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Correlations among Anthropometric Measurements, Serum Lipid Levels and Nutrient Intake in Female University Students

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ABSTRACT

The purpose of this study was to investigate the correlations among the anthropometry, serum lipid levels and nutrient intake in Korean female university students. The subjects were 119 female students at a university located in Incheon. This study was conducted using a self-administered questionnaire. Anthropometric data were measured and blood lipid levels were analyzed. Nutrient intake collected from 3 day-recalls was analyzed by the Computer Aided Nutritional Analysis Program. The data were analyzed by SPSS 10.0 program. Average age, height and weight of the subjects were 20.9 years, 160.1cm and 54.3kg, respectively. Average serum TG (triglyceride), total cholesterol, HDL-C (high density lipoprotein-cholesterol) and LDL-C (low density lipoprotein-cholesterol) levels of the subjects were 69.47mg/dl, 146.85 mg/dl, 50.49mg/dl and 82.52mg/dl, respectively. Average AI (atherogenic index) of the subjects was 2.03, which was in the normal range based on risk values. Average intake of most nutrients except protein, vitamin B_1, vitamin C and phosphorus were lower than the Korean RDA. Especially calcium and iron intakes of the subjects were under 65% of the Korean RDA. Serum TG, total cholesterol and LDL-C levels were negatively correlated with DBP (diastolic blood pressure). HDL-C/LDL-C and HDL-C/total cholesterol were positively correlated with height. Age was positively correlated with phosphorus intake. DBP of the subjects was positively correlated with calcium and iron intakes. Serum TG level was positively correlated with total cholesterol, HDL-C, LDL-C and AI, while negatively correlated with HDL-C/total cholesterol. Total cholesterol level was positively correlated with HDL-C, LDL-C and AI, while negatively correlated with HDL-C/LDL-C, HDL-C/total cholesterol. HDL-C level was positively correlated with LDL-C, HDL-C/LDL-C and HDL-C/total cholesterol, while negatively correlated with AI. LDL-C level was negatively correlated with HDL-C/LDL-C and HDL-C/total cholesterol, while positively correlated with AI. HDL-C/LDL-C ratio was positively correlated with HDL-C/total cholesterol and AI. HDL-C/total cholesterol was negatively correlated with AI. Fat intake was positively correlated with total cholesterol, HDL-C level, and vitamin B_2 intake was positively correlated with TG, HDL-C/LDL-C. Therefore, nutrition education is necessary for female university students to promote the lipid profile and to optimize the nutritional status. (*J Community Nutrition* 4(3) : 151~158, 2002)

KEY WORDS : female university students · anthropometry · serum lipid levels · nutrient intake · correlation.

Introduction

The nutritional status has improved rapidly as a result of the socioeconomic growth in Korea. Although nutritional status has improved, other health problems such as obesity, cardiovascular disease, hyperlipidemia, hypertension and type 2 diabetes have increased (Kim et al. 1998 ; Montoya et al. 2002 ; Janssen et al. 2002 ; Heitmann, Garby 2002 ; Jenkins et al. 2002 ; Kown, Kim 2002). In 1992, 1995 and 1998, the Korean National Nutrition Survey reported that 19.6%, 20.5% and 22.8% of people over 20 years old had a BMI level more than 25kg/m^2, respectively. It has been reported that an overweight or obese condition increased the serum total cholesterol, LDL-C and TG levels and that an overweight or obese condition was inversely related to HDL-C levels (Kim et al. 1998 ; Cheong et al. 2001).

The levels of serum total cholesterol, LDL-C and TG, are associated with energy and fat intakes, especially animal fat, cholesterol and alcohol intakes as well as BMI (Cheong et al. 2001 ; Hong et al. 1993). In 1998, the Korean National Nu-

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trition Survey reported that fat intake of Korean adults increased from 13.5% in 1980's to 19.8% in 1990's and this rate was on the steady increase. In adults study conducted in Seoul for one year in 1997, there was a correlation among dietary intake, BMI and blood lipid levels (Kim et al. 1998). In a previous study conducted in the Chungnam area, there was a significant correlation between nutrient intake and blood lipid levels in female university students (Choi et al. 2001). In the study of adults conducted in Cheju-do in 1996, nutrient intake was correlated with blood lipid levels in male adults, however, nutrient intake was not correlated with blood lipid levels in female adults (Ko et al. 1998). In the study of healthy female adults conducted in the United States, serum concentrations of total cholesterol and LDL-C level were significantly lower after the unsaturated fat diets than after saturated fat diet (Montoya et al. 2002). A number of studies have shown that anthropometric measurements, nutrient intake and BMI might influence serum lipid profile (Choi et al. 2001 ; Hong et al. 1993 ; Ko et al. 1998 ; Kown, Chang 2001 ; Lee, Song 1996 ; Lee 2000).

Therefore, the purpose of this study was to investigate the correlation among age, anthropometric measurements, blood pressure, serum lipid levels and nutrient intake of Korean female university students.

Subjects and Methods

1. Subjects

The subjects were 150 female students at a university located in Incheon. This study was carried out using a self-administered questionnaire from April 1 to 15, 2000. For statistical analysis, 119 well-completed questionnaires were used.

2. Anthropometric measurements

Height and weight of the subjects were measured. Percent body fat was measured with bioelectric impedence analyzer (TBF-611 Tanita). BMI was calculated by dividing body weight in kilograms by height in meters. Triceps and subscapular skinfold thickness were measured using a caliper. Mid upper arm circumference, waist and hip circumference were measured using a tapeline and calculated WHR (waist to hip ratio) by dividing waist circumference in centimeters by hip circumference in centimeters.

3. Laboratory measurements

Subjects underwent blood sampling after an overnight fast. Blood was gathered for biochemical measurements. Serum triglyceride and total cholesterol were analyzed by photometry using a commercial kit (Youngdong Pharmaceutical Co., Korea). HDL-cholesterol was analyzed by the same commercial kit, using the dextran sulfate-$MgCl_2$ coagulation methods. LDL-cholesterol was calculated by the formula of Friedwald et al. (1972), which assumes that the concentration of triglyceride approximates 400mg/dl of the serum.

Friedwald et al. (1972) ; LDL-cholesterol = total cholesterol- [HDL-cholesterol + (triglyceride/5)]

4. Dietary assessment

The three-day recall method was used in-person interview for usual dietary assessment. Nutrient intake was analyzed using the Computer Aided Nutritional Analysis Program for professionals (CAN-Pro, Korean Nutrition Society, 1997) and results were compared with the Korean RDA (Korean Nutrition Society, 7th revision, 2000).

5. Statistical analysis

The statistical analysis was conducted using the SPSS 10.0 program. Mean and standard deviation were calculated for all variables. The correlation among age, anthropometric data, blood pressure, serum lipid levels and nutrient intake

Table 1. Age, anthropometric measurements and blood pressure of the subjects (n = 119)

	Mean ± SD	Range
Age (years)	20.9 ± 1.3	19.0 – 27.0
Height (cm)	160.1 ± 5.3	140.1 – 173.0
Weight (kg)	54.3 ± 6.3	40.6 – 74.4
Body fat (%)	27.0 ± 5.3	12.0 – 46.0
BMI[1] (kg/m^2)	21.2 ± 2.2	16.2 – 28.8
RBW[2]	100.6 ± 11.4	76.8 – 136.0
Mid-upper arm circumference (cm)	24.1 ± 2.3	18.8 – 31.0
Triceps skinfold thickness (cm)	19.1 ± 4.7	10.0 – 36.0
Subscapular skinfold thickness (cm)	17.6 ± 5.0	9.0 – 36.0
Waist (cm)	68.3 ± 7.1	25.6 – 86.0
Hip (cm)	92.7 ± 5.9	77.0 – 127.4
Waist to hip ratio	0.74 ± 0.12	0.3 – 0.9
Systolic blood pressure (mmHg)	119.1 ± 11.2	94.0 – 147.0
Diastolic blood pressure (mmHg)	72.3 ± 10.5	56.0 – 104.0

1) BMI (Body Mass Index) = Weight (kg) / Height $(m)^2$
2) RBW (Relative Body Weight) = Weight (kg) / Height (cm) × 100

were analyzed using Pearson's correlation coefficient.

Results

1. Age, anthropometric measurements and blood pressure

Age, anthropometric measurements and blood pressure of the subjects are shown in Table 1. Average age, height and weight of the subjects were 20.9 years, 160.1cm and 54.3kg, respectively. Average body fat, BMI(body mass index) and RBW(relative body weight) of the subjects were 27.0%, 21.2kg/m^2 and 100.6, respectively. Average triceps and subscapular skinfold thickness were 19.1cm and 17.6cm, respectively. Average mid-upper arm circumference was 24.1cm. SBP(systolic blood pressure) and DBP(diastolic blood pressure) of the subjects were 119.1mmHg and 72.3mmHg, respectively. Waist to hip ratio of the subjects was 0.74.

Table 2. Serum lipid profile of the subjects(n = 119)

	Mean ± SD	Adequate value
Triglyceride(mg/dl)	69.47 ± 37.82	<210
Total cholesterol(mg/dl)	146.85 ± 57.16	<240
HDL-cholesterol(mg/dl)	50.49 ± 20.58	>35
LDL-cholesterol(mg/dl)	82.52 ± 35.48	<160
HDL-C/TC[1]	0.29 ± 0.13	
HDL-C/LDL-C[2]	0.62 ± 0.16	
AI[3]	2.03 ± 0.45	<3

1) HDL-C/TC : high density lipoprotein cholesterol/total cholesterol ratio
2) HDL-C/LDL-C : high density lipoprotein cholesterol/low density lipoprotein cholesterol ratio
3) AI : atherogenic index = (total cholesterol-HDL cholesterol)/HDL cholesterol

2. Serum lipid profile

Serum lipid profile of the subjects are shown in Table 2. Average serum TG(triglyceride), total cholesterol, HDL-C(HDL-cholesterol) and LDL-C(LDL-cholesterol) levels of the subjects were 69.47mg/dl, 146.85mg/dl, 50.49mg/dl

Table 3. Daily nutrient intake of the subjects(n = 119)

	Mean ± SD	% RDA[1]
Energy(kcal)	1597.7 ± 356.0	79.9 ± 17.8
Protein(g)	59.7 ± 24.0	108.5 ± 43.7
Fat(g)	46.0 ± 12.8	
Carbohydrate(g)	237.3 ± 56.9	
Vitamin A(RE)	655.3 ± 321.7	93.6 ± 46.0
Vitamin B_1(mg)	0.9 ± 0.4	103.1 ± 30.4
Vitamin B_2(mg)	0.7 ± 0.5	83.6 ± 46.9
Vitamin C(mg)	81.0 ± 50.3	115.8 ± 71.9
Niacin(mg)	12.4 ± 3.9	95.2 ± 30.2
Calcium(mg)	432.8 ± 173.3	61.8 ± 24.8
Phosphorus(mg)	854.3 ± 243.9	122.0 ± 34.8
Iron(mg)	9.9 ± 3.9	62.1 ± 24.5
Cholesterol(mg)	268.1 ± 128.3	

1) Percent Korean RDA values of daily nutrient intakes (7th revision, 2000)
% RDA = (actual intake/Korean RDA) × 100

Table 4. *Correlation between anthropometric measurements and serum lipid levels*

	TG[3]	TC[4]	HDL-C[5]	LDL-C[6]	HDL/LDL[7]	HDL/TC[8]	AI[9]
Age	−.217*[10]	−.075	−.108	−.014	−.163	−.098	.073
Height	−.178	−.094	.009	−.119	.202*	.216*	−.199
Weight	−.073	.032	.050	.038	.018	.032	−.021
Body fat	.042	.122	.064	.150	−.166	−.141	.127
BMI[1]	.039	.103	.050	.128	−.127	−.120	.120
RBW[2]	.083	.121	.046	.151	−.171	−.168	.164
Triceps skinfold thickness	−.072	−.104	−.083	−.104	.017	.019	−.039
Mid-upper arm circumference	−.048	.017	.004	.035	−.073	−.047	.033
Subscapular skinfold thickness	.093	.010	−.063	.033	−.115	−.168	.181
Waist	−.031	−.026	−.002	−.035	−.002	.015	−.043
Hip	−.113	−.013	.020	−.008	.038	.062	−.055
Waist to hip ratio	.038	−.018	−.013	−.030	−.029	−.026	−.009
Systolic blood pressure	−.141	−.030	−.005	−.016	.012	.059	−.046
Diastolic blood pressure	−.191*	−.198*	−.127	−.204*	.120	.135	−.119

1) BMI(Body Mass Index) = Weight(kg)/Height(m)^2
2) RBW(Relative Body Weight) = Weight(kg)/Height(cm) × 100
3) TG : triglyceride
4) TC : total cholesterol
5) HDL-C : HDL-cholesterol
6) LDL-C : LDL-cholesterol
7) HDL/LDL : HDL-cholesterol/LDL-cholesterol
8) HDL/TC : HDL-cholesterol/total cholesterol
9) AI : atherogenic index = (total cholesterol-HDL cholesterol)/HDL cholesterol
10) * : significant at $p < 0.05$

and 82.52mg/dl, respectively and the values were in normal range. Average HDL-C/total cholesterol and HDL-C/LDL-C of the subjects were 0.29 and 0.62, respectively. AI (atherogenic index) of the subjects was 2.03, and this value was in normal range (Hong et al. 1993).

3. Daily nutrient intake and % RDA

Daily intake of energy and other nutrients are presented in Table 3. Intake of nutrients except protein, vitamin B_1, vitamin C and phosphorus were lower than the Korean RDA. Intake of Energy and vitamin B_2 were under the 85% of the Korean RDA and calcium and iron intakes were under the 65% of the Korean RDA. On the other hand, average daily intake of vitamin C and phosphorus were above 115% of the Korean RDA in female university students.

4. Correlation between anthropometric measurements and serum lipid levels

Correlation between anthropometric measurements and serum lipid levels is shown in Table 4. Serum TG level was negatively correlated with age ($r = -0.217$ at $p < 0.05$), DBP ($r = -0.191$ at $p < 0.05$). Serum total cholesterol level was negatively correlated with DBP ($r = -0.198$ at $p < 0.05$). Serum LDL-C level was negatively correlated with DBP ($r = -0.204$ at $p < 0.05$). HDL-C/LDL-C and HDL-C/total cholesterol were positively correlated with height ($r = 0.202$ at $p < 0.05$, and $r = 0.216$ at $p < 0.05$, respectively).

5. Correlation among age, anthropometric measurements, blood pressure and nutrient intake

Correlation among age, anthropometric measurements, blood pressure and nutrient intake of the subjects is shown in Table 7. Age of the subjects was positively correlated with phosphorus intake ($r = 0.209$ at $p < 0.05$). DBP was positively correlated with calcium ($r = 0.181$ at $p < 0.05$) and iron intakes ($r = 0.222$ at $p < 0.05$), respectively.

6. Correlation among serum lipid levels

Correlation among serum lipid levels of the subjects is shown in Table 5. Serum TG level was positively correlated with total cholesterol ($r = 0.634$ at $p < 0.01$), HDL-C ($r = 0.462$ at $p < 0.01$), LDL-C ($r = 0.540$ at $p < 0.01$) and AI ($r = 0.312$ at $p < 0.01$), while negatively correlated with HDL-C/total cholesterol ($r = -0.382$ at $p < 0.01$). Total cholesterol level was positively correlated with HDL-C ($r = 0.886$ at $p < 0.01$), LDL-C ($r = 0.962$ at $p < 0.01$) and AI ($r = 0.312$ at $p < 0.01$), while negatively correlated with HDL-C/LDL-C ($r = -0.328$ at $p < 0.01$) and HDL-C/total cholesterol ($r = -0.279$ at $p < 0.01$). Serum HDL-C level was positively correlated with LDL-C ($r = 0.749$ at $p < 0.01$), HDL-C/LDL-C ($r = 0.500$ at $p < 0.01$) and HDL-C/total cholesterol ($r = 0.598$ at $p < 0.01$), while negatively correlated with AI ($r = -0.567$ at $p < 0.01$). Serum LDL-C level was negatively correlated with HDL-C/LDL-C ($r = -0.636$ at $p < 0.01$) and HDL-C/total cholesterol ($r = -0.568$ at $p <$

Table 5. Correlation coefficients between anthropometric data and nutrient intakes

	Age	Height	Weight	Body fat	BMI	RBW	Triceps skinfold thickness	Mid-upper arm circumference	Sub-scapular skinfold thickness	SBP[1]	DBP[2]	Waist	Hip	Waist/Hip ratio
Energy	.082	.010	-.064	-.155	-.069	-.067	-.067	-.012	-.053	-.064	.102	.019	-.113	.097
Protein	.148	-.058	-.019	.005	.024	.035	.085	.001	.072	-.093	.052	.042	-.064	.088
Fat	.099	-.072	-.089	-.110	-.039	-.017	-.028	.005	-.037	-.168	.015	.025	-.130	.120
Carbohydrate	.033	.005	-.060	-.149	-.063	-.060	-.097	-.039	-.038	-.029	.142	.023	-.084	.081
Calcium	.143	.110	-.022	-.168	-.086	-.098	-.135	-.023	-.078	.046	.181*	-.019	.007	-.034
Phosphorus	.209*[3]	.042	.013	-.054	-.004	-.009	-.052	.036	-.010	-.083	.090	.045	-.057	.087
Vitamin A	.074	-.057	.025	-.055	.067	.086	.001	.059	.130	-.032	.160	.087	-.025	.111
Vitamin B_1	.086	-.061	-.095	-.137	-.052	-.029	-.089	.002	-.042	-.093	.089	-.002	-.151	.102
Vitamin B_2	.025	.039	.008	-.048	-.010	-.015	.000	.048	.101	-.082	.051	.003	.009	-.005
Niacin	.133	-.119	-.065	-.078	.017	.051	-.119	-.027	.013	-.047	.103	.004	-.154	.112
Vitamin C	.097	-.043	-.003	.010	.024	.028	-.034	.043	.029	-.046	-.060	-.012	-.047	.014
Cholesterol	-.033	-.071	-.087	-.103	-.050	-.037	.040	-.043	-.095	-.041	.110	.007	-.092	.063
Iron	.035	.054	-.062	-.009	-.106	-.114	-.075	-.107	-.127	-.108	.222*	-.060	.021	-.083

1) SBP : systolic blood pressure 2) DBP : diastolic blood pressure 3) * : significant at $p < 0.05$

0.01), while positively correlated with AI ($r = 0.595$ at $p < 0.01$). HDL-C/LDL-C was positively correlated with HDL-C/total cholesterol ($r = 0.953$ at $p < 0.01$) and AI ($r = 0.970$ at $p < 0.01$). HDL-C/total cholesterol was negatively correlated with AI ($r = -0.970$ at $p < 0.01$).

7. Correlation between serum lipid levels and nutrient intake

Correlation between serum lipid levels and nutrient intake of the subjects is shown in Table 6. Fat intake was positively correlated with serum total cholesterol ($r = 0.199$ at $p < 0.05$) and HDL-C level ($r = 0.261$ at $p < 0.01$). Vitamin B_2 intake was positively correlated with TG ($r = 0.215$ at $p < 0.05$) and HDL-C/LDL-C ($r = 0.237$ at $p < 0.05$). However, there was no significant correlation between serum lipid levels and other nutrient intake in female university students.

Table 6. Correlation among serum lipid levels

	TG[1]	TC[2]	HDL-C[3]	LDL-C[4]	HDL-C/LDL-C[5]	HDL-C/TC[6]
TC	.634**[8]					
HDL-C	.462**	.886**				
LDL-C	.540**	.962**	.749**			
HDL-C/LDL-C	-.169	-.328**	.500**	-.636**		
HDL-C/TC	-.382**	-.279**	.598**	-.568**	.953**	
AI[7]	.312**	.312**	-.567**	.595**	.970**	-.970**

1) TG : triglyceride
2) TC : total cholesterol
3) HDL-C : HDL-cholesterol
4) LDL-C : LDL-cholesterol
5) HDL-C/LDL-C : HDL-cholesterol/LDL-cholesterol
6) HDL-C/TC : HDL-cholesterol/total cholesterol
7) AI : atherogenic index = (total cholesterol-HDL cholesterol)/HDL cholesterol
8) ** : significant at $p < 0.01$

Discussion

In this study, the average height, weight, body fat and BMI of female university students were 160.1cm, 54.3kg, 27.0% and 21.2kg/m^2, respectively. These results were similar to previous results showing that the average height, weight and BMI of female university students in Incheon were 162.0cm, 55.4kg and 19.9kg/m^2, respectively (Kwon, Chang 2001). The average height and weight of the subjects were similar to the Korean standard for age (female : height 161cm, weight 54kg) (Korean Nutrition Society 2000). The average BMI of the subjects was 21.2kg/m^2, which was in normal range according to classification of BMI, less than 18.5 underweight, 18.5 – 22.9 normal, 23.0 – 24.9 overweight, 25.0 – 29.9 obese I, 30.0 – 34.9 obese II, more than 35.0 obese III (Korean Society of Obesity 1999). In this study, the SBP and DBP of the subjects were 119.1mmHg and 72.3mmHg, respectively, which were similar to previous study conducted in Seoul (Lee, Song 1996). In a previous study conducted in Kyunggido, the SBP and DBP of female university students were 108.9mmHg and 69.6mmHg (Lee 1996), respectively, which were lower in comparison to those of this study. The waist to hip ratio which evaluates the tendency to deposit fat on the abdomen of the subjects was 0.74, which was in normal range. This value was lower in comparison to those of previous studies (Lee et al. 2001 ; Kim et al. 1999).

Table 7. Correlation between serum lipid levels and nutrient intake

	TG[1]	TC[2]	HDL-C[3]	LDL-C[4]	HDL/LDL[5]	HDL/TC[6]	AI[7]
Energy	.066	.171	.189	.151	.057	.049	-.027
Protein	-.015	.158	.188	.149	.034	.067	-.068
Fat	.082	.199*	.261**	.151	.170	.152	-.110
Carbohydrate	.100	.171	.143	.172	-.046	-.054	.059
Calcium	-.122	.029	.072	.032	.070	.089	-.047
Phosphorus	-.096	.070	.099	.075	.035	.058	-.033
Iron	.087	-.077	-.071	-.101	.094	.010	.008
Vitamin A	-.024	.068	.069	.075	-.019	-.001	-.002
Vitamin B_1	.079	.139	.145	.124	.031	.018	-.012
Vitamin B_2	.215*[8]	.084	.142	.008	.237*	.131	-.106
Niacin	.073	.133	.115	.132	-.011	-.027	.058
Vitamin C	.100	.113	.043	.136	-.130	-.130	.150
Cholesterol	.002	.029	.111	-.017	.165	.168	-.156

1) TG : triglyceride
2) TC : total cholesterol
3) HDL-C : HDL-cholesterol
4) LDL-C : LDL-cholesterol
5) HDL/LDL : HDL-cholesterol/LDL-cholesterol
6) HDL/TC : HDL-cholesterol/total cholesterol
7) AI : atherogenic index = (total cholesterol-HDL cholesterol)/HDL cholesterol
8) * : significant at $p < 0.05$, ** : significant at $p < 0.01$

In this study, the average serum TG, total cholesterol, HDL-C and LDL-C level of the subjects were 69.47mg/dl, 146.85mg/dl, 50.49mg/dl and 82.52mg/dl, respectively and these values were in normal range (Hong et al. 1993). In a previous study conducted in Seoul, the average serum TG, total cholesterol, HDL-C and LDL-C level of female university students were 72.0mg/dl, 183.6mg/dl, 64.3mg/dl and 104.8mg/dl, respectively (Lee, Song 1996), which were higher in comparison to those of this study. Also, the average serum TG, total cholesterol, HDL-C and LDL-C of the subjects in this study were higher and the average AI was lower compared to previous results (Hong et al. 1993). The average HDL-C/total cholesterol of the subjects was 0.29, which was similar to previous result on young healthy women (Park and Yu 1997).

In this study, the intake of protein, phosphorus, vitamin B_1 and C of the subjects was lower than the Korean RDA. Especially calcium and iron intakes were under the 65% of the Korean RDA. In a previous study of university students taking the health and diet course at Mokpo area, the intake of energy, calcium, iron and vitamin A of female university students was lower than the Korean RDA (Kim et al. 1999). In another study of female university students participating in a nutrition and health-related web class at a cyber university, the intake of energy, vitamin B_2, calcium and iron were lower than the Korean RDA (Cheong et al. 2001). The calcium and iron intakes are very important in women of child-bearing age. Therefore, nutrition education for proper intake of nutrients, especially calcium and iron, are necessary for female university students. On the other hand, the percentage of calories from carbohydrates : protein : lipid ratio was 59.4, 14.8, and 25.8. This ratio was similar to previous results on healthy female university students in Chungnam (Choi et al. 2001). However, the percentage of calories from protein was lower and that from fat was higher than that of the Korean RDA (Korean Nutrition Society 2000) which suggested 15% and 20%, respectively.

In this study, serum TG, total cholesterol and LDL-C level of the subjects were negatively correlated with DBP. In a previous study of Korean obese children, serum TG level was positively correlated with BMI, and HDL-C level was negatively correlated with waist circumference (Cheong et al. 2001). In a previous study conducted in Seoul, serum lipids level was positively correlated with DBP rather than SBP (Lee, Song 1996). Therefore, these results showed the DBP influences on serum total cholesterol and TG levels. In another study of university students conducted in Seoul, serum total cholesterol and TG levels showed positive correlation with Kassura Index and BMI. Serum HDL-C level was negatively correlated with weight/height, BMI, lean body mass and total body water. LDL-C level was positively correlated with percent of body fat and BMI (Lee, Song 1996). In a previous study conducted in Incheon, serum TG level of female university students was positively correlated with weight, central fat and peripheral fat (Lee, Lee 1993). These results showed that there is a correlation between blood lipid levels and weight, BMI increased and cardiovascular risk factors. In a previous study conducted at Hoseo university, HDL-C level of female university students was negatively correlated with arm fat area and BMI (Park, Yu 1997).

In this study, serum TG and total cholesterol levels were positively correlated with serum total cholesterol, HDL-C, LDL-C and AI, while negatively correlated with HDL-C/total cholesterol. These results were similar to those of previous study (Lee, Song 1996). In a previous study conducted in Seoul, serum TG level of male and female university students was negatively correlated with LDL-C and HDL-C/total cholesterol, while positively correlated with AI (Lee, Song 1996). However, in previous study conducted in Ulsan, serum total cholesterol was not correlated with LDL-C nor HDL-C/total cholesterol (Hong et al. 1993). Serum HDL-C level was positively correlated with LDL-C, HDL-C/LDL-C and HDL-C/total cholesterol, while negatively correlated with AI. These results were similar to those of a previous study showing that HDL-C level was positively correlated with HDL-C/total cholesterol (Lee, Song 1996). On the other hand, serum LDL-C level was negatively correlated with HDL-C/LDL-C and HDL-C/total cholesterol, while positively correlated with AI, which was similar to the result of a previous study (Lee, Song 1996).

In this study, fat intake of the subjects was positively correlated with serum total cholesterol and HDL-C levels. These results were similar to that of previous study conducted at Hoseo university showing that fat intake of young healthy women slightly influenced serum cholesterol levels (Park, Yu 1997). Also, it was reported that myristic acid intake was positively correlated with serum total cholesterol and LDL-C levels, and polyunsaturated fatty acid intake was negatively correlated with serum total cholesterol levels (Park, Yu 1997). The previous study in Kyungsangdo showed that energy and

the percentage of total energy from carbohydrate in vegetarians were positively correlated with TG levels. These results showed that carbohydrate intake was positively correlated with serum TG levels, and fat intake, especially animal fat, saturated fatty acid intake was positively correlated with serum total cholesterol and LDL-C levels. The intake of crude fiber was negatively correlated with total cholesterol and AI, and the percentage of total energy from fat in vegetarians was positively correlated with AI (Cha 2001). The previous study in the United States showed that the high-fiber diet reduced total cholesterol, LDL-C : HDL-C by hyperlipidemic subjects in a randomly controlled crossover trial (Jenkins et al. 2002). These results showed that the intakes of fruit and vegetables containing the crude fiber maybe effective in making the level of the risk factors causing in cardiovascular disease to be lower. Vitamin B_2 intake was positively correlated with serum TG and HDL-C/LDL-C ratio, which was similar to the result of previous study conducted in Chungnam. It was known that vitamin B_1 and B_2 were coenzyme of carbohydrate, protein and fat metabolism (Choi et al 2001). For this reason, it is considered that vitamin B_2 intake was positively correlated with serum TG levels. In a previous study conducted in Ulsan, vitamin A intake by female university students was positively correlated with TG, total cholesterol and LDL-C level. Also vitamin A and C intakes were negatively corre-lated with HDL-C levels (Hong et al. 1993). It was reported that the lowering of dietary fat component from 21% to 15% of energy intake seems to be an effective way to reduce blood cholesterol and TG levels without decreasing HDL-C level (Hwang et al. 1999). Also it was reported that availability of food with a low fat content (e.g. low-fat milk) and new recipes along with nutrition education has decreased fat consumption in the United States (Park 1996). Therefore, it is important for female university students to reduce the risk of cardiovascular disease by optimal nutrient intake through restriction, of dietary fat, especially animal fat and an increase of vitamins, minerals and dietary fiber.

In a previous study conducted in Incheon, height of female university students was positively correlated with energy, carbohydrate, protein, fat and vitamin B_2 intakes (Kwon, Chang 2001). Also, in another study of university students participating in a web class, the height of female university students was negatively correlated with vitamin B_2 and C intakes. The weight of female university students was negatively correlated with vitamin C and niacin intakes (Cheong et al. 2001). In a previous study from 1989 Continuing Survey of Food Intakes by Individuals (CSFII), the age of the healthy people was negatively correlated with total fat, saturated fatty acid and monounsaturated fatty acid, but positively correlated with fiber (Park 1996). In this study, DBP of the subjects was positively correlated with calcium and iron intakes. It was a small study that calcium, zinc, copper and iron were related to blood pressure and serum lipid level (Carlson et al 1971). Therefore, it may be suggested that female university students need proper nutritional education programs so that they would choose the foods containing low saturated fatty acid and cholesterol and maintain normal weight for staying the healthy.

Summary and Conclusion

In order to investigate the relationship among the anthropometric measurements, nutrient intake and serum lipid levels in Korean female university students, a cross-sectional study was carried out from April 1 to 15, 2000. The subjects were 150 female students at a university located in Incheon. For statistical analysis, 119 well-completed questionnaires were used. The results are as follows :

1) The average age, height and weight of the subjects were 20.9 years, 160.1cm and 54.3kg, respectively.

2) The average serum TG, total cholesterol, HDL-C and LDL-C levels of the subjects were 69.4mg/dl, 146.9mg/dl, 50.5mg/dl and 82.5mg/dl, respectively and these values were in normal range.

3) Nutrient intake of the subjects except protein, phosphorus, vitamin B_1 and C were lower than the Korean RDA. Especially, calcium and iron intakes were under the 65% of the Korean RDA.

4) Serum TG level was negatively correlated with age and DBP. Total cholesterol and LDL-C levels were negatively correlated with DBP.

5) Age of the subjects was positively correlated with phosphorus intake. DBP was positively correlated with calcium and iron intakes.

6) Serum TG level was positively correlated with total cholesterol, HDL-C, LDL-C and AI, while negatively correlated with HDL-C/total cholesterol. Total cholesterol level was positively correlated with HDL-C, LDL-C and AI, while negatively correlated with HDL-C/LDL-C and HDL-C/total

cholesterol. HDL-C level was positively correlated with LDL-C, HDL-C/LDL-C and HDL-C/total cholesterol. However, HDL-C level was negatively correlated with AI. LDL-C level was negatively correlated with HDL-C/LDL-C and HDL-C/total cholesterol, while positively correlated with AI.

7) Fat intake of the subjects was positively correlated with serum total cholesterol and HDL-C level. Vitamin B_2 intake was positively correlated with TG and HDL-C/LDL-C.

This study showed that there is a correlation among anthropometric measurements, serum lipid levels and nutrient intake in female university students. Therefore, a nutritional education program is necessary for female university students to maintain the optimum blood lipid levels and to reduce cardiovascular risk factors.

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