ORIGINAL ARTICLE

Effects of Eight-Week Moderate Intensity Aerobic Exercises on Dyslipidemia and Body Composition for Overweight and Obese First-Degree Females

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ABSTRACT

Aim: Overweight and obesity cause grave health problems, creating negative effects particularly on blood lipids. Despite it is realized that exercises induce positive effects on obesity and dyslipidemia, it is notedly important to know in detail the effects of different types of exercise applications and the duration, intensity, and frequency of exercises. Therefore, this study was designed in order to examine the changes on blood lipids and body composition caused by aerobic exercises applied at moderate intensity for sixty minutes, excluding warm-up and cooling periods for each exercise, 3 days a week for eight weeks total on overweight and obese first degree females.

Methods: 41 overweight and obese females with ages 22 to 48 participated voluntarily in the study. Two different groups, 21 persons for exercise group and 20 for control group, were made up from the volunteers. 60-minute of moderate-intensity aerobic exercise program was applied for a duration of 3 days a week for eight weeks to the exercise group. The values in terms of height, weight, BMI, body fat percentage, visceral fat rating, hip circumference, waist circumference, triglyceride, total cholesterol, HDL, and LDL were collected from all volunteers prior to and after the eight-week exercise program.

Results: Significant decrease was observed, in weight ($p < 0.001$), BMI ($p < 0.001$), body fat percentage ($p < 0.05$), hip circumference ($p < 0.001$), and waist circumference ($p < 0.001$) of the exercise group. Despite the levels of visceral fat rating, triglyceride, total cholesterol, and LDL decreased and HDL level increased in the exercise group, this difference was not statistically significant ($p > 0.05$).

Conclusions: It was observed thereby that the scope of the exercise program was well enough to form significant changes on the body composition of the volunteers participated in the study, but it didn't induce sufficient effect on blood lipids.

Keywords: Exercise, blood lipids, obesity, overweight

INTRODUCTION

Overweight and obesity themes are common to and one of the most substantial health problems in modern societies. A BMI value of 25 to 30 kg / m^2 is defined as overweight, 30 to 35 kg / m^2 as obesity first degree, 35 to 40 kg / m^2 as obesity second degree, and 40 kg / m^2 and above as obesity third degree [1]. According to data submitted by the World Health Organization (WHO), there are nearly 1.9 billion adults with their BMI level above 25 kg / m^2. 650 million of them, at least, are classified as obese individuals with a BMI of over 30 kg / m^2 [2]. Obesity gives, directly and indirectly, a lead to serious chronic diseases such as hypertension, diabetes, heart disease, and carcinoma [3]. Though many studies have been carrying out to detect a solution to the obesity in recent years, the prevalence of obesity has resulted, unfortunately, with a rise in many countries [3].

The dyslipidemia is an important comorbidity of obesity associated with coronary and vascular hang-ups [4] and is characterized by metabolic disorders which cause changes in circulating lipid levels [5]. These anomalies are characterized with high levels of total cholesterol, triglycerides, low density lipoprotein (LDL), and low levels of high density lipoprotein (HDL) [5]. Dyslipidemia is a potential risk factor that can evoke atherosclerotic cardiovascular disease, including cerebrovascular diseases such as ischemic heart disease and stroke. The World Health Organization claims, meanwhile, that 60% of ischemic heart disease cases and 40% of stroke cases are caused by dyslipidemia [6].

Epidemiological studies indicate a close correlation between lipoprotein profile and cardiovascular morbidity and mortality, and physically active individuals have a 30 to 50% lower risk of cardiovascular disease or type 2 diabetes compared to sedentary individuals [4]. It is also reported that regular exercises result with a similar risk reduction for coronary heart disease [7].

There are various studies in the literature surveying the protective effects of diet, physical activity, regular exercises, and various drug treatments on obesity and dyslipidemia. It is claimed, therefore, that exercises can yield positive effects on productive weight loss, protection of attained weight loss, obesity, and dyslipidemia [3]. The type, frequency, duration, and intensity of the exercises to be applied, however, are quite important both against the risks of injury during exercising and in getting the desired level of efficiency. It is crucial to realize in detail the effects of different types of exercise applications and the intensity, duration, and frequency of different types of exercises on obesity and dyslipidemia.

Aim of the study: This study was scheduled, therefore, in order to examine the changes on blood lipid and body composition caused by aerobic exercises applied at moderate intensity for sixty minutes, excluding warm-up and cooling periods for each exercise, 3 days a week for eight weeks total on overweight and obese first degree females.

MATERIAL AND METHODS

Volunteer Groups: Forty-one overweight and obese first-degree females with ages of 22 to 48, who haven't suffered any health disorder to participate in exercise practices and didn't participate in exercise practices regularly in the last year attended voluntarily in the study. Two different groups were formed from the volunteers, 21 of them for exercise group and 20 for control group. Prior to setting to the study, required information was given to the volunteers and the informed consent forms were signed by the volunteers.

Experimental Procedure: The values of age, height, weight, BMI, body fat percentage, visceral fat rating, hip circumference, waist circumference, triglyceride, total cholesterol, HDL, and LDL were collected from both groups before setting to the study. Then, the aerobic exercise program given below in detail was applied to the exercise group 3 days a week for eight weeks and for a duration of 60 minutes for each exercise, excluding the warm-up and cooling periods. No exercise program was applied to the control group and they were asked to maintain their daily routine life. The same measurements were replicated for both groups after the eight-week exercise program of the exercise group was concluded.

Measurements:

Body Composition Measurements**:** *Heights* of volunteers were taken by means of a wall-mounted height scale with an accuracy of 0.01 centimeters and weights of them measured using an electronic scale with an accuracy of 0.1 kg. *Body Mass Indexes* (BMI) were computed by dividing the weight value by the square of the height value. *Hip circumference* was measured at the level of the symphysis pubis from the front and at the largest protrusion of the gluteal muscles from the back using a tape measure on sports clothing, and attained values were recorded in centimeters. *Waist circumference* was measured at the narrowest part of the waist with a tape measure while the volunteers were standing upright position and recorded in centimeters. *Body fat percentage* and *visceral fat rating* values were measured, on the other hand, by means of the Tanita BIA impedance device (Tanita Corporation, Arlington Heights, IL, USA).

Blood Lipid Measurements: 7 cc of blood samples were collected, for blood lipid measurements, from both groups by the healthcare professionals, complying with the hygienic rules, following a 12-hour fasting period minimum, and two days before setting to the exercise program and one day after the exercise program ended. The blood samples collected were transferred quickly to the Central Laboratory of Erciyes University and the analyses for triglyceride, total cholesterol, HDL, and LDL were carried out accordingly.

Theme of Applied Exercise Program: Aerobic type exercises with moderate intensity were applied to the volunteers, accompanied by a licensed fitness trainer, for eight weeks, 3 days a week. Aerobic type exercises applied were composed of step-aerobics, pilates, walking or running exercises on the treadmill, provided that each exercise day includes different type exercises. The duration of the exercises was 60 minutes, excluding the 20-minute warm-up and 10-minute cooling periods.

The intensity of the exercises was regulated according to the range of 40 to 60% of the VO_2R value defined as moderate intensity by ACSM. HR values corresponding to this range were established separately to be as the lower limit for 40% and the upper limit for 60% using the equation; Target HR = (target intensity) (HR_{max} - HR_{rest}) + HR_{rest} [8]. The values of HRrest were determined by measuring pulses from the carotid artery after the volunteers were allowed for 5 minutes minimum in a stationary sitting position in a reposeful room. HRmax was calculated using the formula 208 - 0.7 x (age) [9]. The lower and upper limit HR values determined during exercise applications for each volunteer were observed using RS400 Polar (Finland) brand watch and the HR values of the volunteers weren't allowed to go beyond the aforespecified range.

Statistical Analysis: Data acquired in the study were assessed using the SPSS 20 program. First, descriptive statistics were accomplished. It was evaluated by means of Shapiro-Wilk testing, the values of skewness and kurtosis, histogram, and graphics of Q-Q and P-P whether relevant data indicated normal distribution or not, and so it was conceived that data indicated normal distribution. The Paired-Samples T testing was applied to compare data before the exercise program to data acquired after the exercise program. Significance level was recognized as $p < 0.05$.

RESULTS

The values of age and height of the volunteer groups who took part in the study are given in Table 1.

After the exercise program accomplished as instructed above, a statistically significant decrease was detected in the weight ($p < 0.001$), BMI ($p < 0.001$), and body fat percentage ($p < 0.05$) values of the exercise group, while no significant change was observed for their visceral fat rating values ($p > 0.05$). No significant difference was determined in weight, BMI, percentage of body fat, and visceral fat rating for the control group ($p > 0.05$) (Figure 1 and Table 2).

No significant difference was observed in the values of both hip circumference and waist circumference of the control group while a significant decrease was found in the hip circumference ($p < 0.001$) and waist circumference ($p < 0.001$) values of the exercise group after the training program ($p > 0.05$) (Figure 2 and Table 2).

Table 1. The Values of Age and Height of the Volunteer Groups

	Exercise Group				Control Group			
	n	x̄ ± SS	Min.	Max.	n	x̄ ± SS	Min.	Max.
Age	21	34.95 ± 9.72	22	48	20	35.27 ± 8.44	23	47
Height (cm)	21	162.00 ± 5.17	153	172	20	160.87 ± 6.11	152	173

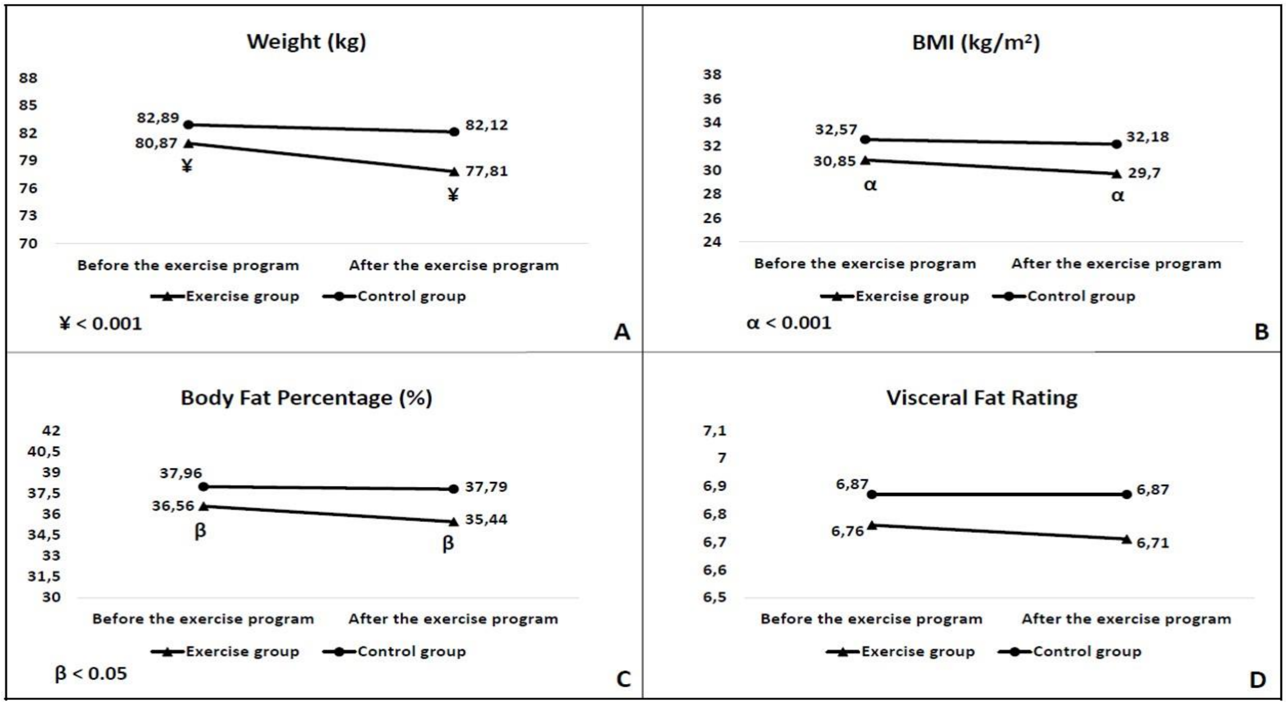

Figure 1. The Values of Weight, BMI, Body Fat Percentage and Visceral Fat Rating of the Volunteer Groups

Table 2. The Values of Body Composition of the Volunteer Groups

		Exercise Group			Control Group		
		x̄ ± SD	t	p	x̄ ± SD	t	p
Weight	Before the exercise program	80.87 ± 15.87	5.140	<0.001**	82.89 ± 14.13	0.134	0.896
	After the exercise program	77.81 ± 15.49			82.12 ± 13.49		
BMI	Before the exercise program	30.85 ± 6.02	5.106	<0.001**	32.57 ± 6.13	0.267	0.746
	After the exercise program	29.70 ± 5.89			32.18 ± 5.89		
Body Fat Percentage	Before the exercise program	36.56 ± 7.44	2.328	0.031*	37.96 ± 6.12	0.147	0.831
	After the exercise program	35.44 ± 7.28			37.79 ± 7.38		
Visceral Fat Rating	Before the exercise program	6.76 ± 3.67	0.175	0.863	6.87 ± 3.71	0.103	0.923
	After the exercise program	6.71 ± 3.80			6.87 ± 3.68		
Hip Circumference	Before the exercise program	111.95 ± 12.03	5.553	<0.001**	112.86 ± 10.25	0.192	0.915
	After the exercise program	107.52 ± 11.66			112.67 ± 11.47		
Waist Circumference	Before the exercise program	109.38 ± 9.21	4.842	<0.001**	110.72 ± 9.27	0.121	0.934
	After the exercise program	103.90 ± 9.70			110.67 ± 9.18		

* p < 0.05, ** p < 0,001

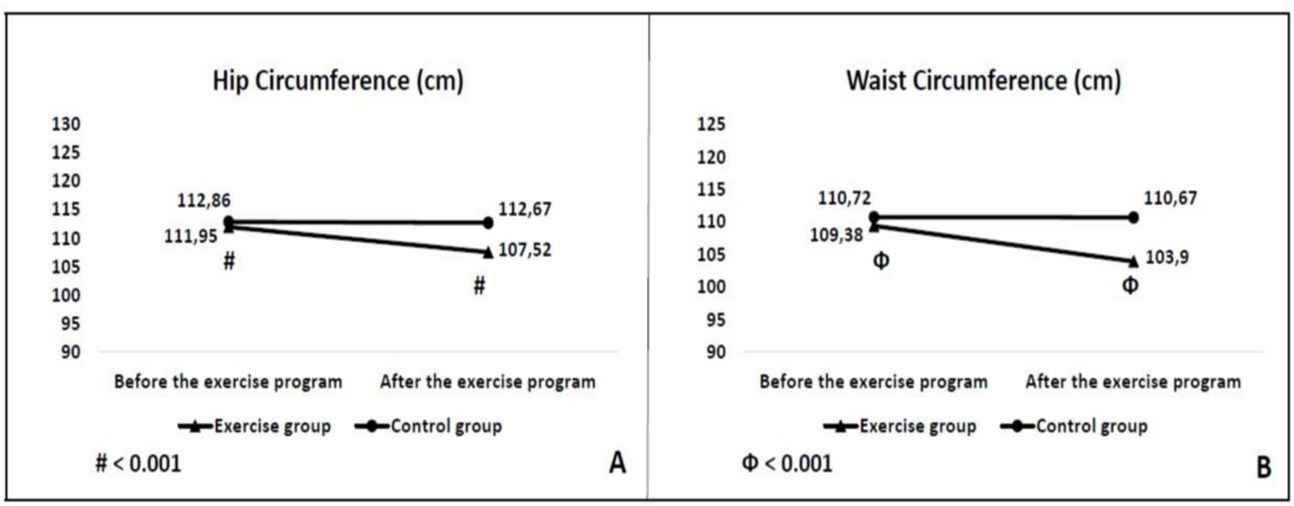

Figure 2. The Values of Hip Circumference and Waist Circumference of the Volunteer Groups

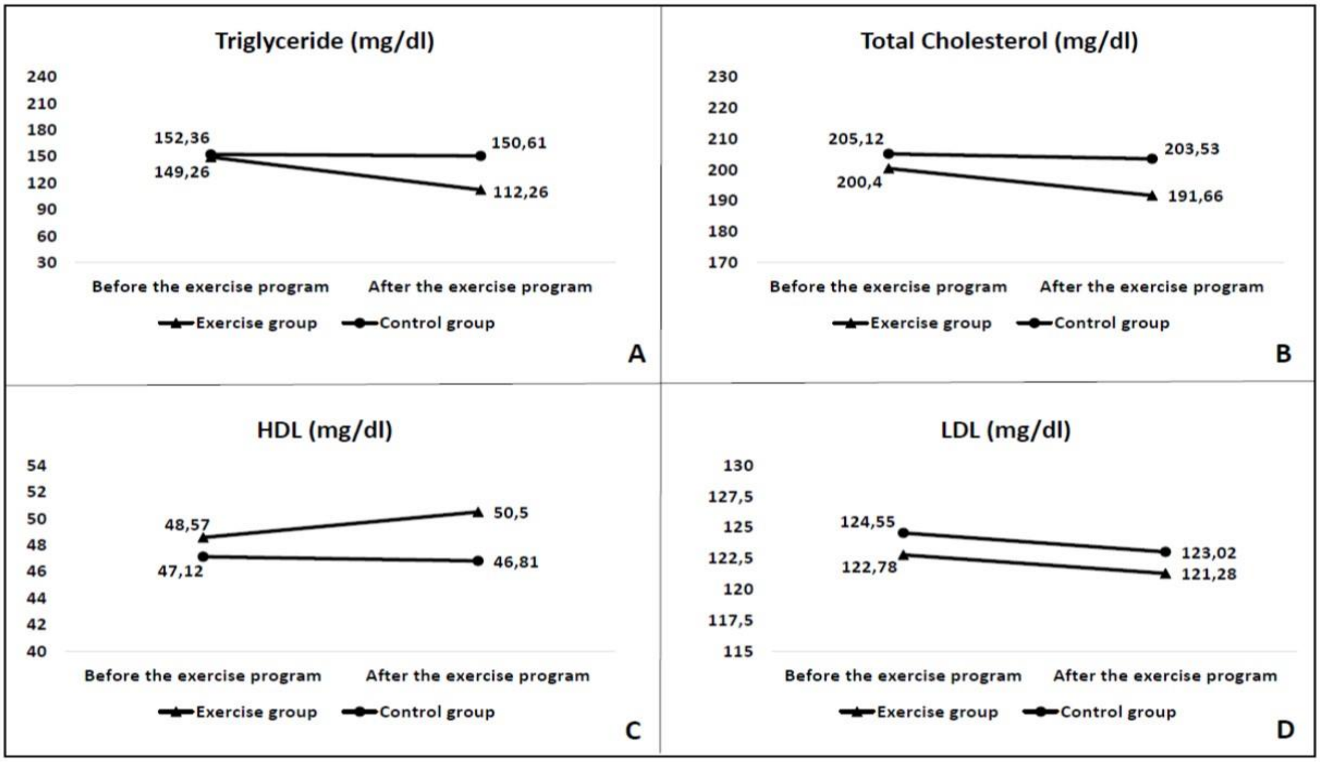

Figure 3. The Values of Triglyceride, Total Cholesterol, HDL and LDL of the Vounteer Groups

Despite the levels of triglyceride, total cholesterol, and LDL decreased and HDL levels increased of the exercise group after the exercise program, these changes were not statistically significant (p> 0.05) (Figure 3 and Table 3).

Table 3. The Values of Blood Lipids of the Volunteer Groups

		Exercise Group			Control Group		
		x̄ ± SD	t	p	x̄ ± SD	t	p
Triglyceride	Before the exercise program	149.26 ± 69.85	2.027	0.062	152.36 ± 42.87	1.017	0.304
	After the exercise program	112.26 ± 34.17			150.61 ± 31.18		
Total Cholesterol	Before the exercise program	200.40 ± 34.71	1.181	0.257	205.12 ± 38.41	0.834	0.497
	After the exercise program	191.66 ± 41.23			203.53 ± 30.29		
HDL	Before the exercise program	48.57 ± 8.14	-1.177	0.260	47.12 ± 7.15	0.448	0.513
	After the exercise program	50.50 ± 8.84			46.81 ± 6.83		
LDL	Before the exercise program	122.78 ± 32.19	0.212	0.835	124.55 ± 31.09	0.307	0.846
	After the exercise program	121.28 ± 34.90			123.02 ± 30.12		

DISCUSSION

It is perceived that overweight and obesity are independent risk factors for heart and cardiovascular diseases, type 2 diabetes, and hypertension [10] and they are closely related to mortality and morbidity resulted from cardiovascular diseases [11]. Decreases in weight, BMI, body fat ratio, waist circumference, hip circumference, and visceral fat rating provide, therefore, crucial health profits [8] and increasing the level of physical activities leads to positive changes in these values [12]. Overweight and obesity can be prevented, on a large scale, with a healthy diet and regular physical activity practices [2]. Physical activities not only increase aerobic capacity, which is crucial for the cardiovascular system and metabolism, but also lead to a rise in energy consumption [13] and basal metabolic rate [14].

It has been claimed that exercise programs executed lead to different responses in resting metabolic rate, energy consumption, and body composition depending on the type, duration, frequency, and intensity of the exercises [15,16]. ACSM recommends the overweight and obese individuals to exercise at moderate intensity 30 minutes a day and 150 minutes a week, and then increasing this duration to 60 minutes a day and 300 minutes a week [8]. Fogelholm et al. [17] and Romijin et al. [18] have claimed that dynamic aerobic exercises at moderate intensity are the most effective method for stepping down the body fat mass, as they lead to an increase in the activity of aerobic oxidation enzymes. It has been reported that triacylglycerol from adipose tissue is mobilized for energy production and this mobilization causes a reduction in fat mass during and after exercises [18].

Kim et al. (2019) reported in their meta-analysis study that many exercises at low and moderate intensities have realized significant effects on body composition values [3]. It was claimed in the meta-analysis study conducted by Türk et al. (2017) that high intensity exercises have been more effective than moderate intensity exercises for reducing the body fat percentage on obese individuals [19]. It has been claimed, meanwhile, that the level of fitness attained after applying the high-intensity interval training is 50 to 60% faster than the continuous aerobic exercises [20]. Kemmler et al. (2014) reported that no decrease was observed in total body fat in high-intensity interval exercises, whereas a decrease was detected in continuous aerobic exercises, and they claimed also that high-intensity interval exercises have realized more weight loss compared to moderate intensity continuous aerobic exercises, but haven't resulted with a difference in body fat mass [21]. Gappmaier et al. (2006) reported, in their study in which middle-aged females were subjected to an exercise program at an intensity of 70% of their maximum heart rate for 40 minutes daily, 4 days a week, and 13 weeks total, a significant decrease in body fat percentage [22]. It was claimed that moderate intensity aerobic exercises applied to middle-aged obese females for 12 weeks have reduced body fat percentage [23,24].

A significant decrease was observed, similar to the literature, in this moderate intensity study applied 60 minutes a day for 8 weeks for weight ($p < 0.001$), BMI ($p < 0.001$), body fat percentage ($p < 0.05$), hip circumference ($p < 0.001$), and waist circumference ($p < 0.001$) values of the exercise group. Though a slight decrease was observed in visceral fat rating values, the difference was not statistically significant ($p > 0.05$). When the studies in the literature are examined, it is obvious that as the duration and intensity of exercises increase, the rate of decrease in body composition values also increases. It should be taken into consideration, however, that though high-intensity exercises provide more benefits, they house high risks of injury [8] Furthermore, the continuity of the exercises applied should be ensured to sustain the benefits obtained therewith.

It has been indicated in many studies that aerobic exercises induce positive effects on dyslipidemia [25,26]. It is stated that healthy diet, weight loss, exercise, and physical activity play a key role in improving cardiometabolic health [27] and adding dietary practices to exercises creates much more positive effects on dyslipidemia [3,28]. Although the mechanism of lipid changes caused by exercises is not fully grasped, exercise itself can cause a progress in the consumption of blood lipids and thus lipid levels decrease [29]. Relevant mechanisms may involve an increase realized in lipoprotein lipase (LPL) activity accounted for chylomicrons and VLDL triacylglycerol (TAG) hydrolysis in granules [30]. Most of the catalytically active LPL is located in the walls of blood vessels and is isolated from the surface of the endothelium, and is released into blood after intravenous injection of heparin [31]. The detected LPL is, therefore, often post-heparin LPL. Kobayashi et al. (2007) claimed that application of high intensity or prolonged aerobic exercises can lead to a significant rise in post-heparin plasma LPL activity, thus the event of LPL-mediated triglyceride hydrolysis can occur [32]. It was reported in a study examining exercise-induced LPL changes that LPL mRNA level reached its peak level 4 hours after exercises [31]. Furthermore, it has been reported that LPL activation may sustain 24 hours after a moderate intensity exercise which lasts only one hour [33].

Researchers advise exercises of 30 minutes duration in most days of the week for obesity treatment [34]. It is strictly recommended to attend to moderate intensity exercises for at least 150 minutes a week and then to gradually increase the daily exercise duration to 60 minutes [35]. It has been declared for young females that exercising 3 days a week for 60 minutes can put the desired effect on blood lipid profiles, and regular exercises can lead to gradual decreases in triglycerides, total cholesterol, LDL, BMI, and body fat percentage and increases in HDL, body mass, and basal metabolic rates [36]. It has been noted in the meta-analysis study conducted by Kim et al. (2019) that exercise programs to be attended more than 120 minutes per week have had moderate or high effects on both lipid profile and body composition; exercise programs to be continued more than 8 weeks had moderate and high body composition; and programs of 12 weeks and above had, on the other hand, moderate and high level effects on the lipid profile [3]. It has been declared that aerobic cycling exercises to be accomplished 3 days a week for 60 minutes lead to an increase in HDL concentration and the increase in HDL level may also be associated with a decline in weight [37]. Brownel et al. (1982) reported that exercises of 3 days a week for 30 minutes at moderate intensity, which caused 1200 kcal consumption per week, have increased HDL concentration in blood [38]. A significant decrease was reported in triglyceride values of middle-aged obese females after performing for 4 days a week for 16 weeks moderate intensity aerobic exercises and resistance exercises at 400 Kcal consumption in each training [39].

Though a decrease in triglyceride, total cholesterol, and LDL levels and a rise in HDL levels were observed in this study, relevant changes were not statistically significant ($p > 0.05$). Despite it has been shown that the effect of exercise on blood lipids has resulted with positive changes on a great number of individuals, it is also reported that these changes may diverge between individuals [1]. Differences between body fat percentage and glucose tolerance of individuals may lead to different responses to the exercises, as well as the type, duration, and intensity of the exercises applied may cause different results [10]. The fact that no significant change in blood lipids was noted in this study may be due to the intensity and duration of the exercise program. Kraus et al. (2002) observed that exercise intensity and total energy consumption were the parent factors for lipid changes [40]. Dunn et al. (1997) stated that short-term exercises can also provide improvements in plasma lipids on condition that exercises to be applied with sufficient intensity [41]. In the study in which O'Donovan et al. (2005) examined the effects of the intensity of exercise on blood lipids, they reported that high intensity exercises had more conspicuous effects on blood lipids for exercises applied at the same workload [42]. Furthermore, it has been reported that exercises should be accomplished for long-term in order to maintain a significant decline in body fat [10].

Herewith, when moderate intensity aerobic exercises were applied for 60 minutes daily, 8 weeks total, a significant decrease was observed in the weight, BMI, body fat percentage, hip circumference, and waist circumference values of the exercise group, whereas no significant change was observed in the values of visceral fat rating, triglyceride, total cholesterol, HDL, and LDL. It is conceived that the scope of the exercise program applied was sufficient to realize significant changes on the body composition of the volunteers, but insufficient on blood lipids. Significant changes in blood lipids can be observed, on the other hand, by augmenting the duration of the exercise program, the duration of the unit exercise, the intensity and frequency of the exercises, and the application of diet control. It should be noted, therefore, that when structuring exercise practices for overweight and obese individuals, relevant risk factors should be taken into account and careful attention should be paid to for realizing aforespecified increases.

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