

Effects of Exercise and Nutrition on Male Body Composition and Obesity

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This study is to investigate the effects of the physical activity and intake of improved food levels on male body compositions. Forty men were assigned to a percentage of body fat (PBF) group (20 men with physical exercise and food) and CONTROL group (20 men with exercise, food intake is free) for this six-month study. An aerobic capacity test to measure maximum oxygen consumption (VO_2 max) was performed to precisely determine the exercise intensities during the experimental conditions. After exercise and food control, the body weight of 20s with exercise and food (A) and only exercise (B) decreased about 2.3 kg and 0.4 kg after 6 months, respectively. If the p -values were 0.697(between baseline and 3 months), 0.535(between 3 months and 6 months), and 0.617(between baseline and 6 months), respectively, then 20s men had evidence of that a significant main effect does not exist amongst the observations of the outcome or within-weights. Their skeletal muscle mass (SMM) of both groups increased slightly through exercise. Although the decrease in total body weight of 30s was correlated with the increase in SMM, there was not shown significant. While total body water decreased in 20s, 40s, and 50s except 30s men, all other values did not shown significant differences. The physical activity and intake of improved food levels were contributed with lost a lot of weight, decrease of SMM and body fat.

Key words : Body weight, improved food, physical activity, skeletal muscle mass

Introduction

Exercise is a type of physical activity consisting of planned, structured, and repetitive bodily movement done to improve and/or maintain one or more components of physical fitness [10]. Health practitioners universally agree that too much body fat is a serious health risk. Problems such as hypertension, elevated blood lipids, diabetes mellitus, cardiovascular disease, respiratory dysfunction, and some joint diseases are all related to obesity. Information related to body composition and balance of food calories between input and output is accumulating rapidly and is extending our knowledge of human biology. In order to stay at the same body weight, people must balance the amount of calories in the foods and drinks they consume with the amount of calories the body uses. An energy balance is the balance of calories consumed through eating and drinking compared to calories burned through physical activity. Physical activity

is an important way to use extra food energy. Most people spend much of their working day in activities that require little energy. In addition, many adults of all ages now spend a lot of leisure time each day being inactive, for example, watching television or working at a computer.

Measuring body composition in humans is usually in response to the need to describe either deficiencies or excesses of a components of the human body closely relate to the status of our health. Body composition is of interest to nutritionists because of the impact that nutritional status, specific diet, exercise, disease, and genetics can have on the major components of the human body [3]. Body composition and growth are key components of health in both individuals and populations.

Age-dependent loss of muscle mass and strength is growing to be a major cause of disability and morbidity among older adults [13]. These alternations impair physical functional status, quality of life and increase the risk of comorbidities [1]. While exercise and nutritional interventions have been proved to be effective to offset these alternations [2], an accurate estimation of body composition is essential to assess the changes that happen along with the interventions [9].

Recent developments include three-dimensional photonic scanning and quantitative magnetic resonance. Collectively,

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these techniques allow for the measurement of fat, fat-free mass, bone mineral content, total body water, extracellular water, total adipose tissue and its subdepots (visceral, subcutaneous, and intermuscular), skeletal muscle, select organs, and ectopic fat depots. InBody measures body composition and displays it on an organized. InBody with exceptional precision and convenience of use widely recognized by experts worldwide.

The purpose of this study is to investigate the effects of the physical activity and improved food levels of adolescents on their body compositions.

Materials and Methods

Exercise training program

Forty men, with no resistance training experience or clinical problems, were randomly assigned to a percentage of body fat (PBF) group (20 men with physical exercise and food: marked as A) and control group (20 men with exercise, food intake is free: marked as B) for this six-month study. All volunteers did a pre-exercise screening to make sure they could complete the exercise interventions of the study. A 30-minute rest period was provided between the aerobic fitness assessment and the muscular fitness assessment. All volunteers programmed to perform as uniform motion as possible. There are two basic physiological considerations that need to be addressed in designing any conditioning program. First, the major source of energy utilized to perform the given activity must be identified. The second consideration involved in program design is developing a progressive overload system that will develop that particular energy source. Resting energy expenditure was measured for the purpose of estimating daily energy requirements [16]. The energy expended during the exercise and resting sessions ($t = 0-60$ min) was calculated using the Weir equation [17]. An aerobic capacity test to measure maximum oxygen consumption (VO_2 max) [12] was performed to precisely determine the exercise intensities during the experimental conditions [11] (Table 1). Energy and macronutrient contents were assessed by using Canadian Nutrient File software [6].

Participants undertook combined physical exercise and improved food. The physical exercises included the chest press, seated row, shoulder press, triceps extension, leg press, leg extension and leg curl, with abdominal crunches also performed [4]. Sessions commenced and concluded with general flexibility exercises. The aerobic component of the

Table 1. Energy expenditure and duration of the low- and high-intensity exercise sessions and daily macronutrient intake

Variable	Low-intensity exercise	High-intensity exercise
Energy expenditure (kcal)	350±12.5	380±15.2
Duration (min)	35±6.8	45±5.5
Intensity (% VO_2 peak)	45±2.6	70±3.7
Carbohydrate (g)	244±54.1	298±24.8
Lipid (g)	92±15.3	103±17.7
Protein (g)	84±12.6	92±9.4

All value are mean \pm SD. The main effects of the model were assessed with repeated-measures ANOVA ($p < 0.05$). Post hoc testing was followed by paired t tests (Bonferonni corrections were applied for multiple comparisons). Means in a row with different superscript letters are significantly different ($p < 0.05$).

training program conducted 30 minutes twice a week for six months.

Direct segmental multi-frequency bioelectrical impedance analysis (DSM-BIA)

DSM-BIA was performed using the In-Body (720) body composition analyzer. This equipment has previously been shown to have high test-pretest reliability and accuracy [4, 5].

Random assignment

Control participants could undergo the training after the assessment period had been completed. After completion of the baseline assessment, participants were randomly selected using a computer random assignment program. Forty men in their 20s, 30s, 40s, and 50s were randomly selected.

Statistical analyses

The measurements were prepared in triplicate for each analysis. Data were analyzed using the SPSS version 21 (SPSS Inc, Chicago, IL) statistical software package. The Greenhouse-Geisser is used to assess the change in a continuous outcome with three observations across time or within-subjects. Means and standard deviations should be reported for each observation of the outcome with Greenhouse-Geisser corrections.

Results

Muscle-fat analysis

Characteristics of muscle-fat analysis and change over six months are reported in Table 2. PBF (group A) is the result

Table 2. Muscle-fat analysis and change over six months exercise training

Gender (Age)	Measure	Baseline	3 months	6 months	F, p
Male (20s) A	Total Weight, kg	71.0±4.44	70.1±4.81	68.7±4.40	0.753, NS
	SMM, kg	28.4±3.05	29.1±3.40	29.8±3.35	0.236, NS
	PBF, %	14.8±1.51	13.9±1.39	13.9±1.75	0.546, NS
Male (20s) B	Weight	73.9±3.40	73.6±2.73	73.5±2.30	0.036, NS
	SMM	30.8±1.30	31.2±1.77	31.3±2.21	1.455, NS
	PBF	13.5±0.46	13.4±0.42	13.3±0.33	0.144, NS
Male (30s) A	Weight	81.4±4.96	80.6±5.20	77.4±3.44	1.052, NS
	SMM	35.6±4.25	35.2±4.31	35.2±3.05	0.142, NS
	PBF	15.1±1.07	14.6±1.31	13.6±1.37	2.201, NS
Male (30s) B	Weight	76.4±6.50	75.5±6.54	75.1±6.39	0.052, NS
	SMM	30.5±3.18	30.1±2.98	30.2±2.99	0.042, NS
	PBT	13.4±2.00	13.2±1.30	13.1±1.32	0.050, NS
Male (40s) A	Weight	75.4±2.88	74.4±3.02	71.8±3.59	1.708, NS
	SMM	30.3±1.91	30.3±2.21	31.0±1.83	0.218, NS
	PBF	11.4±1.59	11.2±1.45	10.9±1.44	0.122, NS
Male (40s) B	Weight	78.5±3.31	74.8±2.95	73.1±2.99	3.954, *
	SMM	30.3±4.04	29.7±3.51	29.9±3.54	0.038, NS
	PBF	15.1±3.37	15.2±3.27	15.1±2.94	0.002, NS
Male (50s) A	Weight	77.6±1.34	75.0±2.30	74.2±1.61	4.856, *
	SMM	29.2±3.18	29.1±1.64	30.0±2.02	0.233, NS
	PBF	19.4±3.40	18.9±3.43	19.6±2.67	0.057, NS
Male (50s) B	Weight	73.8±2.42	71.9±3.32	71.1±3.06	1.088, NS
	SMM	29.1±3.96	28.6±4.04	29.9±3.54	0.146, NS
	PBF	16.8±5.06	17.2±4.09	14.7±1.62	0.625, NS

SMM: Skeletal Muscle Mass, PBF: Percentage of body fat. Results are from three experiments and are expressed as mean ± SD. NS: Non-significant, $p>0.05$. *: Significant, $p<0.05$.

of a survey of five 71-kg men in their 20s. After exercise and food control, the body weight of 20s with exercise and food (A) and with only exercise (B) decreased about 2.3 kg and 0.4 kg after 6 months, respectively. If the p -values were 0.697(between baseline and 3 months), 0.535(between 3 months and 6 months), and 0.617(between baseline and 6 months), respectively, then 20s men had evidence of that a significant main effect does not exist amongst the observations of the outcome or within-weights. Their skeletal muscle mass (SMM) of both groups increased slightly through exercise. On the other hand, their percentage of body fat (PBF) decreased by 0.9%. Although the decrease in total body weight of 30s was correlated with the increase in SMM, there was not shown significant. However, difference between total weight change measurements was associated with fat loss PBF. They performed exercise and food control very well (Fig. 1). 30s PBF (group 30s A) is the result of a survey of mean 81.4 kg. The body weight of 30s with exercise and food (30s A) and only exercise (30s B) decreased

about 4.0 kg and 1.3 kg after 6 months, respectively. Although they performed exercise, food control very well, loss of body weight, SMM did not increase through exercise. 30s A performed exercise and food control very well and 30s B did not do them (Fig. 1). The body weight of 40s with exercise and food (A) and only exercise (B) decreased about

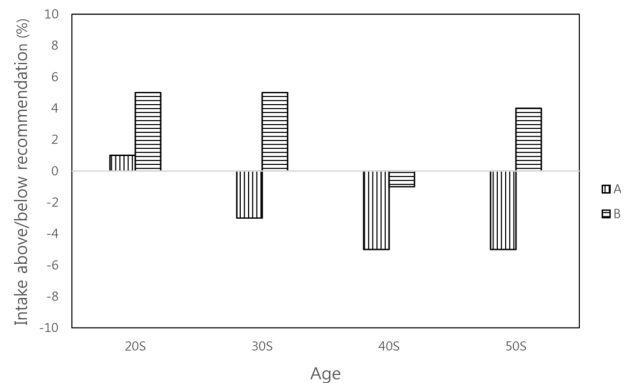


Fig. 1. Percentages of intake food during six months above/below recommended dietary allowances according to ages.

3.6 kg and 1.0 kg, respectively. The significance of *F* for 40s with exercise (A) was 3.954, which was significant because it was less than the criterion value of 0.05. There was a significant difference in the time (six months) taken exercise after eating controlled foods. They lost a lot of weight and body fat. Though they were not a food control group, they performed exercise and food control very well (Fig. 1). Because of obesity, each person exercised diet and exercise. Thus, the divergent results for % fat change may be attributable to the marked fat loss coupled with changes in lean mass from the exercise. The body weight of 50s with exercise and food (A) and only exercise (B) decreased about 4.5 kg and 2.7 kg, respectively. *F* of 50s with exercise and food was 4.856 and there was significant difference. The 50s A per-

formed exercise and food control very well, but the group 50s B did not do food control very well (Fig. 1). The 50s man is deemed to be decreasing-weight due to the increased weight of their skeletal muscle. The three men of the group 50s B-participants were sometimes absent from the exercise session or were eating irregular meals. Decrease of SMM and body fat were contributed with lost a lot of weight.

Body composition analysis

Table 3 shows body composition analysis and change over six months exercise training. While total body water decreased in 20s (groups A and B), 30s (group B), 40s (group B), and 50s (group B), all other values did not shown significant differences. Difference between total body water

Table 3. Body composition analysis and change over one year exercise training

Gender (Age)	Measure	Baseline	6 months	One year	<i>F</i> , <i>p</i>
Male (20s) A	Intracellular Water	24.4±1.48	24.2±1.26	25.4±1.58	1.087, NS
	Extracellular Water	17.7±2.13	17.3±1.93	15.1±2.11	3.032, NS
	Protein	11.0±0.82	11.5±0.74	11.7±0.97	1.127, NS
	Mineral	3.80±0.49	3.92±0.42	3.93±0.54	0.116, NS
Male (20s) B	Intracellular Water	28.4±1.73	28.3±1.82	28.4±1.73	0.019, NS
	Extracellular Water	15.7±1.01	14.9±3.91	15.8±0.78	0.101, NS
	Protein	11.0±0.88	11.5±0.86	11.7±0.94	1.127, NS
	Mineral	4.17±0.25	3.40±0.41	3.42±0.34	0.049, NS
Male (30s) A	Intracellular Water	31.4±1.58	29.1±3.12	30.8±1.58	4.782, *
	Extracellular Water	17.4±2.78	17.1±2.10	15.2±2.27	10.253, **
	Protein	10.7±2.58	11.2±2.94	12.5±4.24	0.790, NS
	Mineral	4.46±0.27	4.62±0.34	4.66±0.27	0.636, NS
Male (30s) B	Intracellular Water	29.2±2.90	29.0±2.89	29.0±3.16	0.002, NS
	Extracellular Water	17.0±1.65	16.8±1.67	16.6±1.45	0.101, NS
	Protein	12.5±1.08	13.0±1.56	12.5±0.85	0.336, NS
	Mineral	4.23±0.33	4.17±0.23	4.07±0.30	0.049, NS
Male (40s) A	Intracellular Water	31.4±1.58	29.5±1.81	29.0±1.01	6.503, *
	Extracellular Water	15.7±2.70	15.1±2.26	13.2±2.77	4.573, *
	Protein	11.4±1.16	11.7±1.15	13.3±1.10	3.945, *
	Mineral	6.08±2.67	4.71±1.93	4.47±1.87	0.787, NS
Male (40s) B	Intracellular Water	28.1±2.25	27.8±2.40	27.5±2.30	0.084, NS
	Extracellular Water	16.6±1.83	16.5±2.24	16.2±2.12	0.064, NS
	Protein	12.7±1.91	12.4±1.11	12.8±0.56	0.170, NS
	Mineral	4.06±0.36	4.17±0.23	4.13±0.17	0.048, NS
Male (50s) A	Intracellular Water	33.9±1.58	32.4±1.34	32.4±2.75	4.148, *
	Extracellular Water	16.1±2.91	14.9±1.34	14.6±1.26	4.124, *
	Protein	11.0±1.17	12.1±1.40	13.4±2.07	2.874, NS
	Mineral	3.46±0.20	3.56±0.05	3.57±0.29	0.461, NS
Male (50s) B	Intracellular Water	25.6±3.26	23.7±2.64	24.1±2.84	0.597, NS
	Extracellular Water	16.3±1.35	15.4±1.54	15.5±1.42	0.530, NS
	Protein	11.3±1.19	11.6±1.13	12.8±0.66	3.054, NS
	Mineral	3.84±0.35	3.94±0.45	4.12±0.18	1.364, NS

NS: Non-significant, $p > 0.05$. *: Significant, $p < 0.05$. **: Significant, $p < 0.01$.

was related to body fat loss. Three groups (30s A, 40s A, and 50s A) were shown significant differences. Weight alone does not correctly reflect the effects of exercise. Loss of weight reflected the combined effects of exercise and improved diet. Mineral help the body preserve and play a care role in the human body. Mineral mass was closely related to protein and soft lean mass. Protein and minerals increased in the 20s A, 30s A, and 50s men (A and B). Some men in 20s B and 40s B have lost her protein and minerals.

Table 4 shows men obesity analysis and change, throughout six months of exercise and/or controlled food, had minimal change. Overall, the BMI index improved significantly through exercise. There was a significant decrease in BMI in the 40s A and 50s A. Waist-Hip ratio (WHR) is determined by dividing the waist circumference from the navel line by the hip's maximum circumference. It is a useful indicator for comprehending the distribution of body fat. There was no significance, but the WHR index improved except 20s B. Visceral fat area is defined here as the cross-sectional area of visceral fat found in the abdomen. Indices of visceral fat

were not significantly different among groups, but was much lowered.

Discussion

Understanding the effects of exercise on food intake is complicated by limitations of methodology [15]. Several independent variables also affect the results of exercise-food intake studies, even with laboratory rats where food intake measurements can be quite accurate. These variables include exercise protocols, subject characteristics, types and amounts of food available for consumption, environmental conditions, and sociocultural factors. Participants were asked to maintain their normal dietary and physical activity programs throughout the duration of the study. Physical activity is often considered a futile form of weight control because of the possible concomitant compensation of food intake. However, it should be noted that some studies have shown that exercise induces a brief suppression of appetite (hunger) [8], even if this does not necessarily translate into

Table 4. Obesity analysis and change over one year exercise training

Gender (Age)	Measure	Baseline	6 months	One year	F, p
Male (20s) A	BMI	23.4±2.10	23.4±1.99	22.9±1.91	0.276, NS
	Waist-Hip Ratio	0.86±0.12	0.85±0.07	0.84±0.08	0.130, NS
	Visceral Fat	6.0±1.12	5.6±1.82	5.0±1.83	1.708, NS
Male (20s) B	BMI	25.8±1.55	25.7±1.41	25.6±1.21	0.183, NS
	Waist-Hip Ratio	0.97±0.09	0.96±0.09	0.97±0.11	0.182, NS
	Visceral Fat	9.40±2.70	9.20±0.85	8.80±2.39	0.676, NS
Male (30) A	BMI	25.2±1.45	24.6±1.59	23.4±0.79	1.052, NS
	Waist-Hip Ratio	0.92±0.02	0.90±0.05	0.85±0.06	2.811, NS
	Visceral Fat	7.7±0.58	7.5±1.29	6.4±1.14	2.472, NS
Male (30) B	BMI	26.3±0.99	26.0±1.18	25.9±1.03	0.018, NS
	Waist-Hip Ratio	0.97±0.08	0.96±0.09	0.96±0.09	0.018, NS
	Visceral Fat	7.80±2.95	7.60±3.13	7.20±2.77	0.922, NS
Male (40) A	BMI	26.1±0.47	25.3±1.02	24.7±1.01	3.954, *
	Waist-Hip Ratio	0.95±0.03	0.91±0.03	0.87±0.04	1.738, NS
	Visceral Fat	6.7±1.15	5.6±1.34	4.6±1.34	4.739, *
Male (40) B	BMI	26.9±1.28	26.2±0.57	26.1±0.61	1.030, NS
	Waist-Hip Ratio	1.01±0.07	0.94±0.05	0.91±0.08	3.037, NS
	Visceral Fat	8.40±3.76	8.01±3.54	7.40±3.21	0.747, NS
Male (50) A	BMI	26.8±0.53	26.0±0.80	25.7±0.56	4.856, *
	Waist-Hip Ratio	0.94±0.05	0.92±0.06	0.90±1.71	1.061, NS
	Visceral Fat	7.0±1.41	6.8±0.96	5.0±1.71	2.051, NS
Male (50) B	BMI	26.3±1.02	25.6±1.59	25.3±0.71	0.902, NS
	Waist-Hip Ratio	1.01±0.07	0.94±0.05	0.91±0.08	3.037, NS
	Visceral Fat	7.80±2.49	7.40±2.30	7.20±2.39	0.834, NS

BMI: Body mass index. *: Significant, $p < 0.05$.

a decrease in subsequent food intake. Men who detrain after 6 months of training regain bodyweight and body fat lost during training despite a reduction of energy intake and the percentage of calories from dietary fat.

Most participants who fall into this body type have an excessive amount of body weight and are diagnosed as being chronically obese. In these individuals, it is common to see the measured SMM over the average range [7]. While body weight decreased for 40s and 50s with exercise and food, all other values did not shown significant differences. However, difference between % fat change measurements was related to fat loss. Participants exposed to exercise commercials reduced their caloric intake by 1-7% relative to the control condition.

Fitness was correlated with self-reported total caloric intake in males. There was no weight change in either control or trained subjects. Research results range from increased carbohydrate, fat, or protein consumption to no change in significant body composition (20s A, 20s B, 30s B, 50s B). Men who detrain after 6 months of training regain bodyweight and body fat lost during training despite a reduction of food energy intake and the percentage of calories from dietary fat. Because regular exercise can lead to energy intake, weight or fat loss may not be significantly reduced. Therefore, care must be taken not to supplement the energy consumed by the regular exercise with food, which can reduce weight and fat content. Regularly performed strenuous exercise decreased the amount of food consumed by male rats, resulting in decreased body weight and fat caused by the caloric cost of exercise and the decreased food intake [14].

This study has several limitations. There is certainly a need for more comprehensive studies to better understand the relationship between the intensity of exercise and foods.

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초록 : 운동과 영양 조절이 남성 연령별 체조성 및 비만에 미치는 영향

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본 연구는 운동과 영양 조절을 통한 남성 체 구성을 조사하였다. 훈련을 수행하는데 문제가 없는 건강한 40명을 임의로 선정하여 20명에게는 운동과 영양조절 그룹으로 선정하였고, 나머지 20명에게는 운동만 6개월간 수행하도록 하였다. 실험조건 동안 운동강도를 정확하게 측정하기 위해 최대산소 소모량($VO_2 \text{ max}$)을 측정하였다. 운동과 영양조절일 실시한 20대 남자와 운동만 수행한 남자는 6개월 후 체중이 2.3 kg과 0.4 kg이 감소하였다. 0~3개월 간 실시한 결과에서 체중 측정값에 p 값은 0.697이었으며, 3~6개월 측정값의 p 값은 0.535로 나타났고, 0~6개월 측정값의 p 값은 0.617로 나타났다. 20대의 골격근은 약간 증가하였다. 30대의 체중은 6개월 후 운동과 영양조절 그룹이 4.0 kg, 운동만 수행한 그룹에서 1.3 kg이 감소하였다. 비록 체중의 감소는 골격근의 증가와 연관성이 있지만 유의성은 없었다. 체중의 변화는 지질 감소와 수분(세포 내 및 세포 간 수분) 감소와 연관이 있었다. 30대를 제외한 20대, 40대, 50대의 체중 감소는 있었지만 유의성은 없었다.