Effects of Different Types of Exercises on Body Composition in Young Men and Women

Yilmaz UCAN

Abant Izzet Baysal University, School of Physical Education and Sports, Bolu, 14280, Turkiye
mr_ucan@hotmail.com

Abstract: The purpose of this study was to determine the effects of different types of exercises on body composition in young men and women. Thirty-seven physical education and sports college students participated in the study voluntarily. Height, body weight, body mass index, and waist-to-hip ratio measurements were held. Skinfold measurement taken from seven sites was conducted by a caliper and percent body fat values were calculated by using the Siri equation. After completing the pre-test measurements, the subjects were randomly assigned into one of these groups: aerobic exercise, resistance exercise, and combined (both aerobic and resistance). At the end of the 10-week training period, paired t-test results showed that there was a significant ($p<0.05$) decrease in the aerobic exercise and combined exercise group subjects' body weight, body mass index, waist-to-hip ratio, % body fat, and skinfold measurements. In the resistance exercise group, while there was a significant ($p<0.05$) decrease in the % body fat, skinfold, and waist-to-hip ratio values, changes in the body weight and body mass index were not significant ($p>0.05$). ANOVA test results revealed no significant differences among the exercise groups on body compositions. These results showed that aerobic and combined exercises had a decremental influence on the body weight, body mass index, % body fat, skinfold, and waist-to-hip ratio values. Resistance exercises showed an influence on decreasing % body fat rather than decreasing body weight.
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1. Introduction

Both coaches and sportsmen are strongly agreed that, for top level performance in sports, it is important to keep the body weight at its optimum. The critical point for success in almost any sports activity is "optimum" sport-specific body size and body composition (Wilmore & Costill, 1994). Body weight refers to a person's body size or body mass. Body composition can be defined as absolute and relative amounts of muscle, bone, and fat tissue composing body mass (Heyward, 1991). Body composition is the chemical compound of the body. When explaining body composition, scientists often mention two components: fat mass (FM) and fat-free mass (FFM). While FM refers to the relative body fat percentage (%BF) that the total body mass has, FFM basically refers to, all the body components except FM (Wilmore & Costill, 1994).

Body composition is a key component of the health and physical fitness profiles of the people. Exercise scientists emphasize the importance of being aware that people may be overfat although they don't look overweight (Heyward, 1991). Body composition and body weight are among the factors that contribute to optimal exercise performance. These two factors may affect an athlete's potential for success for a given sport. Body composition can affect an athlete's strength, agility, and appearance whereas body weight can influence an athlete's speed, endurance, and power (ACSM, 2009). Body composition is an important component that improves maximal work capacity by affecting training based alterations and some physiological parameters. It will be helpful to assess the body composition periodically for a coach or trainer to be aware of the current states of the sportsmen and adjusting the intensity of the training. By doing so, coaches may make some alterations in their training programs to obtain the desired, or optimal, body weight for the top performance (Ramana et al., 2004). Body structure, size and composition are mostly determined by heredity through the genes from parents. However, it does not mean that the structures that determine the physical profiles of the athletes will never be changed or improved by anything. Although the body size and structure may be altered a little, there may be great changes on body composition by diet and exercise. By this way, the changes needed to reach at the top physical performance are established (Wilmore & Costill, 1994). The eventual cause of gaining weight that has a negative effect on body composition is the excess energy intake over expenditure, or positive energy balance (Jakicic & Otto, 2006). Energy balance is affected by the energy expenditure as a result of exercise. The most effective and important factor to stimulate the energy release is the energy expenditure based on physical activity (Jakicic & Otto, 2006; Heyward, 1991). Research proves that regular participation to exercise programs may change the body composition of the attedants and has positive effects on the aging of the organism (Heyward, 1991; Falls, 1968). The physical activities at proper intensity are very important to lose weight and to prevent from regaining weight (Andersen & Jakicic, 2009). In this context, physical activity is an important factor on controlling body weight and FM by increasing energy expenditure. Sports researchers study on different and new forms of exercise to control weight, to improve body composition and exercise performance, and to support health.

There is a general acceptance that continuous endurance trainings are more advantageous to lose body weight and to change body composition, because they increase the energy expenditure than do the other forms of training (Ballor & Poehlman, 1992). On the other side, if the first objective of an individual is to decrease his/her own %BF, the most ideal exercise method to advise is to attend to a CE program. It is because, that type of training (aerobic and resistance together) is seen effective on increasing FFM and decreasing FM (Hoffman, 2002). Aerobic exercise (AE) and resistance exercise (RE) are effective to make body weight and composition better (Heyward, 1991). Cardiorespiratory training and weight training, in both men and women, are effective methods on decreasing %BF, FM, skinfold (SF) thickness and body weight (Heyward, 1991). Beside these; the most effective trainings to decrease the FM are moderate intensity resistance and endurance trainings. Further, the RE promotes an increase in muscle mass (Wilmore & Costill, 1994). On the other hand, there are some studies in literature showing that RE has positive effects on body composition. These changes are not limited to increase in individuals' muscle mass and muscle strength. They also contribute to improving fitness components, decreasing FM, and increasing the ratio of FFM by the decrement of the FM. This situation affects the athletes' performance positively (Hoffman, 2002). Strength training is an effective type of exercise that leads biochemical, neurological, and morphological changes in the muscle tissue and alters the body composition, as well (ACSM, 2001). Research showed that isotonic strength trainings changed body composition significantly in both men and women (Brown & Wilmore 1974; Wilmore, 1974).

As shown, there are different forms of exercises under research to contribute to improving body composition. Any treatment affects the FM, FFM or total body weight differently. In this context, the aim of this study is to try to reveal which types of exercise are more effective in improving body composition which is critically important in athletic performance and health.

2. Material and Methods

2.1. Participants

A total of 37 students (23 men and 14 women, aged 22-29) from the school of physical education and sports department volunteered to participate in this study. All subjects have been informed of the purpose of the study, completed a medical history form and signed a written consent form approved by the Clinical Research Ethics Committee of Abant Izzet Baysal University. They were also informed that they could withdraw from the study at any time, even after giving the written consent. Participants meeting the criteria were randomly assigned into one of the three exercise treatment groups: AE, RE or combined (aerobic and resistance) exercise (CE).

2.2 Anthropometric Measurements

Anthropometric measurements were performed according to the protocols of the International Society for Advancement of Kinanthropometry (ISAK, 2001). All anthropometric measurements were conducted by same trained staff.

Weight and height: All measurements were performed by trained staff and took place under laboratory conditions. Participants were asked not to eat or drink within 2 hours before the appointment and to empty their bladder before the measurements were started. The weights were measured to the nearest 10 g using a digital scale. Subjects were weighed in the morning with shorts, t-shirt and on bare feet. Height measurements were held by using a metal meter with 0.01 cm sensitivity. BMI was calculated as kg/m^2. Waist and hip circumferences were measured using a non-stretchable tape to the nearest 0.1 mm. Waist circumference was measured at the mid-point between the iliac crest and the lower rib margin, while hip measurement was taken as the maximum circumference around the buttocks posteriorly and pubic symphysis anteriorly. The waist-to-hip ratio (WHR) was calculated for each subject by using the equation below:

WHR = waist circumference (in centimeters) / hip circumference (in centimeters)

Skinfold thickness: Skinfold thickness was measured on the right side of the body. In total, eight skinfolds (triceps, subscapular, biceps, iliac crest, supraspinale, abdominal, front thigh, medial calf) were measured according to the protocol recommended by ISAK. Skinfold thickness was measured in triplicate using Holtain (Holtain Ltd, Crymych, UK) skinfold caliper. The sum of seven of eight skinfolds was calculated. For each skinfold, the mean of all three trials was taken as the final measurement. All measurements were done by a well-trained anthropometrist.

Determining %BF: Durnin and Womersley (1974) equations were used to determine the body density. Durnin and Womersley equations for ages between 20-29 for men and women are; D = 1.1631 – (0.0632

* L) and D = 1.1599 – (0.0717 * L), respectively. D = predicted body density (g/ml), and L = log of the total of the 4 skinfold thicknesses (triceps, subscapular, biceps and iliac crest) (in mm). The density values were converted to %BF using the Siri Equation given below:

%BF = (495 / Body Density) – 450.

2.3 Exercise program

After completing the pre-test measurements, each subject participated for 10 weeks, and three days per week in one of the exercise groups, AE, RE, or CE. All subjects were instructed not to change regular daily activities and dietary habits.

AE protocol: The exercise intensity for the AE group (n=11) was set to 75-80% of the maximum heart rate which was calculated by using Karvonen formula which is given below:

Target heart rate = (220-age) x intensity%

The subjects were trained for 10 weeks, 3 days per week and 65 minutes of aerobic exercise each session. The AE program was composed of 5-10 minutes of warm-up exercises, 50 minutes of aerobic exercise (running), and 5 minutes for the cool-down and stretching exercises. All of the exercise sessions were by appointment and were supervised by a physical educator.

RE protocol: A total of 14 subjects were in the RE group. The resistance training program was a circuit training model that included the following 16 exercises: barbell curl, preacher curl, pushdown, triceps extension, back press, lateral raise, dumbbell fly, pec deck fly, lat pull down, seated row, leg press, leg extension, lying leg curl, floor hip extension (kick back), floor hip abduction, and crunch. Every training session began with a 5 to 10-min warm-up. During the resistance training sessions, subjects performed three sets for each exercise and 10-12 repetitions per set, with an intensity equivalent to 50-60% of their one repetition maximum. A resistance training session lasted approximately one hour.

CE protocol: 12 subjects were involved in the combined exercise treatment group. CE consisted of two phases. The initial phase was aerobic (CE_A) and the next was resistance (CE_R) training. The exercise intensity for the CE_A group was set to 75-80% of the maximum heart rate which was calculated by using Karvonen formula. This group was trained for 10 weeks, 3 days per week and 30-35 minutes of aerobic exercise each session. CE_A program was composed of 5 minutes of warm-up exercises, 25 minutes of CE_A, and 5 minutes for the cool-down and stretching exercises. CE_R program was a circuit training model that included the following 9 exercises: barbell curl, pushdown, back press, lateral raise, lat pull-down, leg extension, lying leg curl, floor hip extension (kick back), and crunch. Training sessions began with a 5 to 10-min warm-up. During CE_R, subjects performed three sets for each exercise and 10-12 repetitions per set, with an intensity equivalent to 50-60% of their one repetition maximum. A CE_R session lasted approximately one hour. The participants attended CE_A in the morning, after having a rest for a few hours, attended CE_R in the afternoon.

2.4 Statistical Analysis

The mean and standard deviations (mean ± SD) were calculated as descriptive statistics. Data were analysed by using Statistical Packages for the Social Sciences software (SPSS for Windows version 10.0.5). Differences between pre- and post-test were analysed using paired *t*-tests. The difference between the groups was analysed by ANOVA. The level of significance was set at $p<0.05$.

3. Results

The major findings of the present study are related to the changes in the body composition of young men and women who participated in one of the three different training programs while diet was not controlled. Men and women did not differ in their responses for any variables measured, and thus, the data were analysed together for each group.

The pre- and post-test body composition results of the AE group are presented in table 2. AE group showed a significant decrease in body weight (t=-2.88; p<.05), in BMI (t=-2.77; p<.05), in %BF (t=-2.98; p<.05), in SF (t=-4.32; p<.05) and in WHR (t=-5.71; p<.05).

Table 1. Pre-test means and standard deviations (mean ± SD)

Variable	AE n = 11		RE n = 14		CE n = 12	
	M	F	M	F	M	F
	n=7	n=4	n=8	n=6	n=8	n=4
Age (yr)	25±2	26±2	24±1	24±1	25±1	24±1
Weight (kg)	78±6	57±4	65±7	54±5	74±8	54±7
Height (cm)	176±1	162±1	175±1	165±1	175±1	163±1
BMI (kg/m^2)	25±2	22±1	22±2	20±1	24±1	20±2
WHR (cm)	0.88±0.04	0.76±0.04	0.84±0.04	0.76±0.06	0.87±0.03	0.74±0.03
BMI = body mass index, WHR= waist-to-hip ratio, M=male, F=female						

Table 2. Paired t-Test results for AE group.

	Mean ± SD	Mean	SD	t	df	P
$Weight_{1kg}$ $Weight_2$	70.1 ± 12.0 69.3 ± 11.6	-.78	.89	-2.88	10	.016*
BMI_{1kg/m^2} BMI_2	24.1 ± 2.7 23.8 ± 2.5	-.25	.30	-2.77	10	.020*
$\%BF_1$ $\%BF_2$	23.4 ± 4.9 22.1 ± 5.2	-1.10	1.23	-2.98	10	.014*
SF_{1cm} SF_2	99.97 ± 23.3 93.30 ± 22.9	-6.67	5.11	-4.32	10	.001*
WHR_{1cm} WHR_2	0.83 ± .07 0.80 ± .07	-.036	.021	-5.71	10	.000*

*Significant at $p<.05$

The pre- and post-test body composition results of the RE group are presented in table 3. RE group showed a significant decrease in %BF (t=-2.98; $p<.05$), in SF (t=-4.32; $p<.05$) and in WHR (t=-5.71; $p<.05$), but there were no significant change in the body weight (t=-.93; $p>.05$) or BMI (t=-.93; $p>.05$).

Table 3. Paired t-Test results for RE group.

	Mean ± SD	Mean	SD	t	df	P
$Weight_{1kg}$ $Weight_2$	60.6±8.5 60.3±8.4	-.32	1.28	-.93	13	.366
BMI_{1kg/m^2} BMI_2	20.6±2.2 20.5±2.1	-.11	.45	-.93	13	.368
$\%BF_1$ $\%BF_2$	20.0±6.4 18.6±6.1	-1.42	.85	-6.25	13	.000*
SF_{1cm} SF_2	75.8±25.4 69.3±22.9	-6.57	5.8	-4.21	13	.001*
WHR_{1cm} WHR_2	.80 ± .06 .78 ± .05	-.018	.030	-2.27	13	.041*

*Significant at $p<.05$

The pre- and post-test body composition results of the CE group are presented in table 4. CE group showed a significant decrease in weight (t=-3.71; $p<.05$), in BMI (t=-3.91; $p<.05$), in %BF (t=-4.17; $p<.05$), in SF (t=-4.86; $p<.05$) and in WHR (t=-3.39; $p<.05$).

Table 4. Paired t-Test results for CE group.

	Mean ± SD	Mean	SD	t	df	P
$Weight_{1kg}$ $Weight_2$	66.9±13.6 65.5± 12.7	-1.39	1.29	-3.71	11	.003*
BMI_{1kg/m^2} BMI_2	22.8± 2.5 22.3± 2.2	-.45	.40	-3.91	11	.002*
$\%BF_1$ $\%BF_2$	20.8± 5.1 19.5± 5.1	-1.28	1.06	-4.17	11	.002*
SF_{1cm} SF_2	83.8±18.6 75.8±18.9	-8.02	5.7	-4.86	11	.000*
WHR_{1cm} WHR_2	.82 ± .07 .80 ± .06	-.021	.021	-3.39	11	.006*

*Significant at $p<.05$

The result of ANOVA is presented in table 5. There is no statistical difference between any groups ($p>.05$).

Table 5. ANOVA results between groups.

Variables		df	Mean Square	F	Sig.
Weight, kg	Between Groups	2	3,705	2,618	,088
	Within Groups	34	1,415		
	Total	36			
BMI, kg/m^2	Between Groups	2	,384	2,384	,107
	Within Groups	34	,161		
	Total	36			
%BF	Between Groups	2	,618	,514	,603
	Within Groups	34	1,202		
	Total	36			
SF, cm	Between Groups	2	8,080	,259	,774
	Within Groups	34	31,239		
	Total	36			
WHR,cm	Between Groups	2	,001	1,648	,207
	Within Groups	34	,001		
	Total	36			

4. Discussions

In the present study, the effects of three different types of exercises, with no dietary restriction, on some of the body composition parameters, %BF, WHR, BMI, SF and body weight, are examined. The results of this study showed that each of the exercise groups (AE, RE and CE) improved body composition parameters.

In the AE group, statistically significant differences are seen on %BF, WHR, SF and body weight, at the end of the 10-week training period. The differences are -1.1 %, -.036 cm, -6.67 cm, -0.8 kg, respectively. Many studies prove these findings. Wilmore et al. (1970) studied the effects of jogging exercises, conducted for ten weeks/three days per week, on the body composition changes. In the study mentioned, there was no control on the dietary regimens of the subjects neither was in our research. At the end of the 10-week jogging program, there were minor but significant differences on the body composition of the subjects. The body weight decreased a little more than 1 kg, %BF decreased from 18.9% to 17.8; skinfold measurements taken from scapula, chest, midaxillar and thigh showed a significant decrease. In another research, Lean et al. (1979) studied the effects of high intensity walking exercises on the body composition, carbohydrate and lipid metabolisms of young males. There was no control over the diet programs of the subjects through the study. The subjects followed a high intensity walking exercise program for 16 weeks, 5 days per week for 90 mins a day. At the end of the 16-week program, there was a decrease on the subjects' FM (5.9 kg) and an increase on the FFM (0.2 kg). Similarly, Marra et al. (2005) studied the effects of moderate and high intensity AE on the body composition of the obese males. At the end of a 14-week exercise period, any of the AE treatments showed positive effects on the body composition, but it was concluded that high intensity exercises did better than did moderate intensity exercises.

In the present study, the effects of the RE on the body composition parameters were examined, as well. It seems that RE caused positive alterations on the body composition. These alterations are not limited to muscle mass or muscle strength. At the same time, although the improvements in the fitness components and body weight are minor, it seems as a decrease in %BF and an increase in FFM (Heyward, 1991; Hoffman, 2002). In the RE group, although a statistically significant decrease in the %BF, WHR, and SF is seen, the differences in the body weight and BMI are not significant. %BF, SF, and WHR decreased 1.42 %, 6.57 cm, and -0.18 cm, respectively. In literature, there are abundant studies about the effects of RE on the body composition and body weight. There are some studies in literature that have similar findings along with the present study. Shaw et al. (2009) studied the effects of RE on abdominal fat, with no energy intake restriction during the study. 25 healthy male subjects (25±1 years) participated in that study. The RE program was executed for 16 weeks, 3 times per week. At the end of the 16-week period, although there were no significant changes on the subjects abdominal fat (waist circumference and WHR), there were significant decreases in the subjects' %BF, total skinfold, and BMI values. Ferreira et al. (2009) conducted a study on 14 sedentary females (33-45 years) to reveal the effects of a 10-week, 3 days per week, circuit resistance training (CRT) on the body composition. The results of the study proved that CRT increased the FFM, decreased the FM and %BF. 47 female and 26 male (mean 20.3 years) volunteered for a study conducted by Wilmore (1974). REs lasted for 10 weeks, 2 days per week. Body composition measurements via hydrostatic weighing were held both at the beginning and at the end of the study. At the end of the 10-week period, it was seen that the changes on body compositions were similar for both males and females. Body weights of the subjects did not change during the 10-week period, but relative FM decreased 10% and 7.6% for males and females respectively, yet a significant decrease in the seven-site skinfold measurements. In some other studies, researchers found no significance of RE on body composition. Brown and Wilmore (1974) conducted a research in which 7 female national throwers (aged 16-23) were participated voluntarily. REs were followed for 6 months, 3 days per week. At the end of the 6-month period, all of the subjects showed a considerable gain in strength, but no significant changes in their body weights or %BF were observed. Hanson et al. (2009) used 81 healthy volunteer subjects (male=35, female=46; aged 65-85) in his research and at the end of a 22-week RE, 3 days per week, he concluded that for both males and females, there was a significant increase FFM of the subjects but no difference in %BF.

At the present study, the effects of combined CE on the body composition parameters were examined. When the main purpose of a person is to decrease %BF, the best training method to advise is the combination of endurance and REs. It is because, this type of exercise is considered to be effective in increasing FFM and decreasing FM (Hoffman, 2002). In the CE group, at the end of the 10-week period, a significant decrease on %BF, WHR, BMI, SF, and body weight values were observed. The average amounts of decrement are as follows: 1.39 kg of body weight, 1.28 %BF, 8.02 cm of skinfold total and .021 cm on WHR. There are plenty of studies supporting the findings of the present study. Twelve mid-aged women participated in one of these studies. In the study mentioned, the effects of the CE on the regional body composition were examined. The treatment lasted for 14 weeks, 3 days per week and at the end of this period, no significant difference in total body weight was observed but %BF decreased (1.4%) and total FFM increased (2.2%) significantly (Fleck et al; 2006). Park et al. (2003) randomly divided 30 obese women as AE, CE and control groups. Treatments lasted for 24 weeks and at the end of this period, CE showed better results in decreasing abdominal fat, when compared to AE alone. There was a decrease in the mean body weight of the AE group by 4.7 kg, and 9.2% in the %BF while there was no change on the FFM. The CE group showed a significant (p<0.05) increase in the FFM while there was a decrease in the mean body weight by 6.4 kg and 1.3% decrease in the %BF. As a result, Park et al. indicated that CE was better for optimizing body composition. Similarly, Seo et al. (2010) showed in his 12-week study, where 22 mid-aged women participated voluntarily, that CE was better than AE in optimizing body performance. As stated above, besides these supporting researches, one may also find some researches that contradict the findings of the present study. In one of these contradicting studies, when CE group and a control group compared at the end of a 24-week, 3 days per week, the results showed that there was no significant difference on the body composition of the male subjects (Dantas et al., 2008). Similarly, Dhooge et al. (2011) did not observe any difference in their study on subjects (n=16) with type I diabetes mellitus when the researchers applied CE trainings for 20 weeks, they found no significant difference on body weight, BMI, waist circumference, BFM, and FFM.

According to the ANOVA results acquired from the present study, it was examined which of the training forms was the most effective on the body composition parameters. At the end of the 10-week training, there was no statistical difference on the %BF, WHR, SF and body weight values among the AE, RE and CE groups. Any of the exercise groups showed similar effects. Silanpaa et al. (2009) stated that, 47 healthy men, aged 40-65participated in their study and the subjects divided into 3 training groups. At the end of the 21-week AE, RE and CE trainings, every group showed a significant decrease on %BF values. All of the subjects (n=47) showed some decrease on their weight, BMI, WHR, and %BF values during the training period. However, there was no difference on BMI, waist circumference and %BF values among the groups. There are many studies supporting the present study as well as opposing ones. 48 sedentary women (mean age 20.4) participated voluntarily on the study conducted by LeMura et al. (2000). At the end of a 16-week training period, no significant decrease was seen on %BF in RE or CE groups but in the AE group (p<0.05; %13.2). In another experimental study, there were 30 obese women (BMI>30; aged 30-45) participants. The subjects were randomly classified as control, AE and RE groups. Training groups exercised for 6 weeks, 3 days per week. There was no dietary restriction for the subjects. At the end of the 6-week exercise, both groups showed an improvement on both BMI and %BF values, but when the groups were compared statistically, no significant difference was observed (Chaudhary et al., 2010). Nevertheless, there are some studies that revealed some different results. In one of these studies, 30 healthy and physical active men (20.0±1.6 aged) participated. The subjects randomly assigned into one of these groups: AE, RE and CE. No specific diet was enforced. The groups trained for 10 weeks, 3 days per week. At the end of the 10-week period, all groups showed significant decrease on %BF and FM when compared to the pre-test values. When the groups were compared, it was found that %BF and FM of CE group were significantly less than they were in the AE and RE groups (Dolezal & Potteiger, 1998). Both the findings of the present study and literature review show that exercise applications, no matter in which form, have effects on increasing energy expenditure and creating a negative energy balance and on improving body composition parameters in this manner. Nonetheless, according to the findings of the present study and the literature reviewed, individuals, trainers or health professionals should determine the proper exercise forms to support physical performance and for health advantages. In this context, although it is hard to say it exactly, according to the findings of the present study, aerobic-type exercises seemed to have a positive impact mostly on the body weight, subcutaneous FM, and %BF. The RE was seemed to have a positive impact on subcutaneous FM, %BF, and WHR values, even though that type of exercise was considered to have little impact on the body weight. According to the results of the present study, although there was no statistically significant difference in favor of the CE, it was found that this type of exercise had significant corrective effects on the body weight, subcutaneous FM, %BF and WHR values which were examined as the body composition parameters. Consequently, it may be considered that CE applications can be a better choice, for especially young men and women, to have a better body composition, to gain strength and take advantage of these in the athletic events for specific sports.

Corresponding Author:
Yilmaz UCAN, PhD
Abant Izzet Baysal University, School of Physical Education and Sports, Bolu/Turkiye
Phone: +90 (374) 2534571
Fax: +90 (374) 2534636
E-mail: mr_ucan@hotmail.com

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