normal growth and for the healthful living (Koo et al. 2002). The intakes of Ca showed deficient range throughout all age groups except 1 − 2 age group in the low economic class, which was mainly resulted from the low intake of milk and its products.

In case of the middle economic class shown in Table 6, two age groups of 13 − 19 and 65+ showed MAR values under 0.75 and the numbers of nutrient with INQ < 1 over 4.5 out of 9 nutrients. The 13 − 19 age group showed RDA% of Ca and Fe below 75%. For the elderly group the intakes

Table 6. Daily nutrient intake status by age groups of the middle income class

Nutrient	Age group(years)								p-value[3]
	1 − 2 (n = 116)	3 − 6 (n = 283)	7 − 12 (n = 371)	13 − 19 (n = 330)	20 − 29 (n = 440)	30 − 49 (n = 1158)	50 − 64 (n = 509)	65+ (n = 288)	
Energy %[1]	89.4 ± 43.2[2]	92.1 ± 40.2	92.4 ± 38.2	88.7 ± 38.9	95.9 ± 39.8	96.5 ± 37.5	93.4 ± 33.7	91.7 ± 36.7	0.017
Protein %	148.7 ± 82.6	160.1 ± 84.9	135.9 ± 67.0	106.6 ± 56.2	122.3 ± 60.7	127.8 ± 65.5	111.1 ± 56.3	93.7 ± 46.8	0.000
Lipid-energy%	27.6 ± 11.0	22.0 ± 8.0	22.3 ± 8.4	21.9 ± 18.5	19.7 ± 10.0	17.6 ± 8.9	13.3 ± 7.7	12.0 ± 7.8	0.000
Ca %	116.6 ± 98.1	69.9 ± 45.5	59.0 ± 36.3	52.4 ± 33.5	69.6 ± 44.2	73.3 ± 48.5	69.4 ± 42.3	60.5 ± 46.0	0.000
Fe %	95.4 ± 84.4	78.6 ± 72.6	75.3 ± 44.3	68.6 ± 55.4	88.8 ± 54.5	103.9 ± 89.1	104.1 ± 67.3	94.8 ± 74.6	0.000
Na/1000kcal	1149 ± 673	1683 ± 823	2005 ± 980	2296 ± 1130	2529 ± 1149	2748 ± 1538	3020 ± 1882	3172 ± 1835	0.000
Vitamin A %	129.1 ± 129.9	90.9 ± 72.1	91.3 ± 95.2	79.5 ± 74.6	99.0 ± 112.8	104.1 ± 129.8	89.3 ± 112.9	70.8 ± 106.4	0.000
Riboflavin %	144.2 ± 102.7	103.2 ± 54.8	95.6 ± 47.2	86.3 ± 51.5	92.5 ± 49.1	90.2 ± 59.3	78.5 ± 47.2	67.0 ± 55.8	0.000
Drinking water(ml)	419 ± 243	614 ± 371	794 ± 418	941 ± 597	907 ± 465	885 ± 476	839 ± 431	780 ± 391	0.000
Alcohol beverage(g)	0	0	0.0± 0.1	2.7 ± 26.7	6.1 ± 24.8	8.6 ± 26.2	7.4 ± 24.1	4.0 ± 13.2	0.000
MAR	0.78 ± 0.22	0.77 ± 0.18	0.79 ± 0.17	0.74 ± 0.19	0.81 ± 0.17	0.83 ± 0.16	0.79 ± 0.18	0.73 ± 0.20	0.000
Nutrient's number of INQ < 1	2.98 ± 2.48	3.88 ± 1.82	3.93 ± 1.76	4.46 ± 1.87	3.8 ± 1.9	3.58 ± 1.95	4.1 ± 2.0	5.10 ± 2.26	0.000

[1]RDA%, [2]Mean ± SD, [3]ANOVA

of Ca, vitamin A, riboflavin, and lipid were appeared to be deficient or inadequate as well as in the low economic class. The rest of the age groups showed relatively good nutrient intake patterns in average. Ca intake in the middle economic class showed the deficiency throughout all age groups except 1 − 2 age group as in the low income.

At Table 7 nutrient intakes by age groups of the high economic class were presented. Only the age groups of 65+ showed mean MAR values under 0.75 and the numbers of nutrient with INQ < 1 over 4.5 out of 9 nutrients. Their intakes of Ca, vitamin A, and riboflavin were appeared to be deficient and that of lipid seemed to be inadequate since mean value of lipid-energy% was 13.0%. These intake patterns are different with those in the low and middle economic classes. The rest of the age groups showed relatively good nutrient intake patterns in average. However, in the group of 13 − 19 Ca and Fe still remained as deficient nutrients, since their RDA% were 58.2% and 70.4%, respectively. In addition

Table 7. Daily nutrient intake status by age groups of the high income class

Nutrient	Age group (years)								p-value[3]
	1 − 2 (n = 65)	3 − 6 (n = 163)	7 − 12 (n = 313)	13 − 19 (n = 278)	20 − 29 (n = 329)	30 − 49 (n = 929)	50 − 64 (n = 268)	65+ (n = 96)	
Energy %[1]	99.6 ± 54.9[2]	100.1 ± 35.8	94.9 ± 33.7	91.9 ± 37.7	92.8 ± 42.8	98.5 ± 39.1	95.3 ± 39.4	88.0 ± 31.0	0.024
Protein %	193.0 ± 184.7	178.5 ± 73.7	140.5 ± 57.5	114.2 ± 50.2	126.0 ± 97.9	132.6 ± 66.5	118.4 ± 68.8	93.3 ± 44.5	0.000
Lipid-energy%	26.9 ± 9.6	22.1 ± 8.0	21.9 ± 8.5	23.3 ± 9.6	20.6 ± 9.3	18.2 ± 8.8	14.1 ± 17.8	13.0 ± 9.1	0.000
Ca %	131.0 ± 98.3	82.6 ± 81.9	62.2 ± 32.6	58.2 ± 33.4	68.5 ± 42.8	77.4 ± 46.7	75.0 ± 56.2	66.4 ± 57.5	0.000
Fe %	125.0 ± 175.8	81.4 ± 47.1	79.8 ± 38.8	70.4 ± 39.6	87.5 ± 68.5	105.0 ± 66.8	117.2 ± 79.0	89.6 ± 63.0	0.000
Na/1000kcal	1341 ± 830	1663 ± 750	2003 ± 938	2190 ± 994	2547 ± 1193	2806 ± 1530	3007 ± 1755	2871 ± 1915	0.000
Vitamin A %	130.5 ± 169.6	102.0 ± 63.1	93.5 ± 70.2	91.9 ± 78.1	90.3 ± 82.2	103.6 ± 99.3	85.3 ± 72.4	71.9 ± 141.9	0.000
Riboflavin %	160.5 ± 103.9	112.7 ± 49.0	97.8 ± 48.3	91.0 ± 42.2	94.3 ± 55.7	93.0 ± 47.8	81.2 ± 43.1	66.4 ± 41.8	0.000
Drinking water (ml)	425 ± 336	659 ± 360	805 ± 417	930 ± 546	883 ± 485	883 ± 465	824 ± 430	852 ± 506	0.000
Alcohol beverage (g)	0	0	0.0 ± 0.1	1.3 ± 10.4	9.0 ± 36.5	9.2 ± 33.5	9.3 ± 31.5	1.6 ± 7.2	0.000
MAR	0.83 ± 0.14	0.84 ± 0.14	0.81 ± 0.16	0.78 ± 0.17	0.80 ± 0.17	0.84 ± 0.15	0.81 ± 0.17	0.72 ± 0.20	0.000
Nutrient's number of INQ < 1	2.62 ± 1.93	3.57 ± 1.73	3.90 ± 1.86	4.06 ± 1.86	3.6 ± 1.9	3.34 ± 1.89	3.7 ± 2.0	5.01 ± 1.97	0.000

[1]RDA%, [2]Mean ± SD, [3]ANOVA

Table 8. Daily nutrient intake status by age groups of the high-above income class

Nutrient	Age group (years)								p-value[3]
	1 − 2 (n = 34)	3 − 6 (n = 141)	7 − 12 (n = 228)	13 − 19 (n = 195)	20 − 29 (n = 312)	30 − 49 (n = 857)	50 − 64 (n = 268)	65+ (n = 89)	
Energy %[1]	100.5 ± 65.4[2]	106.8 ± 51.4	103.1 ± 31.9	90.6 ± 35.0	96.4 ± 40.3	102.3 ± 38.7	99.3 ± 34.6	102.6 ± 43.6	0.002
Protein %	184.5 ± 157.4	198.5 ± 85.2	156.2 ± 65.0	120.4 ± 79.8	132.0 ± 67.1	142.9 ± 73.2	129.3 ± 59.2	116.5 ± 61.0	0.000
Lipid-energy%	26.4 ± 9.9	23.9 ± 8.4	23.9 ± 8.0	23.5 ± 9.0	21.0 ± 8.4	19.6 ± 9.5	15.5 ± 8.1	14.3 ± 8.5	0.000
Ca %	123.2 ± 110.3	78.0 ± 42.9	76.3 ± 38.8	58.6 ± 28.6	73.5 ± 39.5	83.3 ± 53.6	80.5 ± 46.8	74.1 ± 51.1	0.000
Fe %	116.4 ± 135.1	90.3 ± 49.9	94.0 ± 59.6	71.3 ± 46.9	94.7 ± 63.8	110.3 ± 68.4	127.3 ± 78.1	107.6 ± 89.6	0.000
Na/1000kcal	1205 ± 768	1718 ± 784	2187 ± 1061	2174 ± 928	2535 ± 1156	2626 ± 1217	2741 ± 1243	3025 ± 1837	0.000
Vitamin A %	113.3 ± 95.3	108.6 ± 68.9	105.5 ± 65.4	84.7 ± 53.9	101.1 ± 73.5	113.4 ± 97.6	112.7 ± 138.9	83.3 ± 94.3	0.001
Riboflavin %	149.7 ± 110.2	118.1 ± 57.0	114.3 ± 45.8	95.2 ± 47.2	98.3 ± 49.9	102.2 ± 54.2	95.7 ± 49.3	84.8 ± 54.9	0.000
Drinking water (ml)	435 ± 357	635 ± 357	746 ± 359	844 ± 442	946 ± 595	872 ± 434	843 ± 362	816 ± 414	0.000
Alcohol beverage (g)	0	0	0.0± 0.1	2.8 ± 24.2	6.5 ± 19.9	8.6 ± 27.2	7.4 ± 27.0	4.3 ± 20.2	0.000
MAR	0.78 ± 0.20	0.85 ± 0.15	0.87 ± 0.13	0.79 ± 0.16	0.83 ± 0.16	0.87 ± 0.14	0.86 ± 0.15	0.79 ± 0.21	0.000
Nutrient's number of INQ < 1	2.79 ± 1.75	3.72 ± 1.85	3.51 ± 1.79	4.01 ± 1.88	3.3 ± 1.9	3.15 ± 1.96	3.1 ± 2.0	4.61 ± 2.08	0.000

[1]RDA%, [2]Mean ± SD, [3]ANOVA

to the age group of 13 − 19, age groups of 7 − 12, 20 − 29, and 65+ of the high economic class, Ca still remained as the deficient nutrient.

In the high-above economic class, all age groups had MARs over 0.75 and had the numbers of nutrients with INQ < 1 less a half of 9 nutrients. This suggested the good status of overall nutritional intake of the high-above class in terms of adequacy and quality. But there were still the problems of the elderly, adolescents, and Ca. The elderly group had the mean of 4.61 numbers of nutrients with INQ < 1, more than a half of 9 nutrients. Even the 13 − 19 age group showed the deficient intakes of Ca(58.6% of RDA) and Fe. In addition to the 13 − 19 age group, Ca were taken a little bit lower than 75% of RDA in the age groups of 20 − 29 and elderly.

3. Nutrient intakes of each age group by the economic status

In order to find out which age group was mostly affected by the economic status, age groups, of toddlers, infants, children, adolescence, and the elderly which had been reported as high nutritional risk groups, were analyzed for their nutrient intake pattern according to the economic status. Table 9 shows the provability values of ANOVA taking the individual nutrient intake in an age group as a de-pendent variable and the economic class as an independent variable, and also shows the provability values of multivariate test by Pillai's Trace suggesting the differences of overall nutrient intakes among

Table 9. Provability values of the differences among the economic status by the age group

Nutrient	Age groups(years)				
	1 − 2 (n = 237)	3 − 6 (n = 654)	7 − 12 (n = 1033)	13 − 19 (n = 895)	65+ (n = 855)
Multivariate test by Pillai's Trace	0.314[2)3)]	0.000	0.000	0.000	0.000
Energy %[1)]	0.156	0.000	0.001	0.177	0.001
Protein %	0.020	0.000	0.000	0.001	0.000
Lipid-energy%	0.154	0.000	0.000	0.001	0.005
Ca %	0.306	0.003	0.000	0.034	0.094
Fe %	0.196	0.024	0.000	0.114	0.415
Na/1000kcal	0.007	0.552	0.097	0.429	0.601
Vitamin A %	0.486	0.000	0.101	0.054	0.017
Riboflavin %	0.246	0.000	0.000	0.008	0.000
Drinking water(ml)	0.584	0.584	0.082	0.119	0.054
Alcohol beverage(g)	−	−	0.109	0.813	0.067
MAR	0.039	0.000	0.000	0.000	0.000
Nutrient's number of INQ < 1	0.392	0.000	0.003	0.004	0.006

[1)]RDA%, [2)]The provability value less than 0.05 meant that either the nutrient intake or overall nutrients intake was significantly increased as the economic status was going up in an age group., [3)]The values of nutrient intake by age group and the economic status can be searched from Tables 5 to 8 and 10

Table 10. Daily intakes of some nutrients of the infants(1 − 2 yeras old) by the economic status

Nutrient	Low (n = 22)	Middle (n = 116)	High (n = 65)	High-above (n = 34)	Total (n = 237)	p-value[3)]
Energy %[1)]	75.5 ± 31.2[2)]	89.4 ± 43.2	99.6 ± 54.9	100.5 ± 65.4	92.5 ± 49.7	0.156
Protein %	108.1 ± 48.1	148.7 ± 82.6	193.0 ± 184.7	184.5 ± 157.4	162.2 ± 130.2	0.020
Lipid-energy%	22.1 ± 10.7	27.6 ± 11.0	26.9 ± 9.6	26.4 ± 9.9	26.7 ± 10.5	0.154
Ca %	86.1 ± 60.0	116.6 ± 98.1	131.0 ± 98.3	123.2 ± 110.3	118.7 ± 97.4	0.306
Fe %	68.3 ± 60.5	95.4 ± 84.4	125.0 ± 175.8	116.4 ± 135.1	104.0 ± 122.6	0.196
Na/1000kcal	1782.2 ± 1218.9	1149.8 ± 673.0	1341.3 ± 830.1	1205.3 ± 767.9	1269.0 ± 809.8	0.007
Vitamin A %	84.3 ± 75.1	129.1 ± 129.9	130.5 ± 169.6	113.3 ± 95.3	123.1 ± 134.1	0.486
Riboflavin %	110.5 ± 54.9	144.2 ± 102.7	160.5 ± 103.9	149.7 ± 110.2	146.3 ± 101.0	0.246
Drinking water(ml)	518.2 ± 443.6	419.0 ± 243.1	424.6 ± 336.4	435.3 ± 356.7	432.1 ± 309.2	0.584
Alcohol beverage(g)	0	0	0	0	0	−
MAR	0.70 ± 0.19	0.78 ± 0.22	0.83 ± 0.14	0.78 ± 0.20	0.79 ± 0.20	0.039
Nutrient's number of INQ < 1	3.82 ± 2.82	2.98 ± 2.48	2.62 ± 1.93	2.79 ± 1.75	2.93 ± 2.29	0.392

[1)]RDA%, [2)]Mean ± SD, [3)]ANOVA, Multivariate test by Pillai's Trace : p=0.314

the four economic status. Except the age of 1 to 2 group all age groups (3 to 6, 7 to 12, 13 to 19, and 65 and older) showed that overall nutrient intakes were increased as the economic levels became higher (for all four age groups, multivariate tests by Pillai's Trace : $p = 0.000$).

In case of the age group 1 to 2, the differences of overall nutrient intake patterns among economic levels did not appear (multivariate test by Pillai's Trace : $p = 0.314$). As presented in Table 10, their most of the nutrient intakes were thought to be adequate and were not significantly affected by the economic level. It maybe partially because of that a part of the toddlers are taking mother's or formulated milk and the family put feeding their toddlers and infants in the first. The more examination of the KNHNS data is needed to find out the reasons. As previously discussed at Table 5, the RDA% of energy and iron and MAR of the 1 to 2 age group in the low economic class were only 75.5% and 68.3% and 0.70, respectively. These were very low compared with those of three other economic classes (energy : $p < 0.156$, iron : $p < 0.196$, MAR : $p < 0.039$). Na intake per 1000kcal of the 1 to 2 age group in the low economic class was much higher than the other economic classes ($p < 0.007$) as shown in Table 10. Considering the fastest growth rate of the infants, the nutritional inadequacies, particularly energy and iron, might delay the infants' growth. Those nutritional inadequacies could be resulted from the insufficiency of supplementing foods in the low economic class. Since the starting points of giving supplementary foods to the infants were nearly the same as average 6.4 months old among all four economic classes according to the dietary survey (Korea Health and Welfare Ministry 2002), there might be some problems in the preparation of supplementing foods, especially in the amount, food combination, and salty taste.

Conclusions

There have been appeared various nutritional issues in Koreans through analyzing the nutrient intake by economic level and different age group using nationwide data of 2001 KNHNS. Among them, low-income class, adolescents and the elderly age groups, and intakes of calcium and sodium seem to be the most significant key words that we should prepare careful strategies to solve their problems. Excess intakes of energy and sodium are also other problems in all the economic classes and age groups.

The serious nutritional deficiency in the low-income class was confirmed in this study as many previous reports presented. Comparing with the other economic classes, more people of the low-income class took most nutrients, especially calcium and riboflavin, in deficient amounts and saltier diet. Nearly a half of the low-income people could be assessed to take nutritionally inadequate diet in consideration with MAR values. The age groups of 1 to 6 years, 13 to 19 years, and the elderly were shown to be nutritionally more risk groups in the low-income class. Particularly for the toddlers (1 to 2 years) deficiencies of iron and possibly energy were of great concern.

Adolescent age group, regardless of the economic status, has been observed that their calcium and iron intakes were appeared to be the most deficient of all the age groups including the elderly. The energy was another to be worried about its inadequate intake. For the elderly people of all the economic status except high-above class, calcium, vitamin A and riboflavin were commonly deficient nutrients and their diet seemed to be inadequate in average.

Calcium deficiency is the most serious nutritional problem throughout all the ages and all the economic classes. Of the low income people 69.9% and 57.3% of the high-above class took insufficient amount of calcium.

There may be various reasons for the above nutritional problems including a shortage of money, restricted skills and knowledge to provide healthy diet, lacks of social supports and others. Nutrition activities are required for the nutritional risk reduction and the health promotion in a specific way according to the economic level and age of the target group. Programs of food support, school feeding, milk eating campaign, and nutrition information and education are to be developed and implemented under the coordinated surveillance system. However analyses on food intake, dietary behavior, and disease pattern by the economic status are needed to prepare precise and comprehensive information to develop the programs.

References

Blaylock J, Smallwood D, Kassel K, Variyam J, Aldrich L (1999) : Economics, food choices, and nutrition. *Food Policy* 24 : 269-286

Frankle RT, Owen AL (1993) : Nutrition in the Community. 3rd ed., pp.21-40, Mosby, St Louis

Kang HK, Kim SH (2002) : Effect of living conditions on food in-

takes of the aged. *Korean J Nutr* 35(3) : 332-351

Kim CI(1996) : Nutritional issues in relation to income level and region. *Korean J Comm Nutr* 1(2) : 291-300

Kim SH, Kang HK(2000) : Socio-economic factors affecting the health and nutritional status of the aged. *Korean J Nutr* 33(1) : 86-101

Klocke A(1997) : The impact of poverty on nutrition behavior in young Europeans. In : Koehler BM et al(eds), Poverty and Food in Welfare Societies. Berlin, Sigma(recited from Koehler J et al, 2004)

Koehler J, Lehmkuehler S, Leonhaeuser IU(2004) : Nutrition behavior of families with low income. *Intl J Human Ecology* 5(1) : 117-130

Koo JO, Lee JW, Choi YS, Kim JH, Lee JH(2002) : Nutrition throughout the life cycle, Hyoil Publ Co, Seoul

Korea Health and Welfare Ministry(2000) : The report of In-depth Analysis of 1998 Korean National Health and Nutrition Survey : Nutrition survey

Korea Health and Welfare Ministry(2002) : Report on 2001 Korean National Health and Nutrition Survey-Nutrition survey(I)

Korea Health and Welfare Ministry(2003) : The report of In-depth analysis of 2001 Korean National Health and Nutrition Survey : Nutrition survey

Korean Office of Rural Development/ Rural Living Science Institute(2001) : Food Composition Table, 6th ed.

Lee JW, Kim KA, Lee MS(1998) : Nutritional intake status of the elderly taking free congregate lunch meals compared to the middle-income class elderly. *Korean J Comm Nutr* 3(4) : 594-608

Lee KY, Lee YC, Han HJ, Cho HY, Kim MH, Lee SJ, Wang YH, Park MM(1986) : A study on relationships between nutritional status and psychological functionings of elementary school children in Seoul. *Korean J Nutr* 19(4) : 233-245

Lee RD, Nieman DC(1995) : Nutritional assessment, 2nd ed., pp.33-38, Mosby-Year Book Inc., St. Louis

Mo SM, Koo JO, Park YJ, Park YS, Son SM, Suh JS(2001) : Community Nutrition. p.22, Kyomunsa, Seoul

Nam HW, Um YS, Chung EJ(1998) : A comparative study on dietary attitude and nutritional status of preschoolers in different income levels in Seoul and Kyunggido : I. Focusing on preschooler's anthropometry, dietary attitudes and mother factors. *Korean J Diet Culture* 13(5) : 405-414

Son SM, Heo KY(2002) : Salt intake and nutritional problems in Korean. *Korean J Comm Nutr* 7(3) : 381-390

Son SM, Park YJ, Koo JO, Mo SM, Yoon HY, Seung JJ(1996) : Nutritional and health status of Korean elderly from low-income, urban area and improving effect of meal service on nutritional and health status-I. Anthropometry and nutrient intakes. *Korean J Comm Nutr* 1(1) : 79-88

Terry RD(1993) : Introductory Community Nutrition. pp.118-121, Wm. C. Brown Publ, Dubuque