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The Prevalence of Obesity and Nutritional Status in Adult Women Who Exercise Regularly

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Abstract

This study was conducted to investigate the relationship among prevalence of obesity, nutritional status and factors related to obesity of women who exercise regularly. The subjects of this study were 100 women who have been exercising regularly for more than 6 months. They were mostly housewives aged 24 to 63 years and had graduated middle or high school. Their average income was from 700 to 1,500 thousand won per month and most of them had 2 or 3 children. They sleep usually 6~8 hours a day. Most of physical indices of obesity were increased progressively with age. Among them, weight (61.5±1.4 kg), subscapular (16.3±1.4 mm) and abdomen (31.4±1.2 mm) skinfold thickness were higher in 50 years than in others. BMI after exercise was decreased compared with BMI before exercise. WHR was 0.82 in 40 years and 0.85±0.01 in 50- to 60-year-old group. The percentage of body fat increased with advancing years and the highest values were shown in 50- to 60-year-old group (skyndex value: 38.6±0.6, BIA value: 28.7±0.8, $p<0.05$). The prevalence of obesity was measured by bioelectrical impedance fatness analyzer (BIA), body mass index (BMI) and skinfold thickness were 17.0%, 24.0% and 78.0%, respectively. Most subjects were in good nutritional status, but in the subjects aged 24~49, energy (89.3%), iron (93.3%) and vit. A (97.4%) intake were slightly lower than the RDA. Energy intake was slightly insufficient to the 50~63 year old subjects (88.6%) compared with RDA. It seemed that they restricted calorie intake for the weight control. The energy percentage of carbohydrate, fat and protein was 65 : 20 : 15, the result of which came closed to the recommended calorie composition. There were positive correlations between obesity and other variables such as age, number of children and physical indices.

Key words: obesity, exercise, physical indice

INTRODUCTION

The number of obese people is increasing in Korea due to changes of meal patterns to western style and decreasing physical activities. According to the National Nutrition Survey Report (1) in 1995 by the Ministry of Health and Welfare in Korea, it showed that approximately 19% of women in Korea were obese by means of BMI above 25. A study on prevalence of obesity and its related factors of housewives in Taegu reported (2) that the rate of obesity was 24~36% including overweight, and also Kim et al.'s study (3) showed us 37.5% of subjects were obese. Many research observations indicate that obesity is a significant independent predictor of cardiovascular disease, particularly coronary heart disease and stroke (4). Aside from the metabolic abnormalities such as diabetes, cardiac disease and hypertension, there are several consequences socially and psychologically just like anorexia and hypochondria under the influence of obesity. Therefore, the incidence of obesity among housewives in Korea becomes the severe nutritional problem (5).

It is clear that obesity is associated, to a large extent, with lifestyle. There is no single best way to treat obesity. Generally the lifestyle therapies including behavioral modification, nutritional adjustments and exercise consumption are recommended by experts (6). In treating obesity, the major emphasis is particularly placed upon decreasing energy intake and, to a lesser extent, upon increasing energy expenditure. However, food restriction induces a decline in resting energy expenditure which is related to the decline in body mass (7). Numerous reports (8-10) indicate that, although decreased energy intake is undoubtedly the most obvious and effective way to reduce fat, it also causes significant loss of fat-free mass.

Regular exercise is a significant variable to consider in understanding and treating obesity, since it is the

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principal component of energy expenditure (11). There is persuasive evidence that obesity is due to under-exercising rather than overeating. A series of randomized and controlled trials were shown that sedentary men who took jogging became to lose body fat in proportion to miles run, increase their energy intake, and improve their lipoprotein pattern (12). On the study of effect of exercise and diet control program for obese children, energy reduction with exercise program should be more successful than exercise itself only could be carried out (13). Ballor and Poehlman (14) demonstrated that the energy cost in walking increased as the body weight increasing when the speed was kept constant. An increase in walking speed also increased energy expenditure for any given body weight. Thus both the intensity of exercise and the body weight were important in determining the total energy expenditure during exercise. It is well known that treatment of obesity would be effective using an exercise and diet control program with correct data on physical and dietary status of obese individuals.

Therefore, this study was to obtain information on the prevalence of obesity, nutritional status and the factors related to the obesity of women who exercise regularly. We also analyzed the relations between obesity and other variables such as general factors, physical indice and nutritional intakes. The data may be used in developing programs of nutrition education and overweight therapy for overweight adult women.

METERIALS AND METHODS

Subjects

100 women who have been exercising such as aerobics (65%), swimming (18%), and weight training (17%) for more than 6 months at sport centers were studied. They were healthy 20- to 60-year-old adults.

Anthropometry

Anthropometries including height, weight, hip, waist and skinfold thickness (triceps, biceps, abdomen and subscapular) were measured by skyndex (Caldwell. Justiss, USA). Also body fat content was measured by bioelectrical impedance fatness analyzer (BIA : GIF-891, Gilwoo Trading Co., Japan) and calculated from skinfold thickness. The subjects were requested to record their maximum body weight before they started exercise. The criteria for obesity were difined by body mass index (BMI) and percentage (%) of body fat by bioelectrical impedance analysis (BIA) and skinfold thickness. BMI indice groups were classified into two sub-groups. The first group was women who did not have any exercise programs eventhough they were conscious of overweight (BMI before exercise). The second group was women who had taken a regular physical exercise because they were overweight (BMI after exercise). Body density (BD) was calculated using the Durnin and Wormersley's method (15) as follows: women 20~29 BD=1.1599-0.0717 log(SF), women 30~39 BD=1.1423-0.0632 log(SF), women 40~49 BD=1.1333-0.0612 log(SF), women 50+ BD=1.1339 -0.0645 log(SF), where SF=sum of triceps, biceps, abdomen and subscapular thickness in mm. After then we calculated percentage of body fat using the BD by Siri's method (16) as follows: percentage of body fat (%)= [(4.95/BD)-4.50]×100. The criteria for obesity was a BMI above 25 (17,18), and a percentage of body fat above 30 (16,17). We calculated the WHR (waist : hip ratio) that indicated the distribution type of body fat and health risk of overweight.

Nutritional status

Nutritient intake was checked by Moon's convenience method (19), which is a simple nutrition intake survey applicable for Koreans. It was generally to survey the average amount of food intake in spite of some differences daily. It was classified daily foodstuffs by 15 questionnaires as 7 groups such as 1) meat · fish · egg · bean food 2) milk and dairy products 3) fruits 4) vegetables 5) cereals · sweet and white potatoes 6) sugar · candy · wheat-gluten and 7) oil and fat. Then the amount of nutrient intake was calculated by using the conversion factor of nutritions.

Statistical analysis

We used SPSS/P$^+$ programs. Anthropometries and nutrient intakes were presented as mean±standard error and analyzed using the corrected procedure of ANOVA and Duncan's multiple range test to find significant differences among the groups. To determine the correlations between obesity and other variables such as general factors, physical indices and nutrients intake, Pearson's correlation coefficient was used. The least significant difference tests were following significance ($p<0.05$, $p<0.01$) analysis of variance procedures.

RESULTS AND DISCUSSION

General characteristics of subjects

The characteristics of the subjects were shown in Table 1. Most of the subjects were housewives who have had regular exercise such as aerobics (65%), swimming (18%) and weight training (17%) for more than 6 months at social sport centers. Fifty one percentage of subjects have exercised regularly for about one to two years and 20.0% of them have exercised for two years or more. They were 24- to 63-year-olds and 76.0% of them were 30~49 years old. Sixty four percentage of the subjects were middle or high school graduates and 21.0% were junior college or university graduates. Sixty one percentage of the subjects had 2 to 3 children and the rest had 1 and 4 to more than 6 children. Seventy percentage of the subjects slept for 6 or 8 hours everyday. Income of 61.0% subjects was 700~1,500 thousand won per month (61.0%).

Table 1. General characteristics of subjects

	Variables	n (%)
Exercise period		
	< 6 months	5 (5.0)
	6 months~1 year	24 (24.0)
	1 year~2 years	51 (51.0)
	> 2 years	20 (20.0)
Job		
	Non-job	89 (89.0)
	Job	11 (11.0)
Age		
	24~29	7 (7.0)
	30~39	39 (39.0)
	40~49	37 (37.0)
	50~59	15 (15.0)
	60~63	2 (2.0)
Education level		
	Elementary school	14 (14.0)
	Middle, high school	64 (64.0)
	College, university	21 (21.0)
	Graduate school	1 (1.0)
Children (unit: number)		
	0~1	12 (12.0)
	2~3	61 (61.0)
	4~5	25 (25.0)
	6~	2 (2.0)
Sleeping hours		
	< 6 hours	15 (15.0)
	6~8 hours	45 (45.0)
	8 hours	25 (25.0)
	> 8 hours	15 (15.0)
Incomes (unit: thousand)		
	< 700	4 (4.0)
	700~1,000	19 (19.0)
	1,000~1,500	42 (42.0)
	1,500~2,000	17 (17.0)
	2,000~3,000	8 (8.0)
	> 3,000	10 (10.0)
Total		100(100.0)

Anthropometric characteristics of the subjects according to age

The anthropometric characteristics of the subjects were shown in Table 2. Average height and weight were 157.3±0.4 cm and 57.8±0.7 kg, respectively. Compared with the Korean standard (158.3 cm, 55.0 kg) (20), the subjects' average weight was higher than the standard value. Body weight and most of physical indices were increased progressively with age. The maximum values of 'after exercise body weight' was 61.5±1.4 kg, subscapular thickness was 16.3±1.4 mm and abdomen thickness was 31.4±1.2 mm in the subjects older than 50 years. However, waist and hip were the highest in 40's ($p<0.05$) and the values were 94.1±16.8 cm and 115.1±21.7 cm respectively. It was a tendency that the appearance of body fat distribution showed mostly in abdomen area rather than peripheral in elder adult women. In the case of regular exercising adult men (18), the body weight and subscapular skinfold increased with growing age and the maximum values showed more than 50 years old, but the maximum abdomen size was shown in the age of 40's. In Ko's research (21), she studied females in Cheju using anthropometric measurements. Her study showed that the older they were, the bigger their body size was. The author also reported that the body weight, subscapular skinfold thickness, abdomen skinfold thickness, waist and hip were bigger in 50- to 60-year-olds compared with those in other ages. Among anthropometries, the abdomen area was bigger with growing age ($p<0.01$) in Cheju females.

BMI, WHR and percentage of body fat showed a tendency to increase with advancing age significantly and were much higher in over 40 years ($p<0.05$, Table 3). BMI after exercise was decreased compared with BMI before exercise ($p<0.05$, Table 4). BMI after exercise increased with growing age and was recorded the highest over 40 years. This was similar to Ko's research (22) in which she reported BMI was 24.2±2.8 in 50 years old. Considering 71.0% subjects had exercised regulary more than 1 year, exercise could be assessed as a variable factor for BMI control. WHR was 0.82 in 40 years

Table 2. Anthropometric characteristics of the subjects according to age

Variables	20'S (n=7)	30'S (n=39)	40'S (n=37)	50. 60'S (n=17)	signifi-cance
Height (cm)	159.4±1.4	157.4± 0.8	156.6± 0.7	157.5±1.3	NS
Weight (kg)[1)]	54.3±1.8[c]	55.6±1.0[b]	59.0± 1.2[a]	61.5±1.4[a]	**
Weight (kg)[2)]	55.7±1.4[c]	59.2±1.2[bc]	61.8± 1.2[b]	63.6±1.7[a]	*
Subscapular (mm)	12.5±1.4[c]	13.8±0.6[b]	15.9± 0.8[a]	16.3±1.4[a]	*
Abdomen (mm)	20.5±3.1[d]	24.3±1.6[c]	29.1± 1.2[b]	31.4±1.2[a]	**
Biceps (mm)	7.6±1.0[b]	8.4±0.4[ab]	11.1± 1.8[a]	10.6±1.1[a]	*
Triceps (mm)	16.6±2.8	16.3±0.6	19.1± 1.7	16.4±0.8	NS
Waist (cm)	67.9±2.2[cd]	71.5±1.0[c]	94.1±16.8[a]	81.7±1.3[b]	*
Hip (cm)	90.0±2.0[bc]	92.0±0.7[b]	115.1±21.7[a]	95.5±1.4[b]	*

Mean±SE(standard error)
[abcd]Values with different superscripts within a row were significantly different from each other (α=0.05)
*Significant at p<0.05, **significant at p<0.01, NS: not significance
[1)]The subjects' weight which was the value of "after exercise"
[2)]The subjects' weight which was the value of "before exercise"

Table 3. BMI, WHR and percentage of body fat of subjects grouped by age

Variables	20'S (n=7)	30'S (n=39)	40'S (n=37)	50. 60'S (n=17)	signifi-cance
BMI[1)]	21.3 ±0.7[b]	22.4 ±0.3[b]	24.0 ±0.4[a]	24.8 ±0.5[a]	*
BMI[2)]	21.9 ±0.7[c]	23.9 ±0.4[b]	25.1 ±0.4[a]	25.6 ±0.7[a]	*
WHR	0.75±0.02[c]	0.77±0.0[b]	0.82±0.0[a]	0.85±0.01[a]	*
% Body Fat[3)]	27.9 ±1.9[d]	30.8 ±0.5[c]	35.6 ±0.6[b]	38.4 ±0.6[a]	*
% Body Fat[4)]	23.4 ±1.6[c]	24.2 ±0.4[bc]	25.5 ±0.9[bc]	28.7 ±0.8[a]	*

Mean±SE(standard error)
[abcd]Values with different superscripts within a row were significantly different from each other(α=0.05)
*Significant at p<0.05, Body Mass Index=weight (kg)/height^2 (m^2), WHR=Waist/Hip
[1)]BMI: after exercise, [2)]BMI: before exercise, [3)]Percentage of body fat by skinfold thickness
[4)]Percentage of body fat by bioelectrical impedance analyzer

Table 4. Comparison of after and before exercise BMI by age

Variables	20'S (n=7)	30'S (n=39)	40'S (n=37)	50. 60'S (n=17)	Total
BMI[1)]	21.3±0.7	22.4±0.3	24.0±0.4	24.8±0.5	23.3±0.2
BMI[2)]	21.9±0.7	23.9±0.4	25.1±0.4	25.6±0.7	24.5±0.2
	NS	*	*	*	*

Mean±SE(standard error), Paired t-test was used to determine statistical significance
*Significant at p<0.05, NS: not significance, [1)]BMI: after exercise, [2)]BMI: before exercise

and 0.85±0.01 in 50~60 years group. This was lower than Yoo's report (17), in which WHR was 0.93 in 41~54 years old and 0.97 in more than 55-year-old. Choi et al. (18) also reported that regular exercising men had lower WHR value compared with sedentary men during exercise period. The percentage of body fat using skinfold thickness showed 27.9±1.9 in 20 years old, 30.8±0.5 in 30's, 35.6±0.6 in 40's and 38.4±0.6 in 50~60's ($p<0.05$) and using bioelectrical impedance analyzer (BIA) showed 23.4±1.6 in 20 years old, 24.2±0.4 in 30's, 25.5±0.9 in 40's and 28.7±0.8 in 50~60's ($p<0.05$). Therefore the percentage of body fat increased with advancing years and the highest values were shown in 50~60 year group ($p<0.05$). This explained that body fat storage was increased with growing age in exercising adult women. In Yoo's report (17), it appeared that females had higher WHR and BMI than males with growing age.

Distribution of obese women

Frequency distributions of obese women by different

Table 5. Frequency distribution of obese women and upper body type with physical indice %(n)

Variables	Criteria of obesity	Subjects
BMI[1]	≥ 25.0	24.0 (24)
BMI[2]	≥ 25.0	35.0 (35)
% BF[3]	≥ 30.0	78.0 (78)
% BF[4]	≥ 30.0	17.0 (17)

[1]Body mass index "after exercise"
[2]Body mass index "before exercise"
[3]Percentage of body fat by skinfold thickness
[4]Percentage of body fat by bioelectrical impedance analyzer

analysis methods were described in Table 5. As the indication of obesity was defined as BMI more than 25, it was concluded that 24.0% of women were obese according to BMI after exercise, while 35.0% were obese according to BMI before exercise. Therefore, percentage of obese women by BMI was decreased during the exercise period and this result was similar to that of Choi et al. research (18). They reported 41% obesity in regularly exercising men while 50% obesity in the group of men before exercise. Considering the obesity as having more than 30% body fat, obese women were 78.0% by skinfold thickness and 17.0% by bioelectrical impedance analyzer (BIA), respectively. So there was a difference according to obesity classification indices. Eventhough BMI and skinfold thickness are common indices to reflect most adult's obesity, it would be better to calculate the total amount of body fat by BIA rather than BMI or skyndex as obesity classification indice, because the skyndex measurement is influenced by the skin extension(23) and also BMI measured value is not adoptable for short person, children, sportsman, pregnant women, nursing women, and individuals older than 65 years (24,25).

Nutritional status

Average daily nutrient intakes were shown in Table 6. Most subjects were in good nutritional status but energy (89.3%), iron (93.3%) and vit. A (97.4%) intake of the 24- to 49-year-old subjects were slightly lower than RDA's. Energy intake was slightly insufficient in 50- to 63-year old subjects (88.6%). It is well known that exercise, behavioral modification and food restriction are basic elements for weight control. In this paper, only exercise was regarded as a weight control factor because we compared 'the weight before exercise' with 'the weight after exercise'. Therefore, we may pass over the factors-food restriction and behavioral modification which have effect on weight control, because we didn't compare them before and after exercise. But from this data, it was suspected that the subjects' restricted energy intake during 'after exercise period' was due to their consciousness over overweight. The energy percentage of carbohydrate : fat : protein was 65 : 20 : 15, which came close to the recommended calorie composition (carbohydrate 60~65%, fat 20~25%, protein 15%) (20).

Energy intake of overweight housewives aged 30~49 year group living in Taegu city was reported 2,247 kcal (112% of RDA) by Ko (22) and Park and Choi's report (2) showed that daily energy intake was 1,725 kcal (the range of average age between 20~60) in housewives with more than 30% of body fat. The subjects' intake in our study was 1,786 kcal (24~49 years) and 1,772 kcal (50~63 years) which corresponded to 89.3% and 88.6%

Table 6. Average energy and nutrient intakes of subjects

Nutrient	24~49 (yr)			50~63 (yr)		
	Intakes	RDA[1]	% of RDA	Intakes	RDA	% of RDA
Energy (kcal)	1,786.6±49.0[2]	2.000	89.3	1,772.5±69.5	2,000	88.6
Pro (g)	69.1± 2.3	60	115.2	66.6± 4.7	60	111.0
Fat (g)	41.2± 2.0	-	-	36.2± 3.6	-	-
Carbohydrate (g)	286.8± 7.2	-	-	295.0± 7.4	-	-
Fe (mg)	16.8± 0.4	18	93.3	18.7± 0.7	12	150.0
Ca (mg)	786.4±24.2	700	112.3	895.9±31.7	700	127.8
Vit. A (R.E)	681.9±23.8	700	97.4	771.8±30.6	700	110.3
Vit. B_1 (mg)	1.1± 0.0	1.0	110.0	1.2± 0.0	1.0	120.0
Vit. B_2 (mg)	1.3± 0.0	1.2	108.3	1.5± 0.1	1.2	125.0
Niacin (mg)	17.2± 0.4	13.0	132.3	18.4± 0.6	13.0	141.5
Vit. C (mg)	67.1± 2.2	55.0	122.0	78.0± 6.0	55.0	141.8

[1]Recommended Dietary Allowances for Koreans(1995), [2]Mean±SE(standard error)

Table 7. Correlation cofficient between obesity and general factors, skinfold thickness, circumferances, BMI and nutrients intake

Variables		Obesity (30≤percentage of body fat by BIA)[1]
General factors		
	Age	0.403**
	Education	-0.384**
	Incomes	-0.036
	Children	0.348**
	Sleeping times	0.139
	Height	-0.150
	Weight after exercise	0.565**
	Weight before exrecise	0.371**
Skinfold thickness		
	Subscapular	0.557**
	Abdomen	0.568**
	Biceps	0.146
	Triceps	0.172*
Circumferances		
	Waist	-0.001
	Hip	-0.046
	WHR	0.458**
BMI		
	BMI after exercise	0.663**
	BMI before exercise	0.462**
Nutrient intake		
	Energy	-0.042
	Protein	-0.020
	Fat	-0.052
	Carbohydrate	-0.032
	Iron	0.106
	Calcium	0.169*
	Vit. A	0.160
	Vit. B_1	0.081
	Vit. B_2	0.162
	Niacin	0.017
	Vit.C	0.124

[1]Pearson's correlation coefficient was used to determine statistical significance
*Significant at $p<0.05$, **significant at $p<0.01$

of RDA respectively. When compared with the report of Park and Choi (2) who studied nutrient intake with the same method used in our study, our subjects' intake was less than that of the housewives of Taegu city in their report (2). It was regarded that the subjects were aware of not only regular exercise but also restricted energy intake due to their overweight.

Correlations between obesity and other variables such as general factors, physical indices and nutrient intakes

We classified the subjects who have more than 30% body fat by BIA as obesity and then this variable was used obesity term in Table 7. To see the correlations between obesity (%BF≥30) and other variables such as general factors, physical indices and nutrient intakes, we adopted the Pearson's correlation coefficient and its results showed in Table 7. We could see the negative correlation ($p<0.01$) between obesity and the subjects' educational level and could see the positive correlation ($p<0.01$) between obesity and age, children number and body weight. In the correlation of obesity and body measurements factors, the positive correlations were shown in subscapular, abdomen ($p<0.05$), triceps ($p<0.01$), WHR ($p<0.05$) and BMI ($p<0.05$) while between obesity and nutrient intakes didn't show significant difference except for calcium only.

According to reference report about the correlations of weight, BMI, percentage of body fat, WHR and RBW (relative body weight), the correlation of body weight and BMI showed high ($r=0.92$) but the correlation coefficient of body weight and percentage of body fat showed various value ($r=0.4$ or 0.8) (26), which could be attributable to the subjects' characteristics such as age, sex and race (27). It also showed much greater correlation between body weight and the total amount of body fat rather than those between body weight and the ratio of body fat. WHR which indicates the distribution type of body fat, was reported that it had the statistical correlations with BMI or RBW rather than body weight (28). With increasing age, the heavier the weight was, the higher ratio of obesity or upper body obesity appeared. Eventhough women are generally less than men in upper body obesity, they are susceptible to get fat accumulation in the middle of abdomen (28).

In this report, the highest value ($r=0.568$) appeared in the correlation of percentage of body fat and abdomen thickness among skinfold thickness. Therefore, when obesity experts educate the middle aged woman, it will be emphasized that the exercise is important and the various health problems cause to the upper body obesity type as well as the various problems bring about the increasing weight.

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