Korean J Nutrition 31(5) : 927~938, 1998

Relationships of Potential Atherogenic Indices to Anthropometric Measurements, Dietary Intake and Dietary Behavior in Korean Obese Children

Chung, Chin Eun · Chung, Min Chung*** · Park, Ock Jin***

Department of Food and Nutrition, Hannam University, Taejon, Korea*
*Department of Food and Nutrition,** Ansan College, Ansan, Kyongki-Do, Korea*
*Euywang Clinic,*** Euywang, Kyongki-Do, Korea*

ABSTRACT

Epidemiological studies have indicated that a relationship between overweight and cardiovascular disease exists. To assess the relationship of unfavorable changes in serum lipid concentrations, apolipoprotein B, lipoprotein(a), blood sugar and blood pressure to anthropometric variables, nutrient intakes and dietary behavior, 64 obese children were chosen as subjects and 24-hour dietary intake, dietary behavior as well as blood pressure, apolipoprotein B, lipoprotein(a), three kinds of cholesterol concentrations were measured in November 1976. More than half(57.8%) of the children had serum cholesterol concentrations over 175mg/dl, and 26.6% of them had over 200mg/dl and this group could be classified as a high risk group. Abdominal obesity as measured with waist circumference and waist hip ratio was negatively correlated to high density lipoprotein(HDL) cholesterol. Dietary behavior rather than nutrient intakes appeared to have associations with unfavorable lipid profiles. Total dietary behavior scores and fish and bean product consumption had strong correlations with potentially atherogenic lipoprotein concentrations. This study suggests that for the early prevention of cardiovascular disease, waist hip ratio together with obese rate should be included in selective programs to identify risk group of children in Korea. Furthermore, interventions in cardiovascular disease risk groups in obese children should emphasize maintenance of ideal body weight through reducing body fat and adopting desirable dietary behaviors such as increasing intake of fish or bean products. (*Korean J Nutrition* 31(5) : 927~938, 1998)

KEY WORDS : obese children · anthropometric markers · cholesterol · lipoprotein · dietary intakes.

Introduction

Overweight in childhood has been shown to be a predictive cause of health problems. Especially the increased occurrence of coronary heart diseases later in life and the prevalence of cardiovascular disease(CVD) are linked to major causes of death in Korea as well as other countries[1-4]. The childhood obesity rate in Korea has increased dramatically during the past 10 years[5-7]. The obesity rate of elementary school boys in an urban area, for example, rose from 9.5% in 1986 to 19.7% in 1996[7]. The prevalence of risk factors leading to coronary artery disease in children such as total cholesterol over 200mg/dl, low density lipoprotein(LDL) cholesterol over 130mg/dl, systemic hypertension, hyperglycemia, obesity, family history for cardiovascular disease and physical inact-ivi-

Accepted : July 8, 1998
*To whom correspondence should be addressed

ties is also increasing[8,9]. Furthermore, the serious medical problems such as fatty liver, hypertension, diabetes were found among the majority of obese children with over 50% obesity[10-11]. Therefore, the efforts aimed at the primary prevention of coronary disease in childhood through an appropriate detection of risk factors and the following interventions should be made. There are two approaches detecting risk groups in children : the population approach where attempts are made to reduce variable risk factors through population changes in nutrient intake and eating behavior, and the individualized approach where individual identification of high risk children by selective screening is used rather than universal screening[12-14]. The feasibility of selectively screening children who possess potential atherogenicity should be investigated in the field with the above two approach. Preliminary studies on the relationships bet-ween atherogenic lipoprotein profile in obese children and anthropometric measurements, blood pressure, dietary intakes and dietary behavior should be able to provide a possible individualized approach towards dietary intervention in treating children with CVD risks.

In the present study, the possible relationships between atherogenic indices and anthropometric markers, nutrient intakes and dietary behavior have been investigated in selected obese children.

Methods and Materials

The subjects were chosen from the children who were under the screening program for obesity which was already set up by the Board of Education, Kyongki Province. They weighed more than 120% of 50th percentile expected weight for each age value of the Korean Association of Pediatrics in 1985[15]. Sixty-four elementary school students(average age 10. 52±1.86, average BMI 24.7±3.4) were chosen as subjects. The subjects were asked to complete a structured questionnaire containing background data. Dietary intakes were examined with the aid of trained students majoring in nutrition by 24-hour recall method and the amounts of nutrients intake were calculated by the food composition table[16]. The intakes of cholesterol, and saturated, monosaturated and polyunsaturated fatty acid were calculated from the reported values[17][18]. Food consumption frequencies of subjects were computed from the questionnaires and from these frequencies dietary behavior scores were calculated by the sum of points for each questionnaire. The most desirable consumption pattern was given 3 points and the least desirable pattern 1 point.

Height was measured to the nearest 0.5cm with a conventional measuring device, Samwha model #11859, and weight was measured to the nearest 0.1kg with a digital metric scale(Cas model #150A) while the subjects were clothed and shoeless. Body Mass Index (BMI) was computed by weight/height^2(kg/m^2). Rohler Index was calculated by weight in kg$\times 10^6$/height^3(cm^3). For the calculation of waist and hip ratio (WHR), the waist and hip circumferences were measured according to Lapidus and Bengtsson[19]. Systolic and diastolic blood pressure were measured to the nearest 2mmHg. None of the subjects were taking any blood pressure or lipid lowering medication.

For analysis of lipids and lipoproteins, blood was sampled in the morning after overnight fasting into EDTA-coated tubes. Plasma was separated, and plasma cholesterol, triacyglycerol(TG), fasting blood sugar were determined enzymatically according to the methods used previously[20]. High density lipoprotein(HDL) cholesterol was measured enzymatically after precipitation of apolipoprotein B(Apo B) containing lipoproteins with dextran sulphate/$MgCl_2$. LDL cholesterol was calculated according to the Friedewald formula[21]. Apolipoprotein B and lipoprotein(a) were determined by radioimmunoassay methods reported elsewhere[22]. Various serum determinant factors of evaluation of cardiovascular risks such as LDL-Chol/HDL-Chol ratio(LDL-cholesterol per HDL-cholesterol ; LPH), Atherogenic index[(Chol-HDL-Chol)/HDL-Chol ratio ; AI], and Relative Cholesterol(HDL-Chol/Chol ; RChol) were calculated. For identifying the relationships of atherogenic indices to the variables under study, the cut-off points for high risk groups for the biochemical parameters were 200mg/dl for total serum cholesterol, 150mg/dl for triacylglycerol, 40mg/dl for HDL-cholesterol and 150mg/dl for LDL-cholesterol respectively.

Statistical analysis was basically performed by using the Statistical Analysis System(SAS)[23]. Data were ex-

pressed as the mean standard deviation, and statistically significant differences between subgroup means were evaluated primarily by Student's t-test and one or two-way ANOVA. The correlations between the variables were examined by Pearson's correlation coefficient analysis.

Results and Discussion

1. Anthropometric and general characteristics of subjects

The subjects were composed of 36 females and 28 males, and 32 lower grade(grade 1 - 3) and 34 upper grade(grade 4-6) elementary school students. The anthropometric measurements of the subjects are shown in Table 1. The average BMI ranged from 22.7±3.1 to 27.7±2.8. Even though BMI has a limitation in expressing the obesity rate for growing children[24], the more reliable indicator, Weight-Length Index[24], could not be applied in this study since the Korean Children's Growth Standard is now in the process of revising and the old value of 1985[15] is no longer applicable. Furthermore, because of relatively wide range of age(from age 7 - 12) and the limited number of subjects, anthropometric parameters here may not represent all of Korean obese children in urban areas. The average waist measurements in centimeters were from 69.6 to 84.5, and the average hip in centimeters were from 80.9 to 98.3 for four subgroups. Other general characteristics of subjects are

Table 1. Anthropometric characteristics of Korean obese children(n=64)

Variables	Lower grade children		Upper grade children		Total
	male(n=17)	female(n=13)	male(n=19)	female(n=15)	n=64
Height(cm)	129.2±8.2[1]	127.3±7.2	147.9±6.5	149.4±6.7	136.1±12.3
Weight(kg)	38.3±8.7	37.2±8.7	56.6±7.8	62.1±9.9	49.1±13.8
B M I[2]	22.7±2.8	22.6±3.1	25.7±1.9	27.7±2.8	24.7± 3.4
Rohrer Index[3]	17.5±2.0	17.7±1.8	17.4±1.2	18.5±1.7	17.8± 1.7
Relative Weight	29.4±5.1	28.9±5.3	38.1±3.9	41.4±5.2	34.7± 7.2
Waist(cm)	74.1±7.8	69.6±6.7	84.5±5.0	84.2±6.6	78.6± 9.0
Hip(cm)	83.2±6.7	80.9±7.3	94.1±6.2	98.3±6.7	89.5± 9.7

1) Values are Mean±S.D. 2) Body Mass Index : Weight/height^2(kg/m^2) 3) Weight in kg×10^6/height^3(cm^3)

Table 2. Mean serum contents of various lipids, ApoB, fasting blood glucose, blood pressure of Korean obese children(n=64)

Variables	Lower grade		Upper grade		Total
	male (n=17)	female (n=13)	male (n=19)	female (n=15)	(n=64)
Total Chol[2]	180.6 ±45.7[1]	180.4 ±17.2	175.7 ±30.5	193.5 ±22.0	182.1 ±31.7
TG[3]	104.7 ±53.4	117.9 ±63.3	106.1 ±39.7	116.8 ±41.3	110.6 ±48.5
HDL Chol[4]	50.1 ±10.0	48.7 ±14.3	46.7 ± 8.0	47.7 ± 4.5	48.3 ± 9.4
LDL Chol[5]	109.5 ±43.8	108.1 ±16.1	107.8 ±31.6	122.4 ±23.8	111.8 ±31.4
LPH[6]	2.2 ± 0.78	2.36± 0.60	2.44± 1.12	2.59± 0.59	2.4 ± 0.8
AI[7]	2.67± 0.87	2.95± 1.02	2.93± 1.29	3.08± 0.59	2.9 ± 1.0
RCHOL[8]	0.29± 0.07	0.27± 0.07	0.27± 0.06	0.25± 0.04	0.27± 0.06
FBS[9]	77.9 ± 6.4	73.5 ± 5.2	67.0 ±25.0	74.5 ± 6.9	77.0 ± 8.9
ApoB[10]	132.5 ±36.5	145.7 ±15.1	144.4 ±27.2	153.7 ±23.2	143.7 ±27.8
Lip(a)[11]	30.3 ±23.9	24.1 ±20.9	15.6 ±12.0	27.6 ±15.9	24.1 ±19.0
SBP[12]	113.5 ±17.0	127.5 ±33.4	129.0 ±23.7	120.9 ±15.9	122.7 ±23.3
DBP[13]	78.6 ±13.3	88.8 ±34.5	93.3 ±26.1	84.9 ±11.5	86.4 ±23.0

1) Mean±S.D.
2) Total cholesterol(mg/dl)
3) Triacylglycerol(mg/dl)
4) HDL-cholesterol(mg/dl)
5) LDL-cholesterol(mg/dl)
6) Ratio of LDL-cholesterol and HDL-cholesterol
7) Atherogenic Index(see the text)
8) Relative cholesterol(see the text)
9) Fasting blood glucose(mg/dl)
10) Apolipoprotein B(mg/dl)
11) Lipoprotein (a)(mg/L)
12) Systolic blood pressure(mmHg)
13) Diastolic blood pressure(mmHg)

as follow(data not shown). About 50% of subjects' father and 54.8% of subjects' mother were in average body weight range, and 33.3% of subjects' father and 32.3% of mother were slightly overweight, extreme underweight or overweight in both parents were respectively under 10% as judged by their BMI values. More than a half of subjects(55.4%) are first born children. Among subjects, 42.9% were nourished with mother's milk, 30.2% with milk, and the remaining 27.0% were with combinations. The 30.6% of subjects households had an income between 1,000,000-1,500,000 Won and 25.8% had between 1,500,000-2,000,000 Won. More than a half of the subjects exercised regularly more than 2-3 times per week. The average duration subjects were exercising per day lasted slightly more than 30 minutes. The initial period of weight gain in subjects were early infancy(19.4%), 4-5 years of age(11.3%), 6-7 years of age(38.7%) and after 7 years of age(30.6%).

2. Various potential atherogenic indices of subjects

Table 2 shows average serum contents of various lipid fractions, ApoB, fasting blood glucose, and blood pressure of subjects. The average serum cholesterol contents of subjects in this study was 182.1± 31.7mg/dl which is much higher than the value of 155mg/dl reported[22]. The upper grade female subjects had a cholesterol content of 193.5±22.0mg/dl. The average serum total TG, HDL-cholesterol and LDL-cholesterol contents were 110.6mg, 48.3mg, 111.8mg per 100ml respectively. These obese subjects had much higher values of Total Cholesterol (TC), TG and LDL-cholesterol compared to the normal subjects between the age of 10-14 of Kim et al's reported values[25]. The prevalence of atherosclerosis risk of the subjects was 57.8% as the risk was judged by cholesterol contents over 175mg/dl for the age 10-14[25]. The prevalence of systemic hypertension (diastolic blood pressure over 95mmHg) of the study subjects was 28.0%. However, the systemic hyperglycemia(fasting blood glucose level over 140mg/dl) was not found among these subjects. The average atherogenic index of 2.9 of the subjects was much higher than the average school children from

Table 3. Mean daily nutrient intakes of Korea obese children(n=64)

Variable	Lower grade		Upper grade		Total
	male (n=17)	female (n=13)	male (n=19)	female (n=15)	(n=64)
Total food intake(g)	1152.1 ± 377.9[1]	810.9 ± 268.6	1412.0 ± 485.2	1191.7 ± 361.4	1162.5 ± 432.9
Energy(kcal)	1764.1 ± 514.5	1206.6 ± 275.6	1892.1 ± 651.8	1672.1 ± 486.0	1666.7 ± 558.1
Protein(g)	78.6 ± 35.9	50.3 ± 29.6	86.8 ± 29.5	79.7 ± 21.5	75.6 ± 31.7
Fat(g)	39.8 ± 19.7	21.2 ± 9.2	42.0 ± 15.8	38.3 ± 16.9	36.0 ± 17.5
Carbohydrate(g)	274.2 ± 88.1	202.7 ± 46.9	302.7 ± 109.7	265.9 ± 80.1	266.7 ± 91.6
Fiber(g)	4.3 ± 2.7	4.9 ± 4.8	7.1 ± 4.7	5.8 ± 2.5	5.6 ± 3.9
Calcium(mg)	547.4 ± 349.9	362.3 ± 223.7	792.1 ± 361.6	756.1 ± 335.6	632.0 ± 359.3
Phosphate(mg)	1117.1 ± 624.2	619.7 ± 354.9	1192.7 ± 480.6	974.2 ± 329.1	1007.7 ± 504.8
Iron(mg)	12.4 ± 5.5	9.1 ± 4.1	15.7 ± 6.6	16.6 ± 8.8	13.8 ± 7.0
Vitamin A(IU)	3657.5 ± 3771.6	3852.5 ± 3080.0	8901.6 ± 14182.2	4713.6 ± 3449.6	5476.7 ± 8250.4
Vitamin B_1(mg)	1.39 ± 1.15	0.91 ± 0.43	1.47 ± 0.68	1.68 ± 1.97	1.38 ± 1.20
Vitamin B_2(mg)	1.34 ± 0.75	1.04 ± 0.79	1.60 ± 0.77	1.56 ± 0.97	1.42 ± 0.83
Niacin(mg)	17.1 ± 8.7	12.6 ± 4.5	21.0 ± 11.3	15.3 ± 6.3	17.0 ± 8.7
Vitamin C(mg)	67.8 ± 52.1	57.0 ± 30.6	71.6 ± 32.2	57.4 ± 39.2	64.2 ± 38.9
Cholesterol(mg)	197.5 ± 187.1	150.0 ± 143.9	306.7 ± 275.5	264.6 ± 116.1	241.1 ± 202.3
Saturated FA(mg)[2]	11.5 ± 5.2	7.1 ± 3.7	15.5 ± 7.7	20.5 ± 18.4	14.1 ± 11.2
Monosat FA(mg)[3]	12.5 ± 5.0	8.2 ± 4.6	14.8 ± 5.9	12.3 ± 5.2	12.4 ± 5.7
Polyunsat FA(mg)[4]	14.3 ± 21.6	9.8 ± 6.5	14.2 ± 6.7	13.5 ± 12.2	13.2 ± 13.1

1) Mean±S.D.
2) Saturated fatty acid
3) Monosaturated fatty acid
4) Polyunsaturated fatty acid

Choi et al's reported value[26] of obese children(2.45) and approaching the high risk value of 3.0 by the American Pediatric Association[27]. The average lipoprotein(a) was 24.1±19.0mg/L, which is higher value than a Choe et al's reported value[28] of 15.5±2.7 of obese children. The average value of ApoB was 143.7±27.8mg/dl, which is higher than the reported value of 103.8±34.0 for obese children[28].

3. Nutrient intakes and dietary behavior of subjects

Nutrient intakes are presented in Table 3. The subjects' average daily energy intake was 1666.7±558.1kcal/day, fat intake was 36.0±17.5g, total carbohydrate intake was 266.7±91.6mg, total cholesterol intake was 241.1±202.3mg and saturated fatty acid, monosaturated fatty acid, polyunsaturated fatty acid intakes were 14.4±11.2mg, 12.4±5.7 mg and 13.2±13.1mg respectively. The food consumption frequencies which were used as indirect indicators of dietary behavior are shown in Table 4. The subjects who ate more than sufficient amounts were only 21.0%, whereas most of them(61.3%) answered that they did not always eat more than enough. The subjects who were conscious about their nutrient intakes were only 17.7%. The subjects who ate vegetables regularly were 37.1%. This dietary behavior study of subjects also showed that 65.1% of subjects eat breakfast regularly, 14.4% missed breakfast 2-3 times per week, while 9.6% of them did not have any breakfast.

Table 4. Food consumption frequencies (%) of Korean obese children(n=64)

Variables	Frequencies		
Taking more than enough	frequently(21.0)	somtimes(61.3)	seldom(17.7)
Balanced meals	seldom(51.6)	somtimes(29.0)	frequently(17.7)
Skipping meals	once a day(8.1)	2-3 times a week(9.7)	seldom(80.6)
Vegetable consumption	seldom(16.1)	once serving a day(46.8)	three servings a day(37.1)
Meat consumption	every day(14.5)	2-3 times a week(40.3)	once a week(45.2)
Fruit consumption	seldom(6.5)	2-3 times a week(41.9)	every day(51.6)
Fish and bean product consumption	seldom(59.7)	once a day(29.0)	every meal(1.6)
Milk and dairy product consumption	seldom(12.9)	2-3 times a week(16.1)	every day(71.0)
Seaweeds consumption	seldom(4.8)	2-3 times a week(64.5)	every day(30.6)
Processed food consumption	every day(8.1)	2-3 times a week(53.2)	seldom(37.1)

Table 5. Correlation coefficients(r) between anthropometric measurement and cardiovascular disease related parameters in Korean obese children(n=64)

	Height	Weight	BMI	Waist hip ratio	Rohler Index	Relative Weight	Waist	Hip
Total Chol[1]	-0.06555	-0.03066	-0.03806	-0.06924	-0.02058	-0.03594	-0.02894	0.00798
TG[2]	0.12396	0.17925	0.25871*	0.17392	0.26889*	0.21143	0.20937	0.14728
HDL Chol[3]	-0.21571	-0.21520	-0.23871	-0.30771	-0.16401	-0.23080	-0.32016*	-0.20616
LDL Chol[4]	-0.03972	-0.02171	-0.04671	-0.03122	-0.05467	0.03231	0.00231	0.02453
LPH[5]	0.09254	0.10383	0.09343	0.12825	0.04088	0.10298	0.16488	0.12174
AI[6]	0.10232	0.12498	0.14026	0.17563	0.10462	0.13376	0.19250	0.12924
R Chol[7]	-0.10380	-0.14691	-0.18005	-0.19614	-0.16280	-0.16114	-0.23386	-0.16962
Apo B[8]	0.06286	0.08371	0.07806	-0.03559	0.04082	0.08358	0.08604	0.11523
Lip(a)[9]	-0.14885	-0.14962	-0.17619	-0.17622	-0.15188	-0.16183	-0.14905	-0.07983
FBS[10]	0.12079	0.12891	0.10076	0.09628	0.03117	0.12095	0.18407	0.13957
SBP[11]	0.18787	0.14859	0.10466	-0.00392	-0.02443	-0.14078	-0.11260	0.11854
DBP[12]	0.18068	0.12668	0.05905	-0.10377	-0.08725	0.11020	0.05934	0.11853

*p<0.05

1) *Total cholesterol*
2) Triacylglycerol
3) *HDL-cholesterol*
4) LDL-cholesterol
5) *Ratio of LDL-cholesterol and HDL-cholesterol*
6) Atherogenic Index (see the text)
7) *Relative cholesterol* (see the text)
8) Fasting blood glucose
9) *Apolipoprotein B*
10) Lipoprotein (a)
11) *Systolic blood pressure*
12) Diastolic blood pressure

4. The correlations between anthropometric measurements and potential atherogenic indices

In these obese children, correlations between anthropometric markers and CVD related parameters were studied(Table 5). Among various indices, both BMI and Rohler Index showed strong correlations with triacylglycerol contents of plasma, and waist hip ratio and waist had strong negative correlations with HDL cholesterol. From this study, the measurement of waist and waist hip ratio might have a strong implication in predicting atherogenicity in Korean obese school children. In studying determinants of serum cholesterol contents for American obese children, weight for height was found to be the most significant predictive determinants[29]. In another study on Japanese obese children, it reported that body fat distribution is more related to a certain biochemical complication of childhood obesity than the other two kinds of indices, overweight and adiposity[30]. Also from studies on the relationships of childhood obesity, body fat distribution and cardiovascular risk factors including plasma lipids and lipoproteins, body fat distribution appears to be a determinant factor[31-33]. Furthermore, in an epidemiological research of adolescents to define the optimal measure of cardiovascular risk factors, cholesterol and blood pressure were found to be best representatives for body fat distribution[34]. Further studies are needed to clarify the correlations between biochemical complications of Korean childhood obesity and body fat distribution. In the present study with a limited number of obese children, there were found to exist strong correlations between fat distribution measured by waist hip ratio and blood lipids abnormalities.

5. The correlations between nutrient intakes and dietary behavior, and potential atherogenic indices

Table 6 shows the results of correlations between nutrient intakes of subjects and CVD related parameters. It appeared that no correlations between nutrient intakes and various CVD related parameters existed, except that there was a correlation between niacin intakes and TG, and a correlation between intakes of polyunsaturated fatty acids and lipoprotein (a). Serum cholesterol was not significantly correlated with dietary intakes of cholesterol, fiber or saturated fatty acids. In other studies on the relationships between nutrient intakes and serum cholesterol concentrations, intakes of saturated fatty acid have been identified as the predictive variable of children's serum cholesterol levels[35][36]. However, the possibility of a correlation between intakes of saturated fatty acids, cholesterol, other fatty acids and serum atherogenic factors cannot be ruled out from the reason that one 24-hour dietary recall methods may not provide an accurate estimate of typical food consumption[34][35].

Table 7 represents that correlation between food consumption frequencies and various CVD related parameters. The scores of fish and bean product intakes were negatively correlated with ApoB, total cholesterol, LDL-cholesterol and atherogenic index, and those of vegetable consumption and fish and bean product intakes were positively correlated with HDL-cholesterol. The total dietary behavior score, which was calculated from food consumption frequencies and of which high score represents desirable habits, was positively correlated with HDL-cholesterol. Along with the other investigation[39] which showed increased intakes of vegetable foods have association with decrements of atherogenic lipid profiles preventive diets for Korean obese children should be focused on eating the appropriate amount of fish, bean products, and vegetable. There are several evidences from other countries that unfavorable lipoprotein profiles in obese children can be improved by diet[40][41].

6. The comparisons of various determinants between two groups with different serum lipid contents

The grouping among these children into lower and higher levels of several parameters, and the comparison of the various determinants among these two groups would help to identify the contributing factors for atherogenic profiles. Table 8 presents the results of mean differences of various determinants between two groups of total cholesterol contents and two groups of triacylglycerol. ApoB level was higher with subjects with higher cholesterol contents of over 200mg/dl. The higher values of LDL-cho-

Table 6. *Correlation coefficients(r) between nutrient intakes and cardiovascular related parameters in Korean obese children(n=64)*

	Total CHOL[1)]	TG[2)]	HDLChol[3)]	LDLChol[4)]	LPH[5)]	AI[6)]	RCHOL[7)]	ApoB[8)]	Lip(a)[9)]	FBS[10)]	SBP[11)]	DBP[12)]
Total food intakes	0.04110	-0.04921	-0.00921	0.05972	0.01397	-0.01418	-0.00436	0.01230	-0.18215	0.09560	-0.01026	-0.03689
Energy	-0.15100	-0.05347	-0.07800	-0.11161	-0.06692	-0.07890	0.09595	-0.14099	-0.15627	0.00580	-0.02757	-0.05762
Protein	-0.06624	-0.22504	0.07297	-0.01841	-0.07437	-0.13731	0.14385	-0.07127	-0.13635	-0.01494	-0.14994	-0.13726
Fat	-0.14682	-0.03905	-0.00128	-0.13539	-0.13659	-0.14635	0.14219	-0.11481	-0.15438	-0.03625	-0.09188	-0.06461
Carbohydrate	-0.14539	0.01377	-0.15368	-0.10393	-0.00664	-0.00018	0.03201	-0.13580	0.13087	-0.05102	0.05718	-0.01574
Fiber	0.18032	-0.03770	-0.03506	0.20441	-0.17893	-0.13650	-0.10658	0.22029	-0.10494	0.03586	0.15396	0.19266
Calcium	0.03740	-0.07376	0.00340	0.05985	-0.00291	-0.03809	-0.01329	0.04411	-0.14837	0.00162	-0.08715	-0.07149
Phosphate	-0.04897	-0.17387	0.09403	-0.02352	-0.07743	-0.12490	0.16190	-0.12188	-0.09996	0.00595	-0.16475	-0.13184
Iron	-0.03514	0.12281	0.01215	-0.00056	-0.02690	-0.06487	-0.08218	0.07695	0.14503	0.01253	-0.08081	-0.06259
VitaminA	0.07311	-0.05846	-0.00767	0.09444	0.05439	0.02456	-0.06640	0.08735	0.01899	-0.14980	0.02780	0.08790
VitaminB1	0.12685	-0.15444	0.11309	0.14185	0.03349	-0.02408	0.00970	0.11500	-0.05212	-0.07230	-0.03127	0.03776
VitaminB2	0.11038	-0.14098	0.01335	0.15152	0.09417	0.04218	-0.05760	0.12128	0.03094	-0.00229	-0.04782	-0.03136
Niacin	-0.05564	-0.29899*	0.05658	0.02053	-0.02902	-0.09991	0.11578	-0.10389	-0.09259	0.00392	-0.12164	-0.06218
VitaminC	0.18311	-0.02959	0.13406	0.15294	0.07817	0.05271	0.02354	0.09176	-0.07228	0.10189	0.03560	-0.03541
Chol	-0.21225	-0.09304	-0.03872	-0.17238	-0.14081	-0.15301	0.12050	-0.15628	0.00584	-0.09851	-0.10185	-0.23088
Saturated	-0.16822	-0.10449	0.02220	-0.14351	-0.16547	-0.18196	0.14046	-0.11635	-0.21720	0.04515	-0.04998	0.04135
Monosat.	-0.13025	-0.16500	0.02394	-0.08676	-0.14567	-0.18526	0.10123	-0.06411	-0.15714	-0.06771	-0.00408	0.04200
Polyunsat	-0.06059	0.17182	0.00470	-0.00852	-0.01644	-0.05957	0.05567	-0.04898	0.26598*	0.18432	-0.11386	-0.05864

* : $p<0.05$

1) Total cholesterol 2) Triacylglycerol 3) HDL - cholesterol 4) LDL - cholesterol

5) Ratio of LDL - cholesterol and HDL - cholesterol 6) Atherogenic Index(see the text) 7) Relative cholesterol(see the text)

8) Fasting blood glucose 9) Apolipoprotein B 10) Lipoprotein (a) 11) Systolic blood pressure 12) Diastolic blood pressure

Table 7. Correlation coefficients(r) between food consumption frequencies and cardiovascular disease related parameters in Korean obese children(n=64)

	Total Chol[1]	TG[2]	HDL Chol[3]	LDL Chol[4]	LPH[5]	AI[6]	RCHOL[7]	ApoB[8]	Lip(a)[9]	FBS[10]	SBP[11]	DBP[12]
Taking more than enough	0.21447	-0.02863	0.16101	0.17873	-0.02052	-0.05369	-0.07086	0.23521	0.14297	-0.16132	-0.05886	-0.00522
Balanced meals	0.05159	-0.10677	0.19257	0.02822	-0.13954	-0.17312	0.15599	-0.08228	0.12420	-0.09251	-0.14433	-0.02748
Skipping meals	0.02951	-0.10627	0.05464	0.04636	0.05659	0.03569	0.03321	-0.05002	-0.00073	0.00625	0.17677	0.17271
Vegetable consumption	0.18720	-0.16468	0.24447*	0.16815	0.05339	-0.00409	0.06879	0.09621	0.08253	0.03179	0.11428	0.00997
Meat comsumption	0.10200	0.08484	0.00764	0.07516	0.01505	0.01002	-0.02230	0.06607	0.09827	-0.04761	-0.02342	-0.12274
Fruit consumption	0.12655	0.01798	0.17223	0.07199	-0.03732	-0.04342	0.03134	-0.00709	0.16597	0.13768	0.00436	-0.02861
Fish and bean product consumption	-0.26813*	-0.18786	0.29802*	-0.30219*	-0.36582**	-0.37447**	0.51491**	-0.46585**	0.00066	-0.09539	0.06075	0.02147
Milk and dairy product consumption	-0.00213	-0.19026	0.19876	-0.00249	-0.13480	-0.16849	0.10606	-0.12233	0.19498	0.10577	-0.30516*	-0.37301**
Seaweeds consumption	-0.13234	0.26353*	-0.02658	-0.20710	-0.16042	-0.07382	0.02142	-0.12240	-0.17401	-0.05330	0.06906	-0.03566
Processed food consumption	0.13874	-0.00607	-0.10452	0.17335	0.15969	0.14267	-0.24390*	0.14521	0.28689*	-0.02858	-0.12638	-0.10169
Dietary behavior score[13]	0.09766	-0.13723	0.32084*	0.04642	-0.16163	-0.20003	0.18713	-0.10685	0.23799	-0.05463	-0.06408	-0.12282

*$p<0.05$ **$p<0.01$

1) Total cholesterol 2) Triacylglycerol 3) HDL - cholesterol 4) LDL - cholesterol

5) Ratio of LDL - cholesterol and HDL - cholesterol 6) Atherogenic Index(see the text) 7) Relative cholesterol(see the text)

8) Fasting blood glucose 9) Apolipoprotein B 10) Lipoprotein (a)

11) Systolic blood pressure 12) Diastolic blood pressure 13) For the calculation of dietary behavior scores see the text

Table 8. Mean differences of various determinants between two groups of serum total cholesterol(less risk group ; <200mg/dl and high risk group ; ≥200mg/dl), and two groups of serum triacylglycerol(less risk group ; <150mg/dl and high risk group ; ≥150mg/dl) respectively in Korean obese children(n=64)

	Total Cholesterol <200mg(n=47)		Total Cholesterol ≥200mg(n=17)		Triacylglycerol <150mg(n=54)		Triacylglycerol ≥150mg(n=10)	
SBP	123.3 ±	23.9[1)]	120.7 ±	21.8	123.5 ±	20.6	117.9 ±	35.7
DBP	87.3 ±	23.7	83.7 ±	21.4	86.9 ±	21.3	83.3 ±	32.1
ApoB	133.8 ±	23.4	170.8 ±	19.9**	143.1 ±	29.0	146.9 ±	20.8
Lip(a)	22.0 ±	18.6	29.5 ±	19.5	25.1 ±	19.6	18.2 ±	14.1
TG	108.9 ±	48.1	115.2 ±	50	94.2 ±	28.5	199.2 ±	36.8**
Total Chol	167.4 ±	19.2	222.6 ±	22.7**	182.2 ±	32.9	181.5 ±	25.2
HDL Chol	47.9 ±	9.6	49.0 ±	8.9	50.1 ±	8.5	38.3 ±	8.1
LDL Chol	97.7 ±	18.2	150.5 ±	27.1**	113.3 ±	32.4	103.3 ±	24.9
LPH	2.10 ±	0.52	3.2 ±	0.9**	2.31 ±	0.74	2.86 ±	1.14
AI	2.60 ±	0.74	3.71 ±	1.1**	2.71 ±	0.79	3.94 ±	1.29**
RCHOL	0.28 ±	0.05	0.2 ±	0.04**	0.28 ±	0.06	0.21 ±	0.05**
FBS	76.2 ±	6.8	79.0 ±	13.2	76.6 ±	6.4	78.7 ±	17.7
Total food intakes	1125.6 ±	471.2	1280.3 ±	294.5	1182.2 ±	437.6	1078.8 ±	437.2
Energy	1654.6 ±	592.5	1683.5 ±	477.0	1677.9 ±	575.6	1579.8 ±	499.5
Protein	74.0 ±	33.0	79.0 ±	28.9	78.4 ±	33.0	59.1 ±	19.2*
Fat	35.4 ±	17.5	38.4 ±	18.1	36.9 ±	18.0	32.1 ±	15.4
Carbohydrate	266.3 ±	95.0	262.9 ±	84.8	264.6 ±	92.3	269.5 ±	93.8
Fiber	5.3 ±	3.5	6.4 ±	4.7	5.7 ±	4.2	4.8 ±	1.6
Calcium	609.6 ±	368.3	689.0 ±	347.3	649.6 ±	373.5	528.5 ±	288.8
Phosphate	970.5 ±	492.2	1085.4 ±	548.7	1034.7 ±	524.3	820.6 ±	360.4
Iron	13.2 ±	7.54	14.9 ±	5.20	14.1 ±	7.3	11.1 ±	4.0
Vitamin A	5307.6 ±	9467.7	5961.5 ±	3477.6	5892.2 ±	8941.1	3313.8 ±	3114.8
Vitamin B1	1.29 ±	1.2	1.56 ±	1.06	1.45 ±	1.29	0.90 ±	0.3*
Vitamin B2	1.33 ±	0.8	1.61 ±	0.80	1.47 ±	0.85	1.04 ±	0.6
Niacin	16.8 ±	9.2	17.0 ±	7.5	17.7 ±	9.1	12.1 ±	4.4**
Vitamin C	58.5 ±	39.6	80.0 ±	34.1*	64.9 ±	39.1	59.8 ±	41.2
Cholesterol	247.0 ±	226.4	209.1 ±	99.5	244.5 ±	211.8	202.5 ±	147.4
Saturated FA	14.7 ±	12.7	11.8 ±	5.0	14.5 ±	11.6	11.5 ±	9.3
Monosaturated FA	12.3 ±	5.9	11.9 ±	4.6	12.7 ±	5.7	9.7 ±	4.3
Polyunsaturated FA	14.1 ±	15.1	10.4 ±	4.3	13.7 ±	14.2	10.2 ±	5.6
Waist	78.3 ±	9.0	79.4 ±	9.0	78.4 ±	9.4	79.5 ±	6.2
Hip	89.5 ±	9.2	89.5 ±	11.0	89.7 ±	10.0	88.5 ±	7.5
Height	139.6 ±	12.2	137.6 ±	12.8	139.1 ±	12.4	138.8 ±	12.0
Weight	49.3 ±	13.1	48.3 ±	15.8	49.0 ±	14.2	49.1 ±	11.8
BMI	24.7 ±	3.1	24.7 ±	4.1	24.6 ±	3.5	25.0 ±	2.5
Rohler Index	17.7 ±	1.5	17.9 ±	2.0	17.7 ±	1.7	18.0 ±	1.5
Relative Weight	34.8 ±	6.7	34.4 ±	8.4	34.6 ±	7.4	34.9 ±	5.8

1) Mean±S.D. *$p<0.05$ **$p<0.01$

lesterol, Atherogenic index were found in groups with higher serum cholesterol values. There are no differences in circumferences of waist and hip, weight, BMI, RI or RW values with two groups of cholesterol contents. Atherogenic index were different among lower and higher TG levels(Table 8, below 150mg, and over 150mg). Between the two levels of serum TG and among nutrients protein intakes, vitamin B_1, and niacin intakes were different. No anthropometric values were different with two levels of TG contents. The lower HDL-cholesterol group showed the greater TG contents than the higher HDL-cholesterol group, and atherogenic index was much greater with the lower HDL-cholesterol group(Table 9, 4.30 vs 2.64). With higher LDL, ApoB level was significantly greater, total cholesterol was higher and atherogenic index was greater. There were no significant differences in various determinants between two levels of ApoB proteins(Table 9). From analysis of these two levels of serum lipid variables, cholesterol, TG, and HDL-cholesterol and LDL-cholesterol seemed to be varied together. However, lipoprotein(a), the predictor of atherosclerotic disease [42)], did not appear to be varied with other risk factors

Table 9. Mean Differences of various determinants between two groups of HDL-cholesterol(less risk group ; ≤40mg/dl and high risk group ; >40mg/dl), and LDL-cholesterol(less risk group ; <150mg/dl and high risk group ; ≥ 150mg/dl) respectively in Korean obese children (n=64)

	HDL ≤40mg(n=10)	HDL >40mg(n=54)	LDL <150mg(n=56)	LDL ≥150mg(n=8)
SBP	126.4 ± 33.0[1)]	121.9 ± 21.3	122.4 ± 23.4[1)]	124.2 ± 23.3
DBP	89.4 ± 31.1	85.8 ± 21.5	85.9 ± 22.9	89.7 ± ∠4.6
ApoB	150.7 ± 31.4	142.3 ± 27.1	137.7 ± 23.8	185.1 ± 14.9**
Lip(a)	21.9 ± 18.9	24.4 ± 19.1	22.6 ± 18.1	33.8 ± 23.4
TG	162.4 ± 49.2	101.0 ± 42.2**	111.7 ± 50.6	102.5 ± 37.5
Total Chol	179.3 ± 32.1	182.6 ± 31.8	174.1 ± 23.6	237.6 ± 24.9**
HDL Chol	34.2 ± 4.2	50.8 ± 7.6**	48.6 ± 9.4	45.6 ± 9.5
LDL Chol	112.6 ± 30.9	111.5 ± 31.7	103.2 ± 21.3	171.5 ± 24.7**
LPH	3.32 ± 0.99	2.22 ± 0.67**	2.18 ± 0.54	3.90 ± 0.93**
AI	4.30 ± 1.12	2.64 ± 0.70**	2.68 ± 0.74	4.40 ± 1.20**
RCHOL	0.19 ± 0.03	0.28 ± 0.05**	0.28 ± 0.05	0.19 ± 0.04**
FBS	78.0 ± 17.4	76.7 ± 6.5	76.0 ± 6.7	83.6 ± 17.4
Total food intakes	1094.2 ± 462.7	1179.3 ± 433.6	1147.4 ± 452.2	1307.8 ± 250.0
Energy	1630.4 ± 558.8	1668.1 ± 567.1	1668.7 ± 586.8	1610.2 ± 318.5
Protein	64.4 ± 21.0	77.4 ± 33.3	75.1 ± 33.6	76.3 ± 13.0
Fat	34.6 ± 18.9	36.4 ± 17.5	36.5 ± 18.3	33.1 ± 9.9
Carbohydrate	273.6 ± 89.9	263.8 ± 92.9	266.1 ± 95.1	260.3 ± 65.5
Fiber	4.5 ± 2.2	5.7 ± 4.1	5.1 ± 3.3	9.1 ± 6.2
Calcium	533.8 ± 328.2	648.6 ± 368.0	622.4 ± 378.0	690.4 ± 201.3
Phosphate	874.6 ± 296.1	1024.3 ± 535.0	990.3 ± 532.7	1077.7 ± 182.5
Iron	12.5 ± 4.8	13.9 ± 7.3	13.4 ± 7.3	15.3 ± 3.8
Vitamin A	3727.9 ± 3326.3	5812.6 ± 8948.8	5367.1 ± 8785.6	6334.6 ± 2776.2
Vitamin B_1	1.05 ± 0.46	1.42 ± 1.29	1.32 ± 1.26	1.66 ± 0.54
Vitamin B_2	1.40 ± 0.99	1.40 ± 0.80	1.34 ± 0.82	1.92 ± 0.76
Niacin	15.4 ± 4.8	17.1 ± 9.3	16.4 ± 9.0	20.09 ± 6.2
Vitamin C	61.4 ± 41.2	64.6 ± 39.1	60.8 ± 39.6	89.7 ± 4.9*
Cholesterol	195.9 ± 165.5	245.8 ± 209.1	240.7 ± 211.3	213.3 ± 117.1
Saturated FA	11.1 ± 7.3	14.5 ± 11.8	14.5 ± 11.7	10.3 ± 5.6
Monosaturated FA	10.9 ± 6.8	12.5 ± 5.3	12.3 ± 5.7	11.9 ± 4.7
Polyunsaturated FA	10.9 ± 5.9	13.6 ± 14.2	13.5 ± 14.0	10.8 ± 2.8
Waist	80.8 ± 8.0	78.2 ± 9.1	78.6 ± 9.0	78.2 ± 9.4
Hip	90.1 ± 9.6	89.4 ± 9.7	89.6 ± 9.5	88.8 ± 10.9
Height	140.2 ± 12.9	138.8 ± 12.2	139.1 ± 12.4	138.5 ± 12.0
Weight	51.1 ± 13.6	48.6 ± 13.9	49.2 ± 13.6	47.8 ± 15.7
BMI	25.4 ± 3.2	24.6 ± 3.4	24.8 ± 3.1	24.2 ±
Rohler Index	18.1 ± 1.7	17.7 ± 1.6	17.8 ± 1.5	17.4 ± 2.6
Relative Weight	35.9 ± 7.0	34.5 ± 7.2	34.8 ± 6.9	33.9 ± 8.9

1) Mean±S.D. *p<0.05 **p<0.01

statistically in this study.

The present study was undertaken to assess the relationship of unfavorable changes in atherogenic indices to anthropometric variables, nutrient intakes and dietary behavior in 64 obese children. Data indicate that there exist considerable cholesterol and lipoprotein alterations which presently known to be associated with an increased risk for cardiovascular diseases in obese children. However, this result cannot be generalized into all of obese children in Korea because only the limited number of subjects were examined. Among various anthropometric markers, waist and waist hip ratio can be regarded as predictable factors for CVD risk for obese elementary school children. The dietary behaviors rather than nutrient intakes have shown to be correlated with various atherogenic lipid profiles. Special relationships between intakes of fish and bean products, and lipid profiles tended to be strong. Present findings suggest that programs to reduce the risk of cardiovascular disease in children should be focused on maintenance of ideal body weight through reducing body fat and adapting desirable food habits that would result in increased intakes of fish and bean products.

Literature cited

1) Mossberg HO. 40-year follow-up of overweight children. Lancet 2 : 491-493, 1989
2) Must A, Jacques PF, Dallal GE, Bajema CJ, Dietz WH. Longterm morbidity and mortality of overweight adolescents. A follow-up of the Harvard growth study of 1922 to 1935. N Engl J Med 327 : 1350-1355, 1992
3) National Statistical Office, Republic of Korea. Annual report on the cause of death statistics-based on vital registration, 1996
4) American Heart Association. Heart Facts : American Heart Association, 1986
5) Moon KR, Park YB. Statistical Analysis of the prevalence and trend of obesity in elementary school children in Kwangju Korean. *J Ped Assoc* 36(1) : 81-87, 1993
6) Moon AN, Hong SC, Auh SC. The prevalence of obesity in children and adolescents. *Korean J Nutr* 25(5) : 413-418, 1992
7) Kang YJ, Hong CH, Hong YJ. The prevalence of childhood and adolescent obesity over the last 18 years in Seoul area. *Korean J Nutri* 30(7) : 832-839, 1997
8) Kim JQ, Song JH, Kim SI. Prevalence of hyperlipidemia and other risk factors of coronary artery disease in Korean children. *Korean J Lipidol* 2(1) : 72-80, 1992
9) Yang MK. Prevalence of coronary risk factor in Korean children. *Korean J Lipidol* 4(2) : 258-264, 1994
10) Lee DH. The prevalence rate of medical problems among severely obese children. *Korean J Lipidol. 4(2) : 257, 1994*
11) Kim H, Hong YM, Kim GH, Yu JH. Predictor of fatty liver in obese children. *J Pediatric Assoc* 39(6) : 803-810, 1996
12) Garcia RE, Moodie DS. Routine cholesterol surveillance in childhood. *Pediatrics* 84 : 751-755, 1989
13) Lasjarzewski P, Morrison JA, deGroot I. Lipid and lipoprotein tracking in 108 children over a four-year period. *Pediatrics* 64 : 584-591, 1979
14) Webber LS, Cresanta JS, Voors AW. Tracking of cardiovascular disease risk factor variables in school-age children. *J Chronic Dis* 36 : 647-660, 1983
15) Korean Association of Pediatrics. '85 Korean Children's Growth Standard. 1985
16) Ministry of Health and Welfare. Korean Food Composition Table. 6th ed. Korea, 1996
17) Jung EK, Paik HY. Fatty acid contents in foods of major fat sources in Korean diet. *Korean J Nutri* 26(3) : 254-267, *1993*
18) Lee YJ. Fatty acid composition of Korean foods. Shin Kwang Pub Co. Seoul, Korea, 1995
19) Lapidus L, Bngtsson C. Regional obesity as a health hazard in women-a prospective study. *Acta Med Scand* S 723 : 53-59, 1988
20) Park OJ, *et al.* Mechanisms of fructose-induced hypertriglyceridaemia in the rat. *Biochem J* 282 : 753-757, 1992
21) Friedewald WT, Levy RI, Fredrickson DS. Estimation of concentration of low density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clin Chem* 18 : 499-502, 1979
22) Kim CJ, Jang HC, Kim HS, Min YK, Shin HH, Han IK. Diseases and parameters influencing the concentration of lipoprotein (a). *Korean J Lipidol* 1(1) : 65-70, 1991
23) SAS Institute. Inc. SAS/STAT User's guide, Release 6.03 ed. Cary NC : SAS Institute, Inc. USA, 1988
24) Gibson H. Principles of Nutritional Assesment. In Rosalind S, Gibson H ed. Anthropometric assessment of growth., pp.178-181, Oxford University Press, New York, Oxford, 1990
25) Kim JQ, Song JH, Kim SI. Prevalence of hyperlipidemia and other risk factors of coronary artery disease in Korean children. *Korean J Lipidol* 2(1) : 72-80, 1992
26) Choi SH, Kim KB, Park SG, Chung JT, Son CS, Tockgo YC. The study of serum lipids in grossly obese elementary school students in Seoul. *J Pediatric Assoc* 36(1) : 73-80, 1993
27) Wyder EL, Berenson GS, Strong WB, Williams C. Coronary artery disease prevention : Cholesterol, a pediatric perspective. *Prev Med* 18 : 323-409, 1989
28) Choe YH, Choi Y, Kim JQ. Apolipoprotein A-Ⅰ, apolipoprotein B, lipoprotein (a) in elementary school children and a history of coronary or cerebral vascular events in their older family members. *Korean J Lipidol* 5(1) : 53-60, 1995
29) Wilson DK, Lewis NM. Weight-for-height measurement and saturated fatty acid intake are predictors of serum cholesterol level in children. *J Am Diet Assoc* 92 : 192-196, 1992
30) Asayama K, Hayashibe H, Dobashi K, Uchida N, Kawada Y, Nakazawa S. Relationships between biochemical abnormalities and anthropometric indices of overweight, adiposity and body fat distribution in Japanese elementary school children. *Int J Obes Relat Metab Disord* 19(4) : 253-259, 1995
31) Zwiauer K, Widhalm K, Kerbl B. Relationship between body fat distribution and blood lipids in obese adolescents. *Int J Obes* 14 : 271-277, 1990
32) Fox K, Peters D, Armstrong N, Sharpe P, Bell M. Abdominal fat deposition in 11-year-old children. *Int J Obes* 17 : 11-16, 1993
33) Flodmark CE, Sveger T, Nilsson-Ehle PN. Waist measurement correlates to a potentially atherogenic lipopro-

tein profile in obese 12-14-year-old children. *Acta Padiatr* 83 : 941-945, 1994

34) Sangi H, Mueller WH. Which measure of body fat distribution is best for epidemiologic research among adolescents? *Am J Epidemiol* 133 : 870-883, 1991

35) Hubert HB, Feinleib M, McNamara PM, Castelli WP. Obesity as an independent risk factor for cardiovascular disease : a 26-year follow-up of participants in the Framingham study. *Circulation* 67 : 968-977, 1983

36) Ward SD, Melin JR, Llyod FP, Norton JA, Christian JC. Determinants of plasma cholesterol in children-a family study. *Am J Clin Nutr* 33 : 63-70, 1980

37) Todd KS, Hudes M, Calloway DH. Food intake measurement : Problems and approaches. *Am J Clin Nutr* 37 : 139-146, 1983

38) Garn SM, Larkin FM, Cole PE. The real problem with 1-day dietary records. *Am J Clin Nutr* 31 : 1114-1116, 1978

39) Kim JH, Lee YN, Mo S, Choi H. A study on effects of dietary intake and obesity on serum lipid levels of elementary school children in a high-socioeconomic apartment complex in Seoul. *Korean J Lipidol* 3(2) : 181-190, 1993

40) Sveger T, Flodmark CE, Fex G, Henningsen NC. Apolipoproteins A- I and B in obese children. *J Pediatric Gastroenterol Nutr* 9 : 497-501, 1989

41) Ylitalo V. Treatment of obese school children with special reference to the mode of therapy, cardiorespiratory performance and the carbohydrate and lipid metabolism. *Acta Paediatr Scand S290* : 1-108, 1981

42) Harris ED. Lipoprotein (a) : A predictor of athero-sclerotic disease. *Nutr Rev* 55(3) : 61-64, 1997