Studies on Body Fat Ratio and Nutrient Intakes of College Students

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The aim of this study researchs status of the nutrient intake between male and female students and the nutrient intake by BMI. This study was done to investigate the body composition and nutrient intakes of 340 college students (170 males, 170 females) in Gyeonggi area. Weight, height, BMI, and blood pressure of these college students were measured. Nutrient intake was assessed using the 24-hour recall method, and then calculated using the nutritional evaluation program [CAN Pro 2.0 professional (Korean Nutrition Society, 2002)]. Average height and weight were 176±5.1 cm, 70.60±1.1 kg in male students and 162.2±4.5 cm, 54.4±7.7 kg in female students respectively. Subjects were divided into three groups by BMI: underweight (less than 18.5), normal weight (18.5 to less than 23), and overweight (more than 23). The ratios of male and female subjects among these groups were 5.3% and 17.6% in underweight, 50% and 65.3% in normal weight, and 44.7% and 17.2% in overweight. Systolic and diastolic blood pressures were 124.0±1.5 mmHg and 76.1±14.8 mmHg in males and 110.1±12.9 mmHg and 70.1±10.8 mmHg in females, all in the normal range. Using nutrient values of the 7th Recommended Dietary Allowances, the nutrient intake was calculated to Korean RDA (%). Nutrients below 75% Korean RDA were Calcium, Vitamin B_2, and Folate and nutrients above 100% RDA were Protein, Fe, Phosphorous, and Vitamin B_6. BMI showed positive correlations with body fat (%)(p<0.01) and WHR (p<0.01). Nutritional education is desirable for the improvement of dietary behaviors, body composition and nutrient intake of college students.

Key words: Nutrient intake, Blood pressure, Body fat ratio

INTRODUCTION

Recently, the overall dietary life has been greatly changed as the economic development and the westernization in the country accelerated. Accordingly, the developmental pattern of many chronic diseases related to dietary behavior has been changed[1] and the social interest on the health promotion by nutritional improvement has been increased.

In particular, the incident of obesity has been increased every year and the metabolic disorder from the relationship between obesity and chronic diseases has been known as closely related not only to the degree of obesity but also to the anatomical distribution of body fats.[2] Also, some studies reported that the abdominal obesity was positively related to systolic blood pressure[3] and hyperlipidemia.[4,5] Particularly increased the risk for cardiovascular diseases and metabolic syndromes such as hypertension, diabetes, and the current dietary life is much more abundant when compared to the past, but serious problems such as obesity and other chronic diseases have been increased. The establishment of proper dietary habits is greatly college students who are in the vulnerable

situation of irregular dietary habits.[6] Adolescence including college life is a phase of the life cycle with active physical and mental growth, in which the nutritional status greatly affects the health of the lifetime in addition to the growth and development.[7,8] Nevertheless, today's college students are not interested in health because of the idea that they are young and healthy[9] and also the value for the importance of dietary habits is not properly established,[10] resulting in rather serious situations. The consumption of a well balanced nutritional diet is essential for the maintenance of healthy body and mind and the prevention of diseases, for which the distribution of nutrition knowledge through nutritional education and the application of nutrition information are required. Results from this study can research the status of the nutrient intake of the college students and status of the nutrient intake by BMI, also understand the problems of the dietary behaviors and provide the needed basic resource which is about nutrition and health education of the subject of college students.

SUBJECTS AND METHODS

1. Subjects

A total of 340 healthy college students (170 males and

170 females) in Gyeonggi area participated in this study. The survey was performed between June 7 and June 14 of 2004.

2. Data Collection and Processing

Anthropometry & Body Fat Content
Body fat content was measured with TANITA(BC418) using Bioelectrical Impedance Fatness Analysis.

Obesity Measurements
BMI values were used that were calculated after the input of height and weight of subjects into TANITA (BC418). Bodyfat distribution was assessed by calculating the waist-hip ratio (WHR) with waist circumference and hip circumference of subjects directly measured by trained survey assistants using a tape measure.

Nutrient Intake & Food Consumption
Food consumption of the previous day was recorded as a visually-measured quantity by using the 24-hour recall method and converted to the weight scale, and then the nutrient intake was analyzed by using the food composition table. Nutrient intakes were calculated by using a nutritional evaluation program [CAN Pro 2.0 professional (Korean Nutrition Society, 2002): Computer Aided Nutritional Analysis Program for Professionals].

Blood Pressure Measurement
Systolic blood pressure and diastolic blood pressure in the sitting position were measured by using an electronic automatic blood pressure monitor (OMRON, Digital blood pressure monitor: HEM-705C) after a subject was sitting for over 5 minutes in comfortable condition.[11]

3. Statistical Analysis
All data was analyzed by using SPSS (Version 11.0). The mean and standard deviation for all values in male and female subjects were obtained and the X^2-test was performed for the verification of significance. Also, the t-test and ANOVA test were performed to compare the difference between male subjects and female subjects. Pearson's correlation coefficient was obtained for the correlation analysis among the factors.

RESULTS AND DISCUSSION

1. General Characteristics of the Subjects
General characteristics of subjects are shown in Table 1. The age distribution was the highest in the range of 19-20 years old, Drinking of 84.7% males and 78.2% females, Smoking of 33.5% males and 4.7%, and exercise 94.7% males and 79.4% females.

Table 1. General characteristics of subjects.

n (%)

	Male	Female	X^2
Age			
≥18	17(10.0)	18(10.6)	
19-20	59(34.7)	60(35.6)	
21-22	23(13.5)	47(27.6)	0.152**
23-24	34(20.0)	21(12.4)	
≤25	37(21.8)	24(14.1)	
Drinking			
Yes	144(84.7)	133(78.2)	0.125*
No	26(15.3)	37(21.8)	
Smoking			
Yes	57(33.5)	8(4.7)	<0.001***
No	113(66.4)	162(95.3)	
Exercise			
Yes	161(94.7)	135(79.4)	<0.001***
No	9(5.3)	35(20.6)	
Total	170(100.0)	170(100.0)	

2. Anthropometric Characteristics

Body Composition
The average height of subjects was 176.0±5.1 cm in males and 162.2±4.5 cm in females. The average body mass index (BMI) was 22.8 kg/m^2 in males and 20.7 kg/m^2 in females, showing higher BMI values in male students.

Yim[12] reported similar results in which male students had the average BMI of 22.1 kg/m^2, but Lee & Choi[13] reported results which are more higher : male students 21.3 kg/m^2 and female students 20.5 kg/m^2.

Fat-free mass(FFM) was higher in males than in females, and the body fat contents by body parts such as arms, legs, and trunk was higher in females than in males(Table 2).

Table 2. Anthropometric characteristics of subject

	Male	Female	p-value
Height (cm)	176.02±5.18	162.28±4.54	
Weight (kg)	70.60±10.98	54.40±7.72	
BMI[2]	22.84±30.12	20.71±2.59	
Obesity index	3.11±13.47	2.91±11.82	
Body fat (%)	18.12±5.59	27.91±5.22	
FFM[3] (%)	57.49±6.09	39.02±3.66	<0.001***[1]
Right leg (%)	19.07±5.03	30.65±4.49	
Left leg (%)	18.70±5.08	30.84±4.43	
Right arm (%)	13.36±5.42	21.43±6.08	
Left arm (%)	14.06±5.32	22.73±6.26	
Trunk (%)	18.53±6.15	27.02±6.03	

Value are Mean±SEM
1) p<0.001 by Student's t-test
2) Body mass index (kg/m^2)
3) Fat free mass

Body Mass Index (BMI) Measurements

Because the BMI standard is designated by the WHO gave much smaller numbers of subjects in the overweight group when compared with the normal weight group, the BMI in this study was re-grouped as underweight with below 18.5 kg/m², normal weight with the range of 18.5~23 kg/m², and overweight with above 23 kg/m². The percent of male and female subjects in each group was 5.3% and 17.6%in the underweight group, 50% and 65.3% in the normal weight group, and 44.7% and 17.2% in the overweight group (Table 3).

Table 3. BMI of subjects by sex

(%)

BMI[1]	Male	Female	Total
>18.5 Underweight	17.90±0.16(5.3) (n=9)	17.67±0.76(17.6) (n=30)	17.72±0.11(11.5) (n=39)
18.5~22.9 Normal weight	21.0±1.13(50.0) (n=85)	20.36±1.11(65.3) (n=111)	20.64±0.08(57.6) (n=196)
23≤ Overweight	25.49±2.58(44.7) (n=76)	25.20±1.95(17.2) (n=29)	25.41±0.23(30.9) (n=105)
Total	n=170	n=170	n=340

Value are Mean±SEM
1) Body mass index (kg/m²)

Body Fat Distribution

According to the waist-hip ratio (WHR) by BMI, female took results more than men both in the normal weight group and in the overweight group.

The waist circumference by BMI showed that most of the male and female subjects were in the normal range, and the value of males was slightly higher than that of females (Table 4).

Table 4. Distribution of WHR and waist of subjects by sex and BMI

(n)

		Male	Female
		WHR	
		≥0.9	≥0.8
BMI	Underweight		0.84±0.64 (n=2)
	Normal weight	0.91 (n=1)	0.83±0.03 (n=14)
	Over weight	0.92±0.02 (n=6)	0.84±0.03 (n=12)

		Waist			
		<90 cm	≥90 cm	<80 cm	≥80 cm
BMI	Underweight	71.61±4.30 (n=9)		62.87±3.19 (n=30)	
	Normal weight	75.89±4.10 (n=85)		69.10±4.16 (n=108)	88.50±7.86 (n=3)
	Over weight	82.32±1.46 (n=60)	96.50±4.50 (n=16)	72.88±4.71 (n=17)	85.92±5.45 (n=12)

Value are Mean±SEM

Blood Pressure Measurement

Systolic and diastolic pressures were measured according to gender and blood pressure ranges such as hypotension, normal blood pressure, and hypertension. Systolic pressures in male subjects was 107.37±25.50 mmHg (n=59) in hypotension group, 129.49±4.96 mmHg (n=89) in normal blood pressure group, and 146.41±5.92 mmHg (n=22) in hypertension group, showing that most values were measured within the normal range.

Systolic pressure in female subjects was 106.92±11.40 mmHg (n=142) in hypotension group, 126.43±5.07 mmHg (n=28) in normal blood pressure group, but nothing in hypertension group, showing higher ratio of hypotension (Table 5).

The diastolic pressure showed different results when compared with the systolic pressure, in which the diastolic pressure of 69.37±13.06 (n=111) in males of the hypotension group was considerably higher. In female subjects, the diastolic pressure of 93.29±6.13 mmHg (n=107) was measured in the hypertension group, which did not show the measurable systolic pressure. Also, the correlations among systolic and diastolic blood pressures

Table 5. Blood pressure by sex

(n)

	Male	Female	Total
	Systolic pressure (mmHg)		
Hypotension	107.37±25.50 (n=59)	106.92±11.40 (n=142)	107.05±16.74 (n=201)
Normal	129.49±4.96 (n=89)	126.43± 5.07 (n=28)	128.76±5.14 (n=117)
Hypertension	146.41±5.92 (n=22)		146.41±5.92 (n=22)
	Diastolic pressure (mmHg)		
Hypotension	69.37±13.06 (n=111)	67.66±9.03 (n=80)	68.39±10.94 (n=261)
Normal	85.18±2.45 (n=39)	84.54±3.18 (n=89)	85.02±2.63 (n=52)
Hypertension	95.30±4.09 (n=20)	93.29±6.13 (n=107)	94.78±4.66 (n=27)

Value are Mean±SEM

Table 6. Correlation coefficients between blood pressure and body fat composition of subjects index

(mmHg)

	Systolic pressure	Diastolic pressure
BMI[2]	.248**	.233**[1]
FAT[3]	-.155**	-.025
Obesity Index	.214**	.223**
WHR[4]	.245**	.182**
Trunk	-.108*	.010

1) Significantly different at p<0.01
2) Body mass index (kg/m²)
3) Body fat (%)
4) Waist to Hip ratio

and body fat content, BMI, and WHR showed positive correlations at the level of p<0.01, and negative correlations between the fat content and the systolic blood pressure (Table 6).

3. Nutrient Intake

Nutrient Intakes of Male and Female Subjects

Nutrient intakes of male and female subjects were assessed by using the Korean RDA (%). In male subjects, nutrients above 100% RDA were protein, phosphorus, iron, vitamin B_1, vitamin B_6, niacin, and vitamin E, among which phosphorus and iron, vitamin E were over 125% (Table 7).

In female subjects, nutrients above 100% RDA were protein, phosphorus, and vitamin B_6, without any nutrient over 125%. The intake of most nutrients showed over 75% RDA, but calcium, vitamin B_2, and folate were below 75% RDA. In female subjects, nutrients above 100% RDA were protein, phosphorus, and vitamin B_6, without any nutrient over 125%. The intake of most nutrients showed over 75% RDA, but calcium, vitamin B_2, and folate were below 75% RDA.

Also, the Korean National Health and Nutrition Survey (2001) as well as this study reported that nutrients consumed below RDA levels were calcium (male, 78.6±41.3% RDA : female, 63.6±36.4% RDA), folate, and vitamin B_2.

The result of nutrient intake in this study showed that the most seriously lacked nutrient was calcium, with 78% in male students and 63% in female students. Iron intake was sufficient as 166% in males, but much lower as 69% in females. The intake of vitamin A was 99% in males and 87% in females, showing rather satisfactory values. In case of vitamin B_2, the intake was low as 78% in males and 71%in females. Vitamin C intake was 96% in males and 89% in females. The condition of protein intake was reported as quantitatively sufficient in other previous studies with college students.[14]

Nutrient Intake by BMI

Nutrient intake was examined by dividing subjects into three groups of overweight, normal weight, and underweight. In male subjects (Fig. 1), the overweight group showed generally higher nutrient intakes, and particularly the vitamin E intake was higher than other two groups.

The intake of vitamin A, vitamin B_1, vitamin C, and folate in the normal weight group was higher than those in the underweight group and the overweight group. In female subjects (Fig. 2), the overall nutrient intake in the overweight group was higher as in the case of male subjects. Also, the overweight group showed higher intakes of niacin, vitamin C, and folate than the normal weight group. The underweight group showed higher intake of iron and vitamin A and the normal weight

Table 7. The percent of RDA of nutrient intakes by sex

Nutrient	Male	Female	Total	p-value
Energy (kcal)	95.0 ±35.7[1]	77.22±31.65	86.15±34.88	<.0.001***
Protein (g)	143.42±65.82	105.23±45.49	124.32±59.64	<.0.001***
Calcium (mg)	78.69±41.34	63.59±36.39	71.14±39.61	0.002**
Phosphorus (mg)	144.18±71.18	105.53±44.72	124.86±62.43	<.0.001***
Iron (mg)	166.82±109.37	69.13±36.26	117.98±94.93	<.0.001***
Zinc (mg)	83.85±38.28	68.45±29.47	76.15±34.96	0.003**
Vitamin A (µgRE)	99.79±81.62	87.69±60.48	93.75±71.98	0.442
Vitamin B_1 (mg)	119.15±67.09	94.81±53.18	106.99±61.67	0.002**
Vitamin B_2 (mg)	78.82±47.30	71.18±39.54	75.00±43.70	0.308
Vitamin B_6 (mg)	131.54±5.53	108.10±4.15	124.82±3.57	<.0.001***
Niacin (mg)	107.89±73.99	90.11±46.83	99.01±62.47	0.017**
Vitamin C (mg)	96.17±77.06	89.22±59.04	92.70±68.65	0.368
Folate (µg)	80.48±46.72	71.00±36.57	75.74±42.16	0.232
Vitamin E (mg)	156.76±124.23	93.09±70.06	124.93±90.04	<.0.001***

Value are Mean±SEM
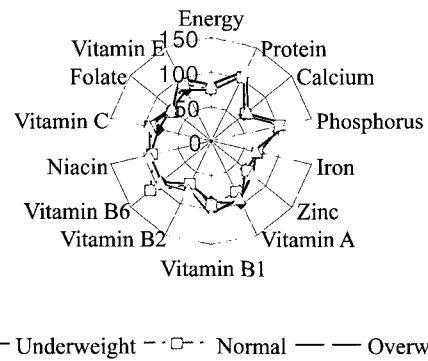*.**.***: Significantly different between male and female by the ANOVA test at p<0.05, p<0.01, p<0.001.

Fig. 1 The percent RDA value of nutient intakes for male by BMI group.
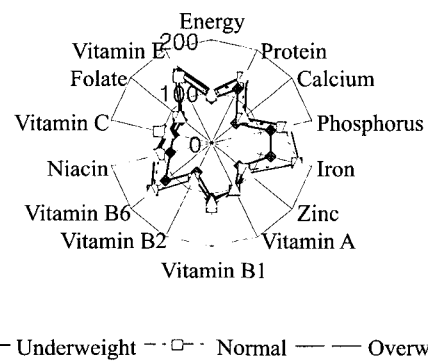

Fig. 2 The percent RDA value of nutient intakes for female by BMI group.

group had higher vitamin B_6 intake but lower folate intake than other groups. The results in this study were consistent with other studies including Lee[15] in which higher BMI increased the nutrient intake in most nutrients.

SUMMARY AND CONCLUSIONS

The body mass index(BMI) was 22.8 kg/m^2 in males and 20.7 kg/m^2 in females, showing higher BMI values in males tan in females. The body fat content by body parts such as arms, legs, and trunk was higher than the normal range in females. The correlation between body composition and anthropometric measurements showed that the positive correlation coefficient was obtained among obesity index and waist-hip ratio, BMI, waist circumference, and hip circumference as the weight increased.

According to the waist-hip ratio by BMI, female took results more than males both in the normal weight group and in the overweight group.

Most subjects were in the normal range, and male subjects showed higher ratio of abdominal obesity on the basis of waist circumference. The average systolic and diastolic blood pressures in male and female subjects were 117.05±18.41 mmHg and 73.03±13.07 mmHg, respectively, which were in the normal range designated by the WHO. The positive correlation was observed among blood pressures and body fat content, BMI, WHR, and abdominal obesity at the level of $p<0.01$. In male subjects, nutrients above 100% RDA were protein, phosphorus, iron, vitamin B_1, vitamin B_6, niacin, and vitamin E. In female subjects, nutrients above 100% RDA were protein, phosphorus, and vitamin B_6. The intake of most nutrients showed over 75% RDA, but calcium, vitamin B_2, and folate were below 75% RDA.

Males are more sufficient nutrient intake than females. There were positive correlations between body com position and anthropometric measurement, BMI and nutrient intake, and blood pressures and abdominal obesity, showing the close association of these factors to obesity. Also, the nutrient intake by RDA% showed that the nutritional intake of subjects participated in this study was not well balanced.

Based on the results of this study, it is considered that nutritional education is needed for the improvement of undesirable dietary habits in college students and also this kind of study should be continued in the future by expanding the subject to all age groups to confront the current situation of increasing chronic diseases due to obesity.

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