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Anthropometric Data, Nutrient Intakes and Food Sources in Overweight and Obese Korean Adult Women

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ABSTRACT

This study was conducted to investigate the dietary intake, anthropometric data, and association between two factors and main food sources contributing macronutrients for overweight and obese females. Subjects were 85 adult females (overweight : 28, obese : 57) where mean age was 38.7y. The results are summarized as follows. Mean fat percent, BMI, obesity rate were 29.3, 23.9 and 15.1%, respectively for overweight women and 32.7, 28.3, 36.4%, respectively for obese women. There were significant differences for most of the anthropometric data between groups. Fat percent for all subjects was significantly correlated with weight, waist circumference, hip circumference, mid arm circumference or skinfold thickness for the triceps, subscapular and suprailiac ($p < 0.001$). The parameter which showed the highest correlation coefficient ($r = 0.6156$) with fat percentage was the waist to hip ratio. Any significant differences were not found in dietary intake of nutrients or in diet composition between groups. The mean energy intake was 2090.1kcal (104% of RDA) for overweight women and 2113.0kcal (106% of RDA) for obese women. PFC ratio for overweight was 17 : 24 : 59 and 18 : 23 : 58 for obese subjects, which can be regarded as higher fat and lower carbohydrate percentages compared to recommended PFC ratio (15 : 20 : 65). 4) Fat intake was positively correlated ($r = 0.2301$, $p < 0.05$) with the triceps skinfold thickness, protein intake was also positively correlated with waist circumference ($r = 0.2668$, $p < 0.05$) or fat weight ($r = 0.2406$, $p < 0.05$). 5) The main food items that contributed to energy intake for overweight or obese subjects were similar (rice, pork, bread, grapes, barley) except corn oil in overweight or instant noodle for obese group. The subjects in this study were taking less energy from rice and more energy from pork and bread than women from 98 National Health and Nutrition Survey. Because there were no significant differences of dietary data between overweight and obese group, further investigation considering basal metabolic rate or activity would be needed. (*J Community Nutrition* 4(1) : 12~21, 2002)

KEY WORDS : overweight · obesity · adult women · anthropometric data · nutrient intake · food source.

Introduction

Obesity is regarded as the number one cause of problems associated with many chronic disease and the occurrence rate of obesity is rapidly increasing in Korea.

The '98 National Health and Nutrition Survey report (Ministry of Health and Welfare : MHW 1999) showed that 22.8% of Koreans was estimated as obese based on BMI (≥ 25), which is an increase of 2.3% compared to that of the '95 National Nutrition Survey.

Overweight is an increase of body weight above a standard defined in relation to height. Obesity, on the other hand, is an abnormally high percentage of body fat, which may be generalized or localized (International Life Science Institute : ILSI 1990). Both the extent of being overweight and fat distribution may be useful predictors of health risk associated with obesity (Bray 1985 ; Hub 1990). The increase in obesity rate appears to be more apparent in adult women residing in the city than women residing in the country side (National Promotion Movement for Good Diet : NPMGD 1989). Obesity is a problem of nutrient imbalance. More food stuffs are stored as fat than are used for energy and metabolism (ILSI 1990).

Studies of energy and nutrient intakes of overweight or

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obese subjects have shown inconsistent results. Many studies showed that the mean caloric intake was less in the obese group (Cheong et al. 1997 ; Kromhout, 1983 ; Son & Lee 1997) or was not significantly different (Kim 1999 ; Huh 1990) especially for females. It was reported that diet composition is more important than actual caloric intake. People who eat high fat diets tend to store body fat more efficiently (Bennett 1992). The dietary fat influences body fat independently of total energy intake (Prewitt et al. 1991). Another study suggested that protein intake is conducive to obesity, neither carbohydrates nor saturated fat or monounsaturated fat are likely to play a major role in increasing BMI (Trichopoulou et al. 2002). Karczewski et al. (2001) suggested that overweight or obesity can be caused by a disturbed proportion in the consumption of the major food components. In addition to dietary factors, environmental factors like age, employment status, family type and food frequency score were significant factors associated with obesity (Kim 1997). Osler et al. (2001) showed an inconsistent relation between food intake pattern and obesity. There were several studies which showed a relationship of obesity and dietary or anthropometric data in children or adolescents (Cheong et al. 1997 ; Lee et al. 1996 ; Son & Lee 1997) but we still need more studies about adults women. In this study, the aim was to investigate the dietary intake, and anthropometric measurements and the association between the two factors for obese or overweight adult women.

Subjects and Method

1. Subjects

Subjects were 85 adult females aged 20 − 50 years, who participated in the weight reduction program at The Catholic University of Korea in August, 1998.

The subjects were identified into one of two groups according to the percent of ideal body weight (PIBW), overweight (PIBW ; 110 − 119%) or obese (PIBW > 120%) group. Twenty eight subjects were estimated as overweight and 57 as obese. Trained interviewers asked subjects about their age, number of family members, family income per month or if they have obese family members. Anthropometric measurements and dietary recall were conducted before the weight reduction program.

2. Anthropometric measurements

The subjects were measured wearing light clothes. Height was measured to the nearest 0.1cm by using a linear height scale and weight was measured to the nearest 0.2kg by using an electronic weight scale.

Skinfold thickness was measured on the right side of the body with a caliper (fat caliper, JAMAR). Triceps skinfold thickness measurement was done on the posterior midline of the right upper arm. Subscapular skinfold thickness was measured 1cm below the lowest angle of the scapula and suprailiac skinfold thickness above the iliac crest at midaxillary line. Three measurements were taken at each site and the average of the measurements was used. If consecutive measurements varied by more than 1mm, more were taken until there was consistency.

Circumferences were measured for mid arm, waist and hip. Mid arm circumference (MAC) was measured around the upper arm at the triceps skinfold site.

The waist circumference was measured at the most narrow area below the rib cage and the hip circumference at the point of the greatest circumference around the hips with the subject standing. A flexible, nonstretchable tape was used.

Fat percent was measured with bio-electrical impedance fatness analyzer (Gilwoo Trading, GIF-891, 1994). Systolic and diastolic blood pressures were measured with sphygmomanometer after 10 hours of fasting.

3. Dietary assessment

Twenty four hour food records were taken for two consecutive days and twenty four hour recall was used for the third day to estimate the food consumption. The average daily nutrient intakes were calculated by using a computerized data analysis program based on Fox Program. The main food items that contributed mainly to supplying energy, carbohydrate, protein and fat were also analyzed.

4. Statistical analysis

Data was expressed as mean and standard deviation. The data for categorical variable was expressed as frequency and percent. A t-test was used to compare mean differences between overweight and obese groups. Pearson's correlation coefficient was used to estimate the relationship between the variables.

Results and Discussion

1. General characteristics of subjects

The range of age was 20 − 50 years. The mean age of the

overweight subjects was 36.3 and 39.8 for obese subjects. The mean age of obese subjects was significantly higher than that of overweight subjects (Table 1).

Mean monthly income per family in the overweight group was 1,780,000 won and 2,070,000 won in the obese group. Mean income for the overweight group was less than 2,152,700 won published by Statistical Institute (1997) as mean family income of urban workers.

Mean number of family members was 3.9 and 4.0. Sixty four percent and 63.2% of the subjects for each group responded that they have obese family members. Family studies showed that obesity runs in families, but they do not critically separate environmental factors (Bray 1976). It was reported that two-thirds of the variability of BMI was attributed to genetic factors (Stunkard et al. 1986).

2. Anthropometry

Table 2 shows mean anthropometric indices of the subjects. Body weight, fat percentage, BMI were significantly different between the two groups, except height. Overweight subjects had a mean height of 157.4 ± 4.7cm, body weight of 59.3 ± 4.1kg and obese subjects 157.1 ± 5.0, 70.1 ± 8.7kg, respectively.

Mean height of the overweight or obese group was slightly lower than the mean height (158.0 ± 5.2cm) of the subjects aged 30 − 39 from the National Health and Nutrition survey II (NHNS II) (MHW 1999). The mean weight of the overweight group was higher than the value of the 50th percentile (56.3kg). For the obese group, it was near to the 95th percentile of NHNS II value (71.3kg).

Mean BMI of the overweight and obese groups was 23.9 ± 0.7, 28.3 ± 2.8, respectively. BMI of the overweight group was lower than that of the overweight group from Yeon Chun area (Park & Kim 1993) and higher than 21.6 ± 1.3 of the normal group (Cha 1992). BMI of the obese group was higher than 26.9 ± 1.7 reported by Lee et al. (1995).

Recently KSSO (Korean Society for the Study of Obesity 2000) decreased the reference value indicative of obesity as BMI ≥ 25 and overweight as 23 ≤ BMI < 25. All of the overweight subjects were included in the criteria of 23 ≤ BMI < 25 and all of the obese subjects showed more than ≥ 25kg/m^2. The proportion of overweight or obesity using PIBW criteria was in agreement with that using BMI. Above BMI 25 mortality and morbidity slowly increased (Lee & Nieman, 1996) and a BMI ≥ 27 is associated with increased risk of health problems such as heart disease, high blood pressure, and diabetes (Gibson 1990). About 62% of the subjects from the obese group were observed as having BMI ≥ 27 (Table 3).

The mean fat percentage of the overweight group was 29.3% and 32.7% obese group, respectively. About 11% of the subjects in the overweight group were estimated as normal when assessed with body fat percentage (< 25%).

Subjects with high fat percentage (≥ 30%) were spread

Table 1. General characteristics of the subjects N(%)

Characteristics	Criteria	Overweight (n = 28)	Obesity (n = 57)	Total (n = 85)
Age (yr)	20< <40	19(67.9)	28(49.1)	47(55.3)
	40 ≤ <60	99(32.1)	29(50.9)	38(44.7)
	Mean	36.3 ± 7.3	39.8 ± 7.6*	38.7 ± 7.7
Family members	≤ 3	8(28.6)	12(21.1)	20(23.5)
	4	13(46.4)	33(57.9)	46(54.1)
	≥ 5	7(25.0)	12(21.0)	19(22.3)
	Mean	3.9 ± 1.09	4.0 ± 0.83	4.0 ± 0.92
Family	<100	2(7.1)	6(10.5)	8(9.4)
Income / month	100 ≤ <150	12(42.9)	15(26.3)	27(31.8)
	151 ≤ <200	11(39.3)	16(28.1)	37(31.8)
	≥ 201	3(10.7)	20(35.0)	23(27.1)
	Mean	178 ± 70.8	207 ± 80.8	197 ± 78.3
Having obese	Yes	18(64.3)	36(63.2)	54(63.5)
Family members	No	9(32.1)	17(29.8)	26(30.6)
	No answer	1(3.6)	4(7.0)	5(5.9)

* : $p<0.05$

Table 2. Mean anthropometric indices of the subjects

Variables	Overweight (N = 28)	Obesity (N = 57)	Total (N = 85)
Height (cm)	157.4 ± 4.7[1)]	157.1 ± 5.0	157.2 ± 4.9
Weight (kg)	59.3 ± 4.1	70.1 ± 8.7***	66.5 ± 9.1
Fat%	29.3 ± 3.4	32.7 ± 3.6***	31.6 ± 3.8
Fat Weight (kg)	17.4 ± 2.3	23.5 ± 5.1***	21.5 ± 5.3
BMI (kg / m^2)[2)]	23.9 ± 0.7	28.3 ± 2.8***	26.9 ± 3.1
PIBW (%)[3)]	115.1 ± 4.6	136.4 ± 13.3***	129.4 ± 15.1
SBP (mmHg)[4)]	102.6 ± 12.3	112.6 ± 17.7**	109.4 ± 16.7
DBP (mmHg)[5)]	68.1 ± 8.8	74.7 ± 11.7**	72.6 ± 11.2

1) Mean ± S.D
2) BMI : Body mass index (kg / m^2) = Body weight (kg) / Height (m^2)
3) PIBW : Percent ideal body weihgt (%) = (Current body weight / Ideal body weight) × 100
* : Ideal Body Weight = (Height (cm) − 100) × 0.9
4) SBP : Systolic Blood Pressure
5) DBP : Diastolic Blood Pressure
* : $p<0.05$, ** : $p<0.01$, *** : $p<0.001$

Table 3. Distribution of the subjects by anthropometric index

Variables	Reference	Overweight		Obesity		Total	
		N	%	N	%	N	%
BMI	20 ≤ <25	28	(100.0)	0		27	(31.8)
	25 ≤ <27	0		22	(38.6)	23	(27.1)
	27 ≤ <30	0		23	(40.4)	23	(27.1)
	30 ≤ <40	0		12	(21.1)	12	(14.1)
Fat %	<25	3	(10.7)	0		3	(3.5)
	25 ≤ <30	13	(46.4)	17	(29.8)	30	(35.3)
	30 ≤ <40	12	(42.9)	39	(68.4)	51	(60.1)
	≥ 40	0		1	(1.8)	1	(1.2)
OR	11<	6	(21.4)	0		6	(21.4)
	11 ≤ <20	22	(78.6)	0		45	(52.9)
	20 ≤ <30	0		23	(40.4)	23	(27.1)
	30 ≤ <50	0		24	(42.1)	24	(28.2)
	≥ 50	0		10	(17.5)	10	(11.8)
SBP	≥ 160	0		2	(4.0)	2	(2.0)
DBP	≥ 95	0		3	(5.0)	3	(4.0)
WHR	<0.80	10	(35.7)	9	(15.8)	19	(22.4)
	0.80 ≤ <0.85	12	(42.9)	14	(24.6)	26	(30.6)
	0.85 ≤ <1.0	6	(21.4)	33	(57.9)	39	(45.9)
	≥ 1.0	0		1	(1.8)	1	(1.2)

over 42.9% of the overweight group. There were no subjects with less than 25% of body fat percentage for the obese group and 29.8% of the obese group was estimated as overweight with body fat percentage (25% ≤ <30%).

The obese group showed significantly higher circumferences of arm, waist and hip. Mean waist circumference (WC) of the overweight and obese groups were 78.5 ± 4.8cm, 89.5 ± 8.6cm, respectively. Mean WC of each group was close to 75th percentile and 96th percentile of the NHNS data for the group aged 30 − 39, respectively.

Overweight subjects showed a mean hip circumference of 96.1 ± 3.4cm and the obese subjects 102.9 ± 5.4cm (Table 4). Each of them was also close to the 75th and 95th percentile of the hip circumferences based on NHNS data, respectively.

Mean WHR for the overweight group was 0.82 and the obesity group 0.86. The WHR provides an index of regional body fat distribution and is a valuable guide in assessing health risk. Bjorntorp (1985) suggested that waist hip ratio greater than 1.0 for men and 0.8 for women were indicative

Table 4. Mean anthropometric measurements of the subjects

Variables	Overweight (N = 28)	Obesity (N = 57)	Total (N = 85)
Circumference			
Arm	29.4 ± 1.1[1)]	32.6 ± 2.7***	31.6 ± 2.7
Waist	78.5 ± 4.8	89.5 ± 8.6***	85.8 ± 9.1
Hip	96.1 ± 3.4	102.9 ± 5.4***	100.6 ± 5.8
WHR	0.82 ± 0.04	0.86 ± 0.06***	0.85± 0.06
Skinfold thickness(mm)			
Triceps	27.2 ± 2.1	32.1 ± 5.4***	30.5 ± 5.1
Subscapular	31.3 ± 5.2	40.1 ± 6.4***	37.2 ± 7.3
Suprailiac	29.2 ± 5.9	35.7 ± 6.6***	33.6 ± 7.1
Triceps + Subscapular	57.9 ± 7.1	72.1 ± 10.1***	67.8 ±11.2

1) Mean ± S.D 2) WHR : Waist-Hip ratio *** : p<0.001

of increased risk of cardiovascular disease and related death. Leonhardt et al. (1990) defined a WHR ≥ 0.85 as android obesity and WHR > 1.0 as severe android obesity. In this study, the overweight group showed 21.4% of android obesity and the obese group 47.1% using WHR criteria ≥ 0.85. Indepth analysis on 1998 NHNS classified subjects with WHR ≥ 0.9 as android obesity for women and showed 35.6% of overweight and 50.0% of the obese subjects had android type obesity.

Mean skinfold measurement at the site of triceps, subscapular, and suprailiac were significantly higher in obese subjects (Table 4). Because we don't have nationwide reference data for skinfold thickness, they were compared to NHANES II data. Mean triceps skinfold thickness of the overweight group (27.2 ± 2.1mm) was slightly higher than the 50th percentile (25.0mm) and obese group (32.1 ± 5.4mm) close to the 85th percentile. Mean subscapular skinfold thickness of the overweight group (31.3 ± 5.2mm) was close to the 75th percentile (31.0mm) and the obese group (40.1 ± 6.4mm) same as the 90th percentile (40.1). Mean sum of the triceps and subscapular site (57.9 ± 7.1mm) of the overweight group was slightly higher than the 75th percentile (57.5mm) and of the obese group (72.1 ± 10.2mm) almost the same as the 90th percentile (72.2mm) of NHANES II data.

The most commonly used approach assessing body composition for young people uses the sum of the triceps and subscapular sites (Lohman, 1987). These sites are highly correlated with other measures of body fatness. Kim (1990) reported that the subscapular skinfold thickness (SST) > 45mm for male or > 60mm for female is considered obesity. Seo (1991) suggested SST ≥ 46mm as light obesity, SST

≥ 60mm as moderate obesity and SST ≥ 74mm as severe obesity.

Using Seo's criteria, the overweight group can be regarded as light obesity and the obesity group as moderate obesity.

Mean systolic and diastolic blood pressure was all within normal range in the overweight group (102.6, 68.1mmHg) and in the obese group (112.6, 74.7mmHg).

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) of the obese group (112.6 ± 17.7mmHg, 74.7 ± 11.7mmHg) was higher than those of the overweight group (102.6 ± 12.3mmHg, 68.1 ± 8.8mmHg), respectively.

SBP of the overweight group was lower and SBP of the obese group was higher that of women aged 30 − 39 reported by Samsung Hospital (110.6 ± 12.0mmHg).

3. Correlation between anthropometric measurements

Table 5 shows various correlations between anthropometric measurements. The highest correlation (γ = 0.8886, $p < 0.001$) was found between the weight the hip circumference (HC). Waist circumference (WC) (γ = 0.8224, $p < 0.001$) or mid upper arm circumference (MAC) (γ = 0.8284, $p < 0.001$) was also highly correlated with the weight, respectively. The weight was moderately correlated with the skinfold thicknesses for 3 sites (γ = 0.5576 − 0.6433, $p < 0.001$).

WHR showed the highest correlation (γ = 0.8545, $p < 0.0001$) with fat percentage. Circumferences for 3 sites (waist

Table 5. Correlation between anthropometric measurement of total subjects

	Height	Weight	Fat%	WC	HC	WHR	MAC	TSF	SSF	SPSF
Weight	0.5279***									
Fat%		0.5283***								
WC	0.3555***	0.8244***	0.6156***							
HC	0.3834***	0.8886***	0.5125***	0.7573***						
WHR	0.4900***	0.4925***	0.8545***	0.3093**						
MAC		0.8284***	0.5133***	0.7792***	0.7836***	0.4934***				
TST		0.6433***	0.3813***	0.6100***	0.6240***	0.3732***	0.8342***			
SST		0.6015***	0.4453***	0.7067***	0.5403***	0.6090***	0.6951***	0.5858***		
SPST		0.5576***	0.4220***	0.5969***	0.4455***	0.5158***	0.5107***	0.4306***	0.6759***	
Fatweight	0.2493*	0.7794***	0.7622***	0.7441***	0.6905***	0.5360***	0.6730***	0.4946	0.5360***	0.4604***

1) WC : Waist Circumference 2) HC : Hip Circumference 3) MAC : Mid-arm circumference
4) TST : Triceps Skinfolds Thickness 5) SST : Subscapular Skinfolds Thickness 6) SPST : Suprailiac Skinfolds Thickness
* : $p < 0.05$, *** : $p < 0.001$

Table 6. Mean daily energy and nutrient intakes of subjects

Variables	Overweight (N = 24)	Obesity (N = 52)	Total (N = 76)
Energy (kcal)	2090.0 ± 495.4[1] (104)[2]	2113.2 ± 597.3 (106)	2106.0 ± 563.9 (105)
Carbohydrate (g)	308.7 ± 80.5	308.3 ± 94.7	308.4 ± 90.1
Protein (g)	87.8 ± 37.4 (160)	96.7 ± 45.8 (176)	93.9 ± 43.3 (171)
Fat (g)	56.0 ± 20.6	54.8 ± 28.2	55.2 ± 25.9
CHO : Pro : Fat	59 : 17 : 24	58 : 18 : 23	59 : 18 : 24
Calcium (mg)	600.1 ± 384.1 (86)	766.3 ± 458.1 (109)	714.1 ± 440.4 (102)
Iron (mg)	16.2 ± 7.9 (101)	20.1 ± 27.7 (126)	19.0 ± 23.2 (119)
Vit A (μg/RE)	566.4 ± 335.1 (81)	879.2 ± 862.3* (126)	780.5 ± 749.3 (112)
Thiamin (mg)	1.5 ± 0.96 (150)	1.2 ± 0.58 (120)	1.3 ± 0.72 (130)
Riboflavin (mg)	1.2 ± 0.62 (100)	1.2 ± 0.48 (100)	1.2 ± 0.52 (100)
Niacin (mg / NE)	18.3 ± 9.3 (141)	18.7 ± 10.7 (144)	19.1 ± 10.2 (147)
Ascorbic acid (mg)	115.2 ± 68.2 (165)	104.4 ± 61.2 (149)	107.8 ± 63.3 (154)

1) Mean ± S.D 2) RDA percentage * : $p < 0.05$

hip and mid upper arm) were moderately correlated (γ = 0.5125 − 0.6156, $p < 0.001$) with the fat percentage. The fat percentage showed low but significant correlation (γ = 0.3813 − 0.4453, $p < 0.001$) with the skinfold thickness for 3 sites. It was reported that the WHR is a simple method for describing the distribution of both subcutaneous and intra-abdominal adipose tissue (Jones et al. 1986 ; Larsson et al. 1984). Single site measurement is sometimes used to assess the total body fat or percentage body fat. In this study the subscapular skinfold thickness (SST) showed the highest correlation with body fat percentage. This result is not in agreement with the finding of Roche et al. (1981). It was reported that triceps skinfold thickness provided the best estimate of percentage body fat in adult women.

4. Energy and nutrient intakes

There were no significant differences between the nutrient intakes of the overweight and obese group even though the anthropometric measurements of obese group were significantly higher (Table 6). Obese subjects may have decreased basal metabolic rate or decreased activity level (Yu et al. 1997) even though they were not evaluated in this study.

The mean caloric intake of the overweight (2090.8 ± 495.4kcal) or obese group (2113.2 ± 597.3kcal) was higher than that (1903.3kcal) of women aged 30 − 39 reported by NHNS II (MHW 1999). The mean energy intake for all subjects (2106.0kcal) were 203kcal higher than that of NHNS II. It was also higher than that (1931.9 ± 511.0kcal) reported by Kim (1992) for obese women. They were similar to the result (2094.3 ± 651.1kcal) of Cha (1992) and were lower than the finding (2249 ± 47.5kcal) of women aged 20 − 50 who participated in a weight reduction program (Kim 1992). The RDA% of the energy intake for the overweight group was 104% and 106% for the obese group ; but more subjects of the obese group (26.7%) were having more than 120% of RDA for energy compared to the overweight group (16.7%).

Many studies showed that the mean energy intake was less in the obese group (Kromhout 1983 ; Son & Yang) or not significantly different (Kim 1997 ; Huh 1990) especially for females. They are probably due to underreport of food intake of obese group or weight gain in the obese subjects is not attributed to increased nutrient intake but must be related to a relatively greater reduction in energy expenditure (Bray 1990).

Overweight or obese subjects were having a much higher intake of protein compared to RDA (160 − 176% of RDA) and that of NHNS II. Protein intake of the overweight group was 87.8 ± 37.4g and 96.7 ± 45.8g for the obese group, which were higher 71.4 ± 13.5g of the normal group reported by Moon & Kim (1998). The mean protein RDA% for total subjects was 171.0%. Fifty nine percent of the subjects were taking more than 120% of RDA (Table 7). It seems the overweight or obese groups were taking in much more protein than RDA compared that they were taking a little bit more energy than RDA.

Diet composition was not significantly different between obese and overweight subjects. (Protein (P) (%), Lipid (L) (%), Carbohydrate (C) (%) : overweight vs obese, 17 vs 18, 24 vs 23, 59 vs 58). Carbohydrate intake percentages for overall subjects was 59%, lower than the recommended percentage (65%), but their fat intake percentages (24%) or protein intake percentage (18%) were higher than the recommended percentage, 20% or 15%, respectively. Their fat intake percentage was much higher than 16.6%, reported as the mean fat intake percentage of women aged 30 − 49 in NHNS (1989). These findings were in agreement with the result of Dreon et al. (1988) and Romieu & Willet (1988) that obese subjects showed high fat intake and low carbohydrate intake percentages. It was reported that people who eat high fat diets tend to store body fat efficiently (Bennett 1992). The dietary

Table 7. Distribution daily energy and nutrient intakes by RDA percentage

Variables	Reference	Overweight		Obesity		Total	
		N	%	N	%	N	%
Energy	RDA < 80%	8	(33.3)	16	(30.8)	24	(31.6)
	80 ≤ < 100	3	(12.5)	10	(19.1)	13	(17.1)
	100 ≤ < 120	9	(37.5)	12	(23.1)	21	(27.6)
	≥ 120	4	(16.7)	14	(26.9)	18	(23.7)
Protein	RDA < 80%	3	(12.5)	4	(7.7)	7	(9.2)
	80 ≤ < 100	3	(12.5)	8	(15.4)	11	(14.5)
	100 ≤ < 120	5	(20.8)	8	(15.4)	13	(17.1)
	≥ 120	13	(54.2)	32	(61.5)	45	(59.2)
Ascorbic acid	RDA < 80%	0	0	5	(9.6)	5	(6.6)
	80 ≤ < 100	2	(8.3)	5	(9.6)	7	(9.2)
	100 ≤ < 120	2	(8.3)	5	(9.6)	7	(9.2)
	≥ 120	20	(83.3)	37	(71.2)	57	(75.0)
Vitamin A	RDA < 80%	14	(58.3)	19	(36.5)	33	(43.4)
	80 ≤ < 100	5	(20.8)	6	(11.5)	11	(14.5)
	100 ≤ < 120	0	0	8	(15.4)	8	(10.5)
	≥ 120	5	(20.8)	19	(36.5)	24	(31.6)

fat influences body fat independently of total energy intake (Prewitt et al. 1991). Studies showed that when excess energy was provided solely as carbohydrates, more energy was required to produce the same weight gain as when excess energy was provided as a mixture of fat and carbohydrates (Danforth 1985). In animal studies excess energy provided with carbohydrate did not contribute to weight gain as efficiently as does excess energy from fat (Oscai & Miller 1986). Data also indicated that the thermic effect of food of carbohydrate is greater than that of fat (Sims & Danforth 1987). Thus a high fat, low carbohydrate diet may play the role to increase the fatness of the overweight or obese subjects in this study.

In this study, fat intake was positively correlated ($r = 0.2301$, $p < 0.05$) with the triceps skinfold thickness. Protein intake was also positively correlated with waist circumference ($r = 0.2668$, $p < 0.05$) or fat weight ($r = 0.2406$, $p < 0.05$) (Table 8).

Table 8. Correlation between anthropometric measurement and nutrient intakes of total subjects

	Fat%	WC	TST	Fatweight
Protein		0.2668*		0.2406*
Fat			0.2301*	
Calcium	0.2303*	0.2402*		

* : $p<0.05$ TST : Triceps Skinfolds Thickness

5. Food items contributing energy, carbohydrate, lipid and protein (Table 9, 10, 11, 12)

The 6 main food items that contributed to energy intake for overweight or obese subjects were similar (rice, pork, bread, grapes, barley) except corn oil (100.8kcal) in the overweight and instant noodles (69.0kcal) for the obese group.

Main food items that supplied energy to total subjects were rice (31.8%), pork (6.9%), barley (5.5%), bread (5.3%) and grapes (4.1%), while women dwelling in the large city were having rice (38.2%), pork (3.2%), bread (3.0%), instant noodles (2.7%) and candies as the main food energy source from NHNS II. Overweight or obese women in this study were taking less energy from rice (613.3 vs 681kcal) and more energy from pork (132.5 vs 57.8kcal) and bread (103.0 vs 53.7kcal) than women from NHNS. They were supplied 80% of energy from a vegetable source and 20% from an animal source.

The main food source of protein for the total subjects was

Table 9. Main foods supplying energy

Rank	Overweight			Obesity			Total			
	Food	Intake (kcal)	(%)	Food	Intake (kcal)	(%)	Food	Intake (kcal)	(%)	accumulated%
1	Rice	636.9	(30.2)	Rice	590.1	(30.7)	Rice	613.3	(31.8)	31.8
2	Pork	167.1	(7.9)	Barley	131.0	(6.8)	Pork	132.5	(6.9)	38.7
3	Bread	144.8	(6.9)	Pork	98.0	(5.1)	Barley	105.4	(5.5)	44.2
4	Corn oil	100.8	(4.8)	Instant noodle	69.0	(3.6)	Bread	103.0	(5.3)	49.5
5	Grape	100.2	(4.8)	Bread	61.2	(3.2)	Grape	79.9	(4.1)	53.6
6	Barley	79.7	(3.8)	Grape	59.4	(3.1)	Corn oil	75.8	(3.9)	57.5
7	Kimchi	41.8	(2.0)	Sweet potato	56.8	(3.0)	Instant noodle	44.2	(2.3)	59.8
8	Beef	38.1	(1.8)	Corn oil	51.1	(2.7)	Beef	43.3	(2.2)	62
9	Potato	32.1	(1.5)	Beef	49.1	(2.6)	Milk	40.1	(2.1)	64.1
10	Milk	32	(1.5)	Milk	48.2	(2.5)	Wheat flour	36.6	(1.9)	66
11	Wheat flour	30.8	(1.5)	Wheat flour	42.4	(2.2)	Sweet potato	33.8	(1.8)	67.8
12	Sugar	26.0	(1.2)	Apple	34.1	(1.8)	Apple	29.7	(1.5)	69.3
13	Apple	25.2	(1.2)	Sesame oil	33.6	(1.7)	Sesame oil	29.1	(1.5)	70.8
14	Sesame oil	24.5	(1.2)	Cracker	26.8	(1.4)	Kimchi	28.1	(1.5)	72.3
15	Anchovy	23.0	(1.1)	Egg	25.7	(1.3)	Sugar	24.2	(1.3)	73.6
16	Soju	22.4	(1.1)	Anchovy	23.6	(1.2)	Anchovy	23.3	(1.3)	74.9
17	Chicken	20.9	(1.0)	Sugar	22.3	(1.2)	Potato	22.6	(1.2)	76.1
18	Instant noodle	19.4	(0.9)	Sesame	20.4	(1.1)	Egg	22.2	(1.1)	77.2
19	Orange	19.4	(0.9)	Soybean	19.9	(1.0)	Chicken	20.2	(1.0)	78.2
20	Egg	18.7	(0.9)	Chicken	19.4	(1.0)	Coffee whiter	16.5	(0.9)	79.1
	Vegetable	1,684	(79.9)		1,526.6	(79.4)		1,549.8	(80.2)	
	Animal	424.3	(20.1)		396.0	(20.6)		381.7	(19.8)	

Table 10. Main foods supplying carbohydrate

	Overweight			Obesity			Total		
Rank	Food	Intake(g)	(%)	Food	Intake(g)	(%)	Food	Intake(g)	(%)
1	Rice	135.5	(42.6)	Rice	126.3	(41.5)	Rice	130.9	(43.4)
2	Grape	26.7	(8.4)	Barley	30.2	(9.9)	Barley	24.3	(8.1)
3	Bread	21.9	(6.9)	Grape	16.2	(5.3)	Grape	21.4	(7.1)
4	Barley	18.4	(5.8)	Sweet potato	13.6	(4.5)	Bread	15.2	(5.0)
5	Potato	7.4	(2.3)	Instant noodle	13.0	(4.3)	Instant noodle	8.5	(2.8)
6	Apple	7.0	(2.2)	Apple	9.5	(3.1)	Apple	8.2	(2.7)
7	Sugar	6.5	(2.0)	Wheat flour	8.8	(2.9)	Sweet potato	8.1	(2.7)
8	Wheat flour	6.5	(2.0)	Bread	8.4	(2.8)	Wheat flour	7.6	(2.5)
9	Kimchi	5.8	(1.8)	Sugar	5.4	(1.8)	Sugar	6.0	(2.0)
10	Citrus fruit	5.0	(1.6)	Milk	4.5	(1.5)	Potato	5.1	(1.7)
11	Instant noodle	3.9	(1.2)	Musk melon	4.3	(1.4)	Kimchi	4.4	(1.5)
12	Peach	3.8	(1.2)	Instant coffee power	3.2	(1.1)	Milk	3.5	(1.2)
13	Instant coffee	3.4	(1.1)	Cracker	3.2	(1.1)	Orange	3.4	(1.1)
14	Do ra ji	3.2	(1.0)	Kimchi	3.1	(1.0)	Coffee power	3.3	(1.1)
15	Cola	3.2	(1.0)	Potato	2.8	(0.9)	Musk melon	3.2	(1.1)
16	Craker	3.9	(0.9)	Peach	2.2	(0.7)	Peach	3.0	(1.0)
17	Yakurt	2.8	(0.9)	Sweet corn	2.0	(0.6)	Red ginseng	2.1	(0.7)
18	Sweet potato	2.6	(0.8)	Red peper power	1.9	(0.6)	Cola	2.1	(0.7)
19	Milk	2.6	(0.8)	Soybean	1.9	(0.6)	Do ra ji	2.1	(0.7)
20	Watermelon	2.4	(0.8)	Orange	1.8	(0.6)	Craker	1.9	(0.6)

Table 11. Main foods supplying protein

	Overweight			Obesity			Total		
Rank	Food	Intake(g)	(%)	Food	Intake(g)	(%)	Food	Intake(g)	(%)
1	Rice	11.5	(12.2)	Rice	10.7	(11.7)	Rice	11.1	(13.3)
2	Pork	10.6	(11.3)	Soybean curd	8.3	(9.1)	Pork	8.5	(10.2)
3	Crab	7.4	(7.9)	Pacific saury	6.8	(7.4)	Crab	6.0	(7.2)
4	Soybean curd	4.3	(4.6)	Pork	6.3	(6.9)	Beef	4.9	(5.9)
5	Chiken	4.2	(4.5)	Beef	5.7	(6.2)	Soybean curd	4.3	(5.1)
6	Beef	4.0	(4.3)	Crab	4.7	(5.1)	Anchovy	3.9	(4.7)
7	Anchovy	3.8	(4.0)	Anchovy	3.9	(4.3)	Chicken	3.9	(4.7)
8	Squid	2.9	(3.1)	Pollavk	3.7	(4.1)	Pollack	3.1	(3.7)
9	Kimchi	2.8	(3.0)	Chiken	3.5	(3.8)	Squid	2.4	(2.9)
10	Pollack	2.4	(2.6)	Barley	2.7	(3.0)	Barley	2.2	(2.6)
11	Milk	1.8	(1.9)	Milk	2.5	(2.7)	Milk	2.1	(2.5)
12	Barley	1.7	(1.8)	Egg	2.1	(2.3)	Kimchi	2.1	(2.5)
13	Egg	1.6	(1.7)	Mackerel	2.0	(2.2)	Egg	1.9	(2.3)
14	Flat fish	1.6	(1.7)	Squid	2.0	(2.2)	Red pepper powder	1.8	(2.2)
15	Grape	1.3	(1.4)	Instant noodle	1.8	(2.0)	Bread	1.6	(1.9)
16	Mushroom	1.1	(1.2)	Soybeans	1.7	(1.9)	Tuna	1.5	(1.8)
17	Mackerel	1.1	(1.2)	Hair tail	1.4	(1.5)	Mackerel	1.5	(1.8)
18	Welsh onion	1.0	(1.1)	Kimchi	1.3	(1.4)	Instant noodles	1.2	(1.4)
19	File fish	0.9	(1.0)	Wheat flour	1.2	(1.3)	Hair tail	1.0	(1.2)
20	Onion	0.8	(0.9)	Coffee poweder	0.9	(1.0)	Soybeans	1.0	(1.2)
	Vegetable	45.5	(48.6)		43.3	(47.2)		41.0	(48.8)
	Animal	48.2	(51.4)		48.5	(52.8)		43.0	(51.2)

rice(11.1g), pork(8.5g), crab(6.0g), beef(4.9g), soybean curd(4.3g) and anchovy(3.9g). They were having 48.8% of protein from a vegetable source and 51.2% from an animal source. While women from NHNS were supplied 53.3% of protein with a vegetable source and 46.7% with an animal source (MHW 1999).

Pork(9.8g), corn oil(8.0g), beef(3.8g), bread(3.5g), sea-same oil(3.0g), soybean curd(2.8g) were the main food sources supplying fat for all subjects.

The subjects of the study were taking more fat from pork (9.8 vs 4.4g) corn oil(8.0 vs 3.1g), bread(3.5 vs 1.5g) and sesame oil(3.0 vs 1.5g) when compared to those of women from NHNS. Subjects in this study showed that 61.4% of dietary fat was from a vegetable source and 38.6% from an animal source. These findings were in contrast to the results of NHNS(54.1% from a vegetable source, and 45.9% from an animal source).

Summary and Conclusion

This study was conducted to investigate the dietary intake, and anthropometric measurements and association between the two factors for overweight or obese females. Subjects were 85 adult females(overweight ; 28, obese ; 57) aged 20 − 50 years who participated in the weight reduction program at The Catholic University of Korea.

The result are summarized as follows :

1) The mean age was 38.7 y. Mean fat percent, BMI and obesity rates were 29.3, 23.9, and 15.1% respectively for overweight women and 32.7, 28.3 and 36.4%, respectively for obese women. There were significant differences for most of the anthropometric data between the groups.

2) Mean systolic and diastolic blood pressure was all within the normal range in the overweight group(102.6, 68.1mmHg) and in obese group(112.6, 74.7mmHg).

3) Body fat percent for all subjects was significantly correlated with weight, waist circumference, hip circumference, MAC, TST, SST or SPST($p < 0.001$). The parameter which showed the highest correlation coefficient ($r = 0.8545$) with body fat percentage was the waist hip ratio.

4) Any significant differences were not found in dietary intake of nutrients or in diet composition between the groups. The mean energy intake was 2090.1kcal(104% of RDA) for the overweight women and 2113.0kcal(106% of RDA) for the obese women. PFC ratio for overweight was 17 : 24 : 59 and 18 : 23 : 58 for the obese subjects, which can be regarded as higher fat and lower carbohydrate percentages compared to the recommended PFC ratio(15 : 20 : 65).

5) Fat intake was positively correlated($r = 0.2301$, $p < 0.05$) with the triceps skinfold thickness. Protein intake was also positively correlated with waist circumference($r = 0.2668$, $p < 0.05$) or fat weight($r = 0.2406$, $p < 0.05$).

6) The main food items that contributed energy to overweight or obese subjects were similar(rice, pork, bread, grapes, barley) except corn oil in the overweight or instant noodles for the obese group.

The subjects in this study were taking less energy from rice and more energy from pork and bread than women from the 98 National Health and Nutrition Survey II(NHNS II).

Pork, corn oil, beef, bread, seasame oil, and soybean curd were the main food sources supplying fat for all subjects. They were taking in more fat from pork, corn oil, bread and sesame oil when compared to those of women from NHNS.

Because there were no significant differences of dietary intake and dietary composition between the overweight and obese groups, further investigation considering basal metabolic rate or activity level would be needed.

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