

Effects of eight-week aerobic exercises combined with resistance training on cardiovascular risk factors in women

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Abstract

Study aim: Main purpose of this study is to examine the effects of moderate-intensity exercises for eight weeks, combined with cardio and resistance exercises, on the cardiovascular risk factors for women.

Material and methods: A total of 30 volunteer females between the ages of 40 and 65 participated in the study. The volunteers were divided into two groups as exercise and control. The exercise group was given exercises three days a week. Height, weight, body mass index, waist, hip, waist-to-hip ratio, resting blood pressure, resting heart rate, total cholesterol, triglycerides, high-density lipoprotein, low-density lipoprotein, glucose levels were collected before and after the exercise program.

Results: There was a significant decrease in weight, body mass index, hip circumference levels after the exercise program ($p < 0.05$), while no significant difference was detected for waist circumference and waist-to-hip ratios ($p > 0.05$). While a significant decrease in systolic blood pressure, diastolic blood pressure, and triglycerides levels of the exercise group was observed after the exercise program ($p < 0.05$), no significant change was found in glucose, cholesterol, high density lipoprotein, and low density lipoprotein levels ($p > 0.05$).

Conclusion: It was observed that moderate intensity exercises combined with cardio and resistance exercises resulted with positive effects on cardiovascular risk factors.

Key words: Aerobic exercise – Resistance exercise – Cardiovascular risk factors

Introduction

Cardiovascular diseases (CVD) are a group of disorders which include many illnesses such as hypertension, coronary heart disease, heart failure, cerebrovascular event (also known as CVA-stroke), peripheral vascular disease, ischemic heart disease, etc. and cause great harms to public health [42]. According to the data submitted by the World Health Organization (WHO), CVD ranks first among the global causes of death and approximately 17.9 million people die yearly due to the aforesaid diseases [39]. CVD accounted for, at the beginning of the 20th century, less than 10% of the causes of death worldwide, but the rate has increased over time, and since the beginning of the 21st century, it has become responsible for 50% of the causes of death in developed countries and 25% in developing countries [28]. While CVD remains as the primary cause of death in the majority of the world, the

prevalence of overweight and obesity has also increased in many regions of the world and such a condition has contributed to an increase in several CVD risk factors [1]. The high mortality rates caused by CVD bring the risk factors to be detected and the necessary precautions to be taken in this direction, and the protection of high-risk individuals. Fundamental prevention measures are the practices that include behaviour change initiatives such as quitting smoking, healthy nutrition, control of blood pressure and weight, and regular exercising [30].

A sedentary lifestyle is one of the fundamental risk factors for CVD [37], and increasing the level of physical activity is a considerable factor in reducing this risk element [22]. Exercises, which have positive effects on the muscle, heart, and respiratory system, play a leading role in treatment and management of common metabolic diseases [5]. The effect of regular exercise in terms of improving quality of life is associated with reduced body fat, obesity, increased muscle strength, improved health, and alleviation

of muscle soreness. Exercise plays, also, an important role in reducing the risk of CVD, hypertension, osteoporosis, cancer, and diabetes [17]. Besides the importance of positive contributions of regular exercises to human health, the exercise prescription to be applied is also so much important. The literature has important advices from institutions such as the American College of Sports Medicine (ACSM) and the Centres for Disease Control and Prevention about CVD prevention and the benefits of aerobic exercises [17]. Resistance training, on the other hand, has an important place in terms of being a suitable alternative to aerobic exercise or being an effective independent intervention means [25]. It has been reported, as a matter of fact, that regular resistance exercises can heal some cardiovascular risk factors [9], and it has been claimed that it will be much more effective in combination with aerobic exercises [38].

Generally, though there are many studies in the literature that model the aerobics and resistance exercises independently of each other, the number of studies created by combining aerobics and resistance exercises together is few. In addition, there are researches denoting that studies examining the effects of exercise on CVD are limited and more studies are needed on this subject [12, 18].

For aforespecified aspects, the study aimed to examine the effects of fitness training, that performed by combining cardio and resistance exercises regularly for eight weeks, on the cardiovascular risk factors for females.

Material and methods

Before initiating the study, approval required was obtained from the Clinical Research Ethics Committee of Erciyes University with the decision No. 2015/573. Prior to the study, all data required was submitted to the participants and a voluntary consent form was signed accordingly.

Participants

The study group consisted of 30 volunteer females aged between 40 and 65 years. Volunteers were divided into two groups, 15 for exercise group and 15 for control group. The cardio and resistance exercises below were applied together, three days a week for eight weeks total, to the exercise group. The control group, on the other hand, continued their usual lives and did not take part in any exercise.

Data collection

Age, height, weight, body mass index, waist circumference, hip circumference, waist-to-hip ratio, resting blood pressure, resting heart rate, total cholesterol, triglycerides, HDL cholesterol, LDL cholesterol, and fasting glucose

levels were collected in both groups before and after the exercise program.

Venous blood samples were collected from the antecubital region for blood analysis with the help of the relevant health personnel, following the hygienic rules. The blood samples taken were sent to Erciyes University Central laboratory for analysis.

Exercise program

Before starting the exercises, the volunteers were subjected to ten-minute warm-up training. Then, cardio exercises consisting of walking on a treadmill for 10 minutes and step-aerobic exercises for 20 minutes were applied. Then, resistance exercises consisting of bench press, seated cable rowing, lat pull down, leg press, leg curl, and sit-up activities were performed for a total of 35 minutes. Finally, it was ended with 10 minutes of cool-down exercises.

Cardio exercises

Cardio exercises were comprised of walking and step aerobic exercises. Walking exercises were performed on a treadmill for 10 minutes without using any incline. Step-aerobic exercises were performed, meanwhile, for 20 minutes with brisk leg opening and closing movements, stepping, arm turning, arm extension, and operating waist and shoulder joints. The intensity of both walking and step aerobic exercises was determined by the Karvonen method and applied in a way that the heart rate to be between 40-60% (moderate intensity).

Resistance exercises

Maximum strength values of the volunteers were taken, 3 days before starting the fitness exercises, with the maximal 1 repetition method for each station. In addition, the maximal strength measurements were renewed after 4 weeks, and the resistance level used was updated accordingly. With 40% of the maximal strength values taken from the experimental group, bench press, seated cable rowing, lat pull down, leg press, leg curl and sit-up movements were applied during a total of 35 minutes as 1 circle, 3 sets of 15 repetitions.

Statistical analysis

The data obtained in the study were evaluated using the SPSS 20 program. First, descriptive statistics were accomplished. Then, whether the data showed an normal distribution or not was analysed by means of Shapiro-Wilk test, skewness, and kurtosis values and histogram, Q-Q, P-P, graphics and it was determined that the data showed normal distribution. The comparison of the data obtained before the exercise program with the data obtained after the exercise program was evaluated using the Paired-Samples T Test. Significance level was accepted as $p < 0.05$.

Results

It was determined that the age mean of the control group is 50.4 ± 3.92 years and mean height is 1.64 ± 0.03 m, while the mean age of the exercise group is 52.33 ± 5.52 years and mean height is 1.65 ± 0.04 m.

When the results of the pre-test and post-test values of the physical variables belonging to the control group are examined as shown in Table 1, no statistically significant difference was observed in the variables of weight, BMI, waist circumference, hip circumference, and waist-to-hip ratio ($p > 0.05$).

When the results of the pre-test and post-test levels of the physical variables belonging to the exercise group were analysed as in Table 2, statistically significant difference was observed in the weight, BMI, and hip circumference ($p < 0.05$). No statistically significant difference was found, on the other hand, in the waist circumference and waist-to-hip ratio ($p > 0.05$).

When the results of the pre-test and post-test values of the blood levels of the control group were examined as in Table 3, systolic blood pressure, diastolic blood pressure, glucose, triglycerides, cholesterol, HDL, and LDL variables were not statistically significant ($p > 0.05$).

Table 1. Comparison of physical variables of the control group

	n	Pre-test $\bar{x} \pm SD$	Post-test $\bar{x} \pm SD$	t	p
Weight [kg]		72.46 ± 4.79	74.66 ± 7.88	-1.305	0.213
BMI [kg/m ²]		26.75 ± 1.21	27.57 ± 2.67	-1.311	0.211
Waist Circumference [cm]	15	85.46 ± 7.46	86.60 ± 5.01	-0.873	0.397
Hip Circumference [cm]		98.40 ± 5.50	99.00 ± 4.19	-0.871	0.398
Waist to hip ratio [cm]		0.86 ± 0.04	0.86 ± 0.02	-0.489	0.632

Table 2. Comparison of physical variables of the exercise group

	n	Pre-test $\bar{x} \pm SD$	Post-test $\bar{x} \pm SD$	t	p
Weight [kg]		78.08 ± 7.29	69.33 ± 8.82	11.470	<0.001
BMI [kg/m ²]		28.60 ± 2.91	25.43 ± 3.61	11.708	<0.001
Waist circumference [cm]	15	91.06 ± 15.07	87.33 ± 18.03	2.111	0.053
Hip circumference [cm]		103.26 ± 6.60	99.53 ± 7.50	4.525	<0.001
Waist-to-Hip ratio [-]		0.87 ± 0.10	0.86 ± 0.13	0.326	0.749

Table 3. Comparison of blood levels of the control group

	n	Pre-test $\bar{x} \pm SD$	Post-test $\bar{x} \pm SD$	t	p
Systolic blood pressure [mmHg]		130.13 ± 2.44	131.20 ± 3.00	-1.258	0.229
Diastolic blood pressure [mmHg]		84.06 ± 3.89	85.46 ± 4.22	-1.840	0.087
Glucose [mg/dl]		98.26 ± 7.09	96.73 ± 1.94	1.006	0.331
Triglycerides [mg/dl]	15	130.40 ± 16.20	128.26 ± 6.11	0.728	0.478
Cholesterol [mg/dl]		198.80 ± 6.90	201.86 ± 7.37	-1.529	0.149
HDL [mg/dl]		45.64 ± 7.22	46.78 ± 3.60	-0.576	0.574
LDL [mg/dl]		108.80 ± 7.81	110.46 ± 9.62	-0.568	0.579

Table 4. Comparison of blood values of the exercise group

	n	Pre-test	Post-test	t	p
		$\bar{x} \pm SD$	$\bar{x} \pm SD$		
Systolic blood pressure [mmHg]	15	132.53 $\pm$ 4.17	125.86 $\pm$ 4.42	12.542	<0.001
Diastolic blood pressure [mmHg]		86.26 $\pm$ 4.78	82.53 $\pm$ 2.92	4.319	0.001
Glucose [mg/dl]		97.80 $\pm$ 19.10	91.00 $\pm$ 8.04	1.620	0.128
Triglycerides [mg/dl]		167.93 $\pm$ 22.76	145.13 $\pm$ 40.51	2.791	0.014
Cholesterol [mg/dl]		217.93 $\pm$ 33.64	209.60 $\pm$ 27.47	1.454	0.168
HDL [mg/dl]		47.38 $\pm$ 6.21	51.22 $\pm$ 7.36	-1.978	0.068
LDL [mg/dl]		137.66 $\pm$ 20.01	133.33 $\pm$ 14.56	1.747	0.103

When the results of the pre-test and post-test values of the blood levels of the exercise group were analysed in Table 4, a statistically significant difference was observed in the systolic blood pressure, diastolic blood pressure, and triglycerides levels ($p < 0.05$). No statistically significant difference was observed in glucose, cholesterol, HDL, and LDL levels ($p > 0.05$).

Discussion

Overweight has historically been associated with many chronic and degenerative diseases such as cardio-metabolic disorders [27]. Furthermore, it has been revealed that overweight or obese ones are associated with a higher incidence of cardiovascular diseases such as coronary heart disease and stroke [32]. In epidemiological studies on obesity, BMI, an indicator of overweight and obesity, is widely used in various disciplines [27].

When the pre-test and post-test weight and BMI values of the control group were compared based on the results of the weight and BMI levels of the groups in our study, no significant difference was observed ($p > 0.05$), while the study revealed a significant decrease in both weight and BMI values in the experimental group that regularly exercised ($p < 0.05$). Such a finding shows that regular combined training practices have positive effects on body weight and BMI values, which are among the CVD factors. In the literature, the results of studies accomplished by Ho et al. [18], Bharath et al. [2] and Lee et al. [20] are in line with the results of our research. Consequently, we can clearly claim that regular exercises play an important role in taking under control the body weight and its components.

Some simple anthropometric measurements are applied to detect the degree of being overweight or obese, which is one of the important indicators of CVD risk factors [6]. BMI is the most commonly utilized method to indirectly determine the degree of obesity. The measurement

methods such as waist circumference, waist/hip circumference ratio, and neck circumference are used to acquire more information about body fat distribution [10]. According to the results of the anthropometric test measurements of the volunteers took part in our research, meanwhile, when the pre-test and post-test waist circumference, hip circumference, and waist-to-hip ratio values of the control group were compared, it was detected that there was no significant difference ($p > 0.05$). When the pre-test and post-test values of the experimental group were compared, it was observed that there was a significant decrease in the hip circumference values ($p < 0.05$). However, there was no significant difference in waist-to-hip ratio ($p > 0.05$) and a decrease was observed in waist circumference, though it was not significant ($p > 0.05$).

Bharath et al. (2018) expressed the central adiposity as fat accumulation in the lower abdomen and stated that central adiposity was associated with an increased risk of metabolic disorders such as type 2 diabetes, inflammation, and CVD. They concluded, furthermore, in their study that there were significant decreases in central adiposity measured by waist circumference after combined training [2]. Ha and So [15] reported a significant change in body fat percentage and waist circumference values in young females and Seo et al. [33] reported a significant change in body fat percentage and waist circumference values in middle-aged females as a result of combined exercise training. Church et al. [7] reported that the waist circumference values of the resistance, aerobic and combined exercise groups decreased compared to the control group and each subject of resistance – 1.4 combination group, therefore, burned an average of – 1.7 kg of their fat mass.

Exercises have been observed to provide benefits not only changes in body composition but also lowering blood pressure and other CVD risk factors [3]. When we analyse the results of blood pressure values collected during our study, there is no significant difference in the systolic and diastolic blood pressure values of the control group

($p > 0.05$), while there is a significant decrease in the experimental group that exercised regularly ($p < 0.05$). A person with a systolic blood pressure of ≥ 140 mmHg and diastolic blood pressure of ≥ 90 mmHg is considered with hypertension [24]. The hypertension may increase the risk of CVD and it is one of the foremost risk factors for mortality [39]. The hypertension is, therefore, one of the most important modifiable hazardous factors for preventing cardiovascular diseases [23]. Changes that happen acutely with exercises begin to burden the cardiovascular system, and various adaptive changes occur in heart and vessels in order to reduce this burden and repress pathological changes in the long term [14]. The results of our studies and the studies in the literature accomplished along with combined exercises revealed that it might have significant effects on the reduction of systolic and diastolic blood pressures [15, 35].

It was observed that glucose levels in the exercise group were 97.80 ± 19.10 mg/dl in the pre-test measurements and decreased to 91.00 ± 8.04 mg/dl after the exercise program, and such a decrease did not indicate a significant difference ($p > 0.05$). Although a decrease was observed after the exercise program applied to the experimental group, the statistical insignificance of this decrease could be resulted from the type, intensity, and repetitions of the exercises applied. Various factors, meanwhile, can affect glucose levels. These include exercise (mode, time, frequency, and intensity), diet patterns, and clinical characteristics of individuals, such as age, gender, maximum oxygen uptake (VO_{2max}), and basic metabolic control [8]. The risk of death due to cardiovascular events in individuals with impaired glucose tolerance was detected to be higher than individuals with normal glucose tolerance, and impaired fasting glucose did not increase this risk level [36]. Exercises stimulate metabolism, support glucose uptake, increase insulin sensitivity, and contribute to the reduce of blood glucose [8]. As a result of aforesaid effects, long-term exercise may reduce blood sugar levels over time in individuals those suffering from Type 2 diabetes [8, 31]. In a study conducted with female volunteers, it was reported that there were significant changes in fasting glucose levels after a combined exercise program [33].

Although the mechanisms underlying the effect of exercise on the lipid profile are obscure, exercise appears to increase the ability of skeletal muscles to use lipids instead of glycogen, thereby lowering plasma lipid levels [13]. The term "lipid profile" describes changing lipid levels in the blood. The most commonly reported ones are LDL cholesterol, HDL cholesterol, and triglycerides. High LDL cholesterol levels indicate excess lipids in the blood which augments the risk of cardiovascular complications. HDL cholesterol takes lipids back to the liver for recycling and disposal and, high HDL cholesterol level is, consequently, the indicator of a healthy cardiovascular system

[4]. Triglycerides in plasma are acquired from fats or other energy sources eaten in foods. Extreme triglycerides in plasma are associated positively and independently with cardiovascular disorders [11].

It has been strongly accepted and reported that exercise leads to a high energy requirement that results with decreased plasma triglycerides concentrations [21]. When we analyse the results, while no significant difference was detected between the pre-test triglycerides levels and post-test levels of the control group ($p > 0.05$), there was a significant decrease between the pre-test and post-test values in the exercise group of the experimental group ($p < 0.05$). Such a result we acquired is similar to the results of some studies conducted with a combination of aerobics and resistance training specified in the literature [26, 41].

Exercise reduces body weight and fat stores, while lowering total lipid levels and serum triglycerides. Such an effect of exercise on serum lipid levels also causes decreases in cardiovascular risk factors [19]. When the pre-test and post-test total cholesterol, HDL, and LDL levels of the control group were compared, our study revealed no significant difference ($p > 0.05$). When both the total cholesterol and LDL levels of the experimental group were compared with the pre-test and post-test values, it was observed that there was no significant difference between the values despite a positive decrease ($p > 0.05$), and when the HDL value was compared with the pre-test and post-test values, no significant difference was detected between the values though there was a positive increase ($p > 0.05$). As a result of our research, we can claim that regular exercise puts positive effects on lipid components and thus plays an influential role for avoiding from cardiovascular risk factors. According to the results of the studies in the literature accomplished with a combination of aerobics and resistance exercises, Ha and So [15] reported no significant difference in total cholesterol, HDL, and LDL; Yang et al. [41] in total cholesterol and LDL; and Marini et al. [26] in total cholesterol and LDL levels [27]. While aforesaid studies are in line with the results of our study, Marini et al., [26] reported significant changes in HDL after a 12-week combined training program, Shaw et al. [34] in LDL after a 16-week combined training program, and Park et al. [29] in total cholesterol, Triglycerides, HDL-C, and LDL-C values after a 24-week combined training. Aforespecified various results in the literature may be due to the contents and duration of the exercise program applied.

Conclusion

Consequently, in this study, moderate intensity cardio and resistance exercises resulted with significant changes in weight, BMI, hip circumference, systolic blood pressure, diastolic blood pressure, and triglycerides values,

which are among the cardiovascular risk factors. Although it did not cause a statistically significant change in waist circumference, waist-to-hip ratio, glucose, cholesterol, LDL, and HDL values, some positive changes were observed. Increasing the duration of the 8-week exercise program, increasing the duration of a single unit of exercise, and also implementation of diet program together with exercise program may also show significant results in cardiovascular risk factors that do not show significant results in our study.

Note: This study was produced from the master thesis entitled "The investigation of effects of eight weeks fitness exercises on cardiovascular risk factors in women" prepared by Murat Akkurt. In addition, this study was presented orally at the 5th International Conference of Physical Education and Sport Sciences – Nevşehir/Turkey.

Conflict of interest: Authors state no conflict of interest.

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