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Dietary Variety and Nutrient Intake by 24-hour Recall in Korean College Students

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Despite the universal recommendation to eat a variety of foods, we still do not know whether and to what extent the variety affects dietary quality. This study was performed to evaluate the dietary variety scores as tools for assessing the dietary quality of Korean young adults. The 1-day dietary intake data were collected from 144 male and 214 female college students (>18 years) using the 24-hour recall method. Relative nutrient intake compared to Korean Recommended Dietary Allowance (KRDA) as the nutrient adequacy ratio (NAR), were computed. Also, the mean adequacy ratio (MAR) was calculated. Dietary variety score (DVS) was determined by counting the number of food items consumed daily, and the dietary diversity score (DDS) by counting the number of food groups consumed daily. Results showed that DVS, DDS and MAR were significantly correlated to each other. The MAR score significantly increased as DDS increased in both men and women. When different DVS (20≤DVS≤30) was evaluated for its sensitivity, specificity, measured prevalence, true prevalence, and positive and negative predictive values towards MAR, DVS 21 was revealed to be optimal dietary variety score as a cutoff point to differentiate Korean young adults with or without an adequate and balanced diet. Nutrient intakes of subjects who had DVS<21 were significantly lower than those of subjects with DVS≥21. These results indicate that the dietary variety score appeared to be an effective tool for evaluating the adequacy of diet in Korean young adults.

Key words : College students, Dietary variety score (DVS), Dietary diversity score (DDS), Mean adequacy ratio (MAR), 24-hr recall

INTRODUCTION

Changes in socio-economic structure, life styles, and health and medical care in Korea have drastically modified health status with chronic disease replacing acute and communicable diseases as major causes of morbidity and mortality.[30)] Consumption of diverse food is most important as a means to insure adequate intake of essential nutrients for optimal health to prevent chronic diseases. Choosing a wide variety of foods across and within the food group leads to improved nutritional status by providing the vitamins, minerals, and other micronutrients.[16)] Therefore, healthy eating patterns may be achieved by increasing food variety. The recommendation of increasing the variety of foods in the daily diet along with modifying selected nutrients has been included in the dietary guidelines of several countries.

Many researchers have attempted to study relationships between diet quality and nutrient intake adequacy,[8,16,17,24,26)] or the variety of foods and food groups.[2,10,12,14,23)] In addition, with the recognition that dietary factors affect the risk of chronic disease, several studies have examined the relation of diet quality with mortality, vascular disease, hypertension, and cancer.[5,6,12,13,18,21,32)] The indices based on foods and food groups relating to diet quality may be worth developing for consumers to plan their diets. Indices of overall diet quality based on foods or food groups are Diet Quality Index,[23)] the Dietary Diversity Score,[10,12)] the Healthy Eating Index (HEI),[14)] and the Dietary Variety Score.[2)]

There is some evidence that young adults in Korea may be at high risk for nutritional problems. According to the 1998 National Health and Nutrition Survey for Koreans,[31)] the average intakes of energy, calcium, iron, and riboflavin were significantly lower than Recommended Dietary Allowances for Koreans.[29)] Despite the dietary guideline for Koreans to eat a variety of foods, relatively little is known of the extent that variety affects the dietary quality of total diet among Korean young age group.[19,22)] This study was performed to evaluate the dietary variety score and diversity score as tools for assessing dietary quality of Korean college

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students and to examine its relationship to nutrition intake adequacy.

SUBJECTS AND METHODS

1. Subjects

One hundred forty four males and 214 females aged 19 years or older were recruited from universities in two large cities, Seoul and Ansung. Subjects' ages, height, weight and dietary data were obtained by in-person interview. BMI (kg/m^2) was calculated from self-reported height and weight.

2. Dietary Data

Interviews were conducted by graduate students majoring in food and nutrition, all of whom were trained by the researchers from the Korea Health Industry Development Institute. Dietary intake data were taken by 1-day 24-hour recall. Both interviewers and subjects used actual size 2-dimensional model of traditional bowls, shapes of foods, and ruler prepared to help the respondents to report the volume and dimensions of the food items consumed. The person responsible for meal preparation in each household was interviewed for recipes and final volume of foods prepared for one day before the interview. By comparing the volume of individual food intake and food prepared, individual intake of each ingredient was calculated in weight based on the recipes collected from each sample household, meal services, schools, and restaurants.

3. Dietary Diversity Score (DDS) and Dietary Variety Score (DVS)

DDS (dietary diversity score) was assessed based on the method developed by Kant et al.[12,13] DDS counted the number of food groups consumed daily from among five food groups - dairy, meat, grain, fruit, and vegetable. The maximum score was five; one point was counted for each food group consumed. All foods (2,337) were grouped into 18 food groups based on Korean Food Composition Tables.[15] Foods were further grouped into the five groups. The grain group products included all grain products plus pulses, and nuts and seeds. Cookies, candies, or cakes were not included in the grain group. All milk and milk products were assigned to the dairy group. The vegetable group included all raw and cooked vegetables, mushrooms, and seaweeds. The fruit group included all fresh and dried fruits, and fruit juices. Oil and fats, beverage such as soft drinks and alcoholic beverage, and sugar and sweeteners were excluded from the diversity score calculation. The minimum reported amount for inclusion in the diversity scores were 30 g for meat, fruit, and vegetable groups (for all solids), 60 g for all beverages and mixed dishes, 15 g for dairy and grain groups (for all solids), and 30 g for dairy and grain groups (for all liquids) and mixed dishes.

Dietary variety score (DVS) counted the number of different foods consumed daily across all food groups. It did not include seasonings such as salt, vinegar, pepper, red pepper powder, and soybean paste, oil and fats, beverage such as soft drinks and alcoholic beverage, and sugar and sweeteners.

4. Nutrient Intake and Nutrient Adequacy Ratio

Nutrient intakes were calculated using Korean Food Composition Tables[15] and expressed as a percentage of Recommended Dietary Allowance for Koreans.[29] Mean nutrient adequacy ratio (MARs) for each subject was calculated from nutrient adequacy ratios (NARs) for energy and nine nutrients based on Recommended Dietary Allowance for Koreans.[29]

5. Data Analysis

Data analyses were performed using SAS.[28] Spearman correlation coefficients were calculated to identify relationships among DVS, DDS, and MAR. ANOVA and Duncan's multiple range test were used to check differences of DVS across DDS. Differences between means of nutrient intake according to gender by DVS were analyzed using the *t*-test.

Sensitivity, specificity, measured prevalence, true prevalence, positive and negative predictive value of the dietary variety score were assessed relative to nutrient intakes defined as low MAR(<0.67) or adequate MAR(≥ 0.67). These indicators were calculated as follows;

	MAR		Total
	Low < 0.67	**Adequate ≥ 0.67**	
Variety score			
Low	a	b	a+b
Adequate	c	d	c+d
Total	a+c	b+d	N

Sensitivity (Sn) = a/(a+c).
Specificity (Sp) = d/(b+d).
measured prevalence = (a+b)/N.
positive-predictive value = a/(a+b).
negative-predictive value = d/(c+d).
true prevalence = (the measured prevalence+Sp-1)(Sn+Sp-1).

RESULTS AND DISCUSSION

1. Characteristics of the Subjects

Subject characteristics are shown in Table 1. The mean age of the subjects was 26.1 years for men and 24.7 years for women. The mean body mass index (kg/m^2) was 23.3 for men and 20.9 for women with no significant difference.

Table 1. Subject characteristics

	Men (n=144)	Women (n=214)
Age (yrs)**	26.1 ± 4.3[1)]	24.7± 3.2
Height (cm)***	173.0 ± 5.1	161.0 ± 5.1
Weight (kg)***	69.3 ± 9.2	54.1 ± 8.2
BMI (kg/m^2)***	23.3 ± 3.0	20.9 ± 3.2

1) Mean±SD
Significantly different between men and women at ** p<0.01, *** p<0.001 by student t-test.

2. Relationship of DVS and DDS to the Mean Adequacy Ratio(MAR)

The distribution of the DVS is summarized in figure 1. On average, men and women consumed 26 to 27 different foods. Approximately 54% of respondents scored 20-30 of DVS. Drewnowski et al.[2,3)] reported that the mean number of different foods consumed for one day was 26 for male and 28 for female in 837 French adults and 13 for young men and 17 for young women in 24 USA healthy young adults. French and Koreans were more likely to consume a diet with more variety than Americans. Studies[4,25)] have found that men consumed diets with more variety than women. In contrast, Krondl et al.[17)] reported that women had diets with more variety than men does. In this study, more females were distributed into higher DVS than males (Fig. 1).

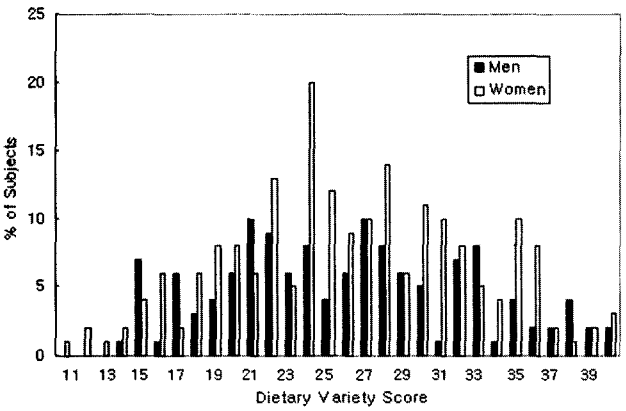


Fig. 1. Percentage distribution of dietary variety scores by sex

Correlation coefficients between dietary variety and mean nutrient adequacy ratio are shown in Table 2. DVS, DDS and MAR were significantly correlated to each other. The DDS and DVS were significantly correlated with mean nutrient adequacy ratios (MARs) (r=0.4206, p<0.001 and r=0.4854, p<0.001). Higher DDS is also associated with higher DVS.

The MAR score was significantly increased as DDS increased in both men and women (Table 3). Males were expected to have an MAR 0.81 with only three major food groups in the diet. Their predicted MAR was 0.96 with all five food groups represented. Females with only three major food groups represented were expected to have an MAR of only 0.77. Males had higher MARs than females with an increasing number of different food major groups. It was found that increases in nutrient levels associated with increases in diversity were greater for males than for females. In contrast to this result, Randall et al.[24)] observed that increases in MAR with increasing diversity were greater for females than for males. There were no significant differences in MAR scores by DDS with DVS score of 21-25, 31-35, and 36-40. However, to evaluate the relationship of DDS and DVS with MAR scores has the following limitations; The MAR measures were constrained by the lack of food composition data for some nutrients including folate and zinc, which are considered to be shortfall nutrients in the diets of many individuals.[1)] Mertz[20)] states that the balance of trace elements in the diet is as important as their absolute level of intake and that the need for balance is reason to consume diets with a wide variety.

Table 2. Correlation coefficient between dietary variety and mean nutrient adequacy ratio(MAR)

	DVS[1)]	DDS[2)]
DDS	0.3238***	
MAR	0.4854***	0.4206***

1) DVS counts the total number of food items consumed daily.
2) DDS counts the number of food groups (dairy, meat, grain, fruit, vegetable) consumed daily
Significance: *** p<0.001

Table 3. Estimated MAR scores for different levels of variety among food groups, by sex, and by number of foods from the five major groups

DDS[1)]	Sex		DVS[2)]					
	Male	female	11-15	16-20	21-25	26-30	31-35	36-40
	←		estimated MAR scores			→		
3	0.81[b*]	0.77[b]	0.81[a]	0.65[ab]	0.77[a]	0.81[b]	0.89[a]	0.90[a]
4	0.87[b]	0.81[b]	0.64[ab]	0.70[ab]	0.81[a]	0.86[ab]	0.87[a]	0.86[a]
5	0.96[a]	0.89[a]	0.86[a]	0.87[a]	0.85[a]	0.93[a]	0.93[a]	0.94[a]

1) DDS(dietary diversity score) counts the number of food groups(dairy, meat, grain, fruit, vegetable) consumed daily
2) DVS(dietary variety score) counts the total number of food items consumed daily.
* Means with the same letter in the same column are not significantly different at p<0.05 by Duncan's multiple range test.

3. Evaluation of Variety Score

Evaluation of variety scores is shown in Table 4. Several criteria were considered in choosing the best cutoff point for the variety score.[7,9,27)] The sum of measured prevalence and specificity must be >1; the sum of sensitivity and specificity must also be >1; sensitivity >0.5; sensitivity must also be greater than one minus specificity. If the estimation is needed to recognize the dimension of variety inadequacy, one must choose a high level of specificity. The level will decrease the number

Table 4. Evaluation of different dietary variety score (DVS) for identifying dietary intake variety judged by MAR

Cutoff DVS[1)]	Sensitivity	Specificity	Measured prevalence	True prevalence	Predictive value	
					Positive	Negative
20	0.4400	0.8939	0.1759	0.2090	0.5238	0.8576
21	0.5600	0.8763	0.2150	0.2092	0.5454	0.8825
22	0.6133	0.8339	0.2597	0.2093	0.4946	0.8905
23	0.7066	0.7809	0.3212	0.2094	0.4608	0.9094
24	0.7466	0.7526	0.3519	0.2093	0.4444	0.9181
25	0.8266	0.6749	0.4301	0.2093	0.4025	0.9362
26	0.8666	0.6289	0.4748	0.2092	0.3823	0.9468
27	0.8933	0.5830	0.5167	0.2093	0.3621	0.9537
28	0.8933	0.5123	0.5726	0.2093	0.3268	0.9477
29	0.9200	0.4416	0.6340	0.2090	0.3039	0.9541
30	0.9466	0.4063	0.6675	0.2091	0.2970	0.9663

1) DVS counts the total number of food items consumed daily.

of false positives. The calculation is even more important if the degree of true prevalence decreases. Thus, tests with low sensitivity inevitably fail to identify an unacceptably high proportion of individuals having a diet of inadequate variety. The cutoff level should be lower to estimate the true prevalence with equal precision. Ranges of cut-off point came up to several criteria were 21-30 of DVS. However, 21 of DVS had the highest positive predictive value. Thus, 21 of DVS revealed the optimal dietary variety score cut-off point with the highest positive predictive value.

Lee et al.[19)] suggested that a daily intake of 24-32 (or 28) of DVS using 1-day 24-hour recall from a sample of 287 individuals (20-49 years) was recommendable for an optimal nutrition of all nutrients if the variety of food groups and sufficient intake of vitamin A and calcium were emphasized together. The level of DVS, which was higher than that of our data, were assessed based on more than 125% or less than 75% of RDA. Kant and Graubard[11)] examined the intra- and inter-individual variability of overall diet quality based on individual foods, food groups, and nutrient intake using Continuing Survey of Food Intake by Individuals (CSFII), Series II, 1989-1991. From the results, variability within subjects was higher than the variability between subjects. Our data were limited to one-day dietary measurement. Therefore, our finding can not be generalized until more is known about intra-individual variability in dietary pattern.

4. Diet Variety and Nutrient Intake

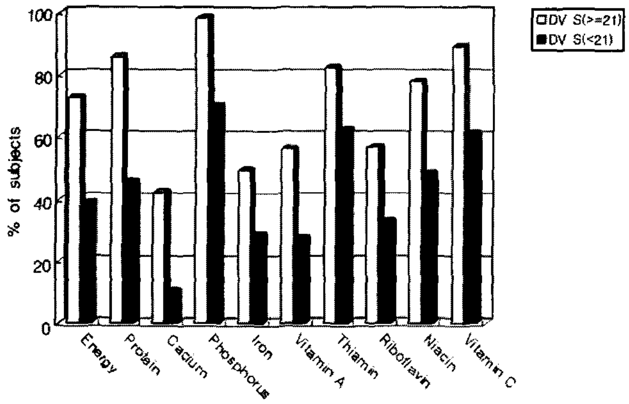
Comparison of nutrient intake and % of RDA by $<$ 21 and $\geq$ 21 of dietary variety score (DVS) according to gender are shown in Table 5 and Table 6, respectively.

Table 5. Comparison of nutrient intake by dietary variety score(DVS) of <21 and ≥21 in men

Nutrient	DVS[1)]			
	<21 (n = 3)		≥ 21 (n = 113)	
(BMI)	16.15±10.67		19.44±9.23 (NS)[2)]	
Energy (kcal)	1717.6 ± 783.6[3)]	67.41 (%)[4)]	2456.3 ± 1002.6***	98.18 (%)***
Protein (g)	55.27 ± 26.55	71.99	100.92 ± 58.79***	134.41***
Fat (g)	39.43 ± 30.34		58.17 ± 41.05*	
Calcium (mg)	313.9 ± 187.8	42.68	591.4 ± 329.3***	84.06***
Phosphorus (mg)	843.0 ± 337.7	115.44	1387.6 ± 580.8***	197.36***
Iron (mg)	10.12 ± 5.36	80.11	15.17 ± 7.60***	125.85
Potassium (mg)	2025.3 ± 860.1		3175.2 ± 1496.2***	
Vitamin A (RE)	571.16 ± 535.3	79.51	845.2 ± 767.8*	120.75*
Vitamin B_1 (mg)	1.28 ± 0.96	96.68	1.72 ± 0.99*	132.35*
Vitamin B_2 (mg)	0.95 ± 0.73	58.45	1.42 ± 0.86**	89.39**
Niacin (mg)	13.03 ± 6.55	74.40	21.26 ± 14.06***	124.98***
Vitamin C (mg)	91.97 ± 86.51	164.39	118.50 ± 70.88	215.46

1) DVS counts the total number of food items consumed daily.
2) NS : No significant
3) Mean ± SD
4) % of RDA
Significantly different from <21 of DVS at $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$ by student t-test.

Nutrient intakes of subjects who have DVS < 21 were significantly lower than those of subjects with DVS ≥ 21 for both men and women. Significantly higher percentage of subjects with DVS of ≥ 21 consumed ≥ 75% of recommended nutrient intake compared to the subjects with DVS of < 21 (Fig. 2). Average nutrient intakes for those with scores of 21 or more were above Korean RDA except for energy, calcium, and riboflavin in men (Table 5) and energy, calcium, iron, and riboflavin in women (Table 6). Average nutrient intakes for those with a score less than 21 were below RDA for all but phosphorus and vitamin C in men (Table 5) and phosphorus, thiamin, and vitamin C in women (Table 6).



All proportion of subjects were significantly different at p<0.0001 exceptiron(p<0.01), thiamin and riboflavin(p<0.001)

Fig. 2. Proportion of subjects consuming more than 75% of RDA by dietary variety score(DVS) of <21 and >=21

SUMMARY AND CONCLUSION

The aims of this study were to evaluate the dietary variety score and dietary score as tools for assessing dietary quality of Korean college students and to examine its relationship to nutrition intake adequacy. The results of this study are summarized as follows;

1) DVS, DDS, and MAR were significantly correlated to each other.

2) The MAR score was significantly increased as DDS increased in both men and women.

3) The optimal dietary variety score cutoff point was determined to be 21.

4) Nutrient intakes of subjects who had DVS ≥ 21 were significantly higher than those of subjects with DVS < 21.

Therefore, dietary variety score 21 could be used in differentiating Korean young adults with or without adequate and balanced diet. Further investigations of diet variety among different age groups are needed. Validation of the various indexes of overall diet quality against biochemical, anthropometric, and clinical parameters of nutritional status is also needed.

Literature Cited

1) Cronin FJ, Shaw AM, Krebs-Smith SM, Marsland PM, Light L. Developing the Food Guidance System for "Better Eating for Better Health," A Nutrition Course for Adults. USDA Human Nutrition Information Service. Administrative Report No. 377, 1985

2) Drewnowsk D, Henderson SA, Driscoll A, Rolls BJ. The

Table 6. Comparison of nutrient intake by dietary variety score(DVS) of <21 and ≥21 in women

Nutrient	DVS[1]			
	<21 (n = 46)		≥ 21 (n = 168)	
(BMI)	18.86±8.91		19.10±5.97 (NS)[2]	
Energy (kcal)	1539.8 ± 661.8[3]	74.70 (%)[4]	1935.1 ± 611.6***	95.93 (%)***
Protein (g)	52.53 ± 31.20	84.19	76.82 ± 52.14***	126.64***
Fat (g)	35.25 ± 31.88		48.24 ± 28.70**	
Calcium (mg)	331.7 ± 300.9	44.62	510.4 ± 287.1***	71.66***
Phosphorus (mg)	764.4 ± 371.2	103.90	1096.3 ± 390.0***	154.21***
Iron (mg)	8.34 ± 5.68	45.36	11.93 ± 5.68***	65.93***
Potassium (mg)	1924.4 ± 1475.5		2650.2 ± 1053.0**	
Vitamin A (RE)	396.8 ± 335.4	54.89	737.7 ± 693.8***	104.56***
Vitamin B_1 (mg)	1.12 ± 0.77	108.44	1.28 ± 0.64	126.91
Vitamin B_2 (mg)	0.82 ± 0.53	65.56	1.18 ± 0.62***	97.57***
Niacin (mg)	11.41 ± 7.37	86.40	15.53 ± 7.05***	118.94***
Vitamin C (mg)	85.67 ± 82.30	153.35	129.92 ± 107.78**	234.89**

1) DVS counts the total number of food items consumed.
2) NS : No significant
3) Mean±SD
4) % of RDA
*Significantly different from <21 of DVS at **p<0.01, ***p<0.001 by student t-test.*

Dietary variety score: Assessing diet quality in healthy young and older adults. *J Am Diet Assoc* 97 : 266-271, 1997

3) Drewnowsk D, Henderson SA, Shore AB, Fischler C, Preziosi P, Hercberg S. Diet quality and dietary diversity in France: Implications for the French paradox. *J Am Diet Assoc* 96 : 663-669, 1996
4) Fanelli MT, Stevenhagen KJ. Characterizing consumption patterns by food frequency methods: core foods and variety of foods in diets of older Americans. *J Am Diet Assoc* 85 : 1570-1576, 1985
5) Fernandez E, D'Avanzo B, Negri E, Franceschi S, La Vecchia C. Diet diversity and the risk of colorectal cancer in Northern Italy. *Cancer Epidemiology, Biomarkers and Prevention* 5 : 433-436, 1996
6) Fransceschi S, Favero A, La Vecchia C, Negri E, Dal Maso L, Salvini S, Decarli A, Giacosa A. Influence of food groups and food diversity on breast cancer risk in Italy. *Int J Cancer* 63 : 785-789, 1995
7) Freire WB. Hemoglobin as a predictor of response to iron therapy and its use in screening and prevalence estimates. *Am J Clin Nutr* 50 : 1442-1449, 1989
8) Guthrie HA, Scheer JC. Validity of a dietary score for assessing nutrient adequacy. *J Am Diet Assoc* 78 : 241-245, 1981
9) Habicht, J-P. Some characteristics of indicators of nutritional status for use in screening and surveillance. *Am J Clin Nutr* 33 : 531-532, 1980
10) Kant AK, Block G, Schatzkin A, Ziegler RG, Nestle M. Dietary diversity in the US population, NHANES II, 1976-1980. *J Am Diet Assoc* 91 : 1526-1531, 1991
11) Kant AK, Graubard BI. variability in selected indexes of overall diet quality. *Int J Vitam Nutr Res* 69 : 419-427, 1999
12) Kant AK, Schatzkin A, Ziegler RG. Dietary diversity and subsequent cause-specific mortality in the NHANES I Epidemiologic Follow-up study. *J Am Coll Nutr* 14 : 233-238, 1995
13) Kant AK, Schatzkin A, Harris TB, Ziegler RG, Block G. Dietary diversity and subsequent mortality in the First National Health and Nutrition Examination Survey Epidemiologic Follow-up Study. *Am J Clin Nutr* 57 : 434-440, 1993
14) Kennedy ET, Ohls J, Carlson S, Fleming K. The Healthy Eating Index: designed and applications. *J Am Diet Assoc* 95 : 1103-1108, 1995
15) Korean Rural Nutrition Institute (KRNI). Korean Food Composition Table, 5[h] revision, Suweon, 1996
16) Krebs-Smith SM, Smiciklas-Wright H, Guthrie HA, Krebs-Smith J. The effects of variety in food choices on dietary quality. *J Am Diet Assoc* 87 : 897-903, 1987
17) Krondl M, Lau D, Yurkiw MA, Coleman PH. Food use and perceived food meanings of the elderly. *J Am Diet Assoc* 80 : 523-529, 1982
18) La Vecchia C, Munoz SE, Braga C, Fernandez E, Decarli A. Diet diversity and gastric cancer. *Int J Cancer* 72 : 255-257, 1997
19) Lee JW, Hyun HJ, Kwak CS, Kim CI, Lee HS. Relationship between the number of different food consumed and nutrient intakes. *Korean J of Comm Nutr* 5 : 297-306, 2000
20) Mertz W. The essential elements: Nutritional aspects. *Nutr Today* 19 : 22(January/February), 1984
21) Miller WL, Crabtree BF, Evans DK. Exploratory study of the relationship between hypertension and diet diversity among Saba Islanders. *Public Health Rep* 107 : 426-432, 1992
22) Paik HY, Sim JE, Moon HK, Kim YO. Comparative analysis and evaluation of dietary intakes of Koreans by age groups: (2) Food and Food Group Intakes. *Korean J of Nutr* 7 : 568-579, 2001
23) Patterson RE, Haines PS, Popkin BM. Diet Quality Index: capturing a multidimensional behavior. *J Am Diet Assoc* 94 : 57-64, 1994
24) Randall E, Nichman MZ, Constant CF Jr. Diet diversity and nutrient intake. *J Am Diet Assoc* 85 : 830-836, 1985
25) Reid DL, Miles JE. Food habits and nutrient intakes of non-institutionalized senior citizens. *Can J Public Health* 68 : 154-158, 1977
26) Ries CP, Daehler JL. Evaluation of the nutrient guide as a dietary assessment tool. *J Am Diet Assoc* 86 : 228-233, 1986
27) Rogan, WJ, Gladen B. Estimating prevalence from the results of a screening test. *Am J Epidemiol* 107 : 71-74, 1978
28) SAS Language for personal computers. version 6.03ed, SAS Institute Inc., pp.558, Cary, NC, USA, 1988
29) The Korean Nutrition Society(KNS). Recommended Dietary Allowances for Koreans, 7th revision, Seoul, 2000
30) The Ministry of Health and Welfare(MOHW). Major program for health and welfare, Korea, 1996
31) The Ministry of Health and Welfare(MOHW). Report of 1998 National Nutrition Survey for Koreans, Korea, 1999
32) Wahlquist ML, Lo CS, Myers KA. Food variety is associated with less macrovascular disease in those with Type II diabetes and their healthy controls. *J Am Coll Nutr* 6 : 515-523, 1986