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THE EFFECT OF EIGHT WEEKS OF COMBINED TRAINING (ENDURANCE-INTERMITTENT RESISTANCE AND ENDURANCE-CONTINUOUS RESISTANCE) ON COAGULATION, FIBRINOLYTIC AND LIPID PROFILES OF OVERWEIGHT WOMEN

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Abstract

Introduction. Inflammatory and coagulation factors are among the various factors that are involved in the development of cardiovascular diseases. The aim of this study was to evaluate the effect of eight weeks of combined training (endurance-intermittent resistance and endurance-continuous resistance) on coagulation, fibrinolytic and lipid profiles of overweight women. ***Material and Methods.*** This was a quasi-experimental study of 36 overweight women, who were divided into three groups of endurance-intermittent resistance training (n = 12), endurance-continuous resistance training (n = 12) and control (n = 12). The training was performed during eight weeks, three times a week, and each session lasted for 80 to 90 minutes. Blood samples were analyzed for the concentrations of coagulation, fibrinolytic and lipid profiles before and after the completion of the training program. ***Results.*** Fibrinogen levels, prothrombin time (PT), partial thromboplastin time (PTT) and platelet count decreased significantly at the end of the training in both intervention groups. However, serum levels of D-dimer increased significantly in both training groups. Also, the levels of triglycerides (TG), total cholesterol (TC), and low-density lipoprotein cholesterol (LDL-C) decreased significantly, while the levels of high-density lipoprotein cholesterol (HDL-C) increased significantly. ***Conclusions.*** Combined exercise improved most coagulation factors and lipid profiles at the end of the training period. Therefore, the results of our research suggest that a combined exercise program can improve the health of overweight women.

Key words: combined exercise, lipid profile, d-dimer, overweight women

Introduction

Cardiovascular diseases (CVDs) are one of the main causes of death in developed and developing countries [1]. Many factors contribute to the development of CVDs, including genetics, dyslipidemia and oxidation, sedentary lifestyle, obesity, inflammatory factors, and coagulation factors [2, 3]. Inflammatory factors such as fibrinogen are considered etiologies for atherosclerosis; studying these factors, particularly during the treatment, is of paramount importance in the prevention and prognosis of the disease. Inflammation could lead to increased coagulation factors such as fibrinogen, which then stimulates the prothrombotic state [4]. Increased risk of cardiovascular diseases could result from prothrombotic imbalance and coagulation dysfunction [5]. Coagulation is dysregulated in CVD patients, which is shown by partial thromboplastin time (PTT) and prothrombin time (PT) [6].

Coagulation factors are necessary for coagulation. Prothrombin (factor II) is a coagulation factor produced in the liver. Following the tissue damage to vascular endothelial cells, the underlying collagen is accessible to the platelets and coagulation factors, leading to their activation. At the beginning of this pathway, factor XI is stimulated by factor XIIa; afterwards, factor IX is converted to factor IXa in the presence of factor IXa [7]. Then, a complex of factors VIII and IX in association with platelet phospholipid and Ca++ finally leads to the activation of factor X. Ca ion is not essential in the formation of factor XII. After the conversion of factor X to factor Xa, both pathways fall into a common pathway. Then, in the presence of cofactor Xa and Ca++ and PF3, factor Xa leads to the conversion of prothrombin to thrombin, which per se leads to the conversion of fibrinogen to fibrin. Thrombin directly breaks down the peptides from alpha and beta chains of fibrinogen, resulting in the formation of fibrin monomers, which later transforms into a regular polymeric fibrin clot. Moreover, thrombin acts as a robust physiological stimulator for platelet activation [8]. Multiple factors, such as changes or the absence of a coagulation factor, could affect and increase PT, which is an indicator of blood coagulation [9].

Physical activities could reduce platelet aggregation, the development of CVDs, and inflammation [10]. Also, the evidence strongly shows the positive effects of exercise and physical activities in the primary and secondary prevention of CVDs [11].

Participating in physical activities, particularly those that increase body stamina, has a significant role in decreasing or removing many CVD risk factors, such as high fibrinogen and blood pressure [12]. Mainly, all physical exercises are beneficial in treating inflammation and could lead to a feeling of freshness by providing the necessary energy and oxygenation and regulating CVD factors such as serum fibrinogen and blood pressure [13].Considering the importance of possible protective or alarming factors for CVDs in overweight and obese individuals, studying the metabolic processes and functions of different body systems and the role of physical activities in improving coagulation factors is of paramount importance. The present study is im-

portant in that the effect of compound exercises could decrease inflammation and the development of cardiovascular diseases in overweight women through affecting physical factors and coagulation factors. Because the effect of compound exercises on physiological indices and coagulation factors is not well studied, and that there are ambiguities in decreasing coagulation factors with limited research, the present study aimed to evaluate the effect of eight weeks of combined training (endurance-intermittent resistance and endurance-continuous resistance) on coagulation, fibrinolytic and lipid profiles of overweight women.

Material and Methods

Subjects

This is a quasi-experimental study in which two experimental and control groups were compared with pre-test and post-test. The statistical population of this study included 36 overweight women with the body mass index between 25 to 29.9 kg/m^2. In the first stage, the participants became acquainted with the nature and how to cooperate with the research. The inclusion criteria were as follows: no history of cardiovascular stroke and diabetes, no lung disease, no musculoskeletal disorders that prevent exercise and having the body mass index above 26 kg/m^2. The exclusion criteria were as follows: inflammatory disease, heart disease, pregnancy, muscle skeletal disorders and consumption of opium and alcohol. The subjects voluntarily participated in the research based on the research conditions and signed the consent form. Then they were randomly divided into three groups of endurance-intermittent resistance training (n = 12), endurance-continuous resistance training (n = 12) and control (n = 12) (Fig. 1). In addition, the test steps were approved by the Ethics Committee of Medical Research at the Faculty of Ferdowsi University of Mashhad carried out under the Code 4251.1. The standard premenstrual symptoms screening tool (PSST) was used to assess women's menstrual cycle. This questionnaire consists of 19 questions divided into two parts. The first part includes 14 mood, physical and behavioral symptoms. The second part, which measures the impact of these symptoms on people's lives, consists of 5 questions [14].

Body composition

To evaluate body composition, the participants' body height was measured with Seca (made in Germany) with an accuracy of 5 mm, while their body weight was checked using a digital scale with an accuracy of 100 g. The BMI (kg/m^2) was obtained from the division of body mass by height squared. All the measurements were taken while the subjects had abstained from eating and drinking for four hours before the test, and their bladder, stomach, and intestines had been emptied as much as possible.

Maximum oxygen consumption

In order to estimate the maximum oxygen consumption, the participants were asked to run for 12 minutes at the maximum possible speed or to cover a distance of 2400 meters [15]. Then, ac¬cording to Equation 1, the maximum oxygen consumption was determined:

Equation 1: Maximum oxygen consumption (ml/kg/min) = Horizontal speed (m / min) × 0.2 + 5/3

Blood samples

In this study, blood samples were collected 24 hours before and 48 hours after the training session (to prevent the acute effect of exercise and research variables). The sampling was conducted at the beginning and the end of the study period at 8-10 a.m. to uniform the time of sampling and control the 24-hour cycle. The participants were asked to avoid food consumption 10-12 hours before blood sampling. A 5-cc blood sample was collected from the left-hand vein of each participant in the resting position. The samples were collected in tubes containing EDTA and were rapidly centrifuged (2000 rpm in 10 minutes) and were stored in -80ºC until the experiments. To measure D-dimer: (Mini vidas machine made in England, kit From Nycocard Company; mean recovery percent, 99-105%), platelet counts: (Diatron Abacus-360 Autoanalyzer); fibrinogen, PT and PTT: (from Stago machine made in Germany, Mahsayaran kit made in Iran, sensitivity 1 ng/ml and the coefficient of variation between and within the process was 1.5 and 2.5%). Concentrations of triglyceride, cholesterol and HDL-C were measured using the enzymatic method (Pars Azmoun commercial kits) with the measuring kit in-test variation coefficient (accuracy) for cholesterol, triglyceride and HDL-C of 4% 4% and 4.5%, respectively.

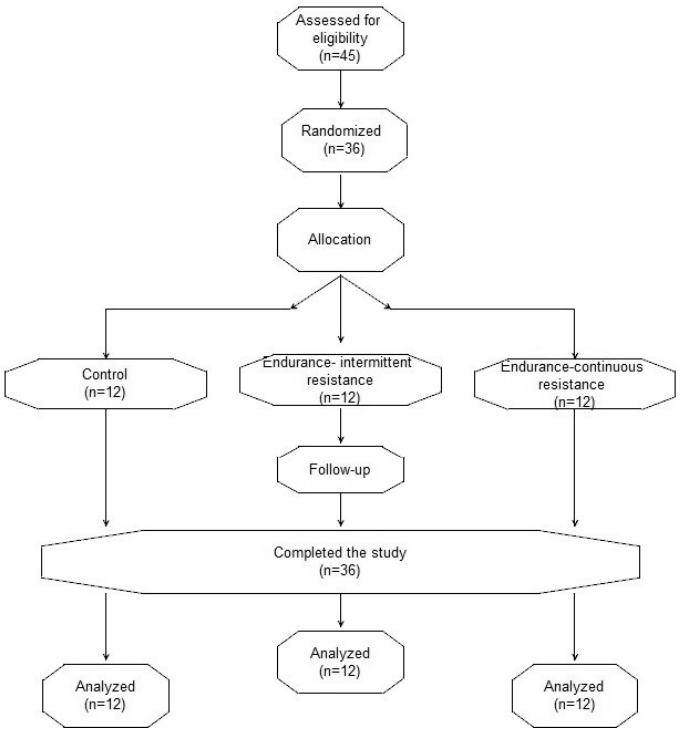

Figure 1. Participants' flow diagram

Experimental protocol

The present study was conducted using an exercise protocol consisting of 8 weeks of compound exercises, 3 sessions a week for 80-90 minutes each.

Endurance-intermittent resistance. Step 1: This step consisted of a 5-minute warm-up and then resistant exercises for 30 minutes. Resistance exercises started with a halter flat chest press, followed by crunches, leg press, opening chest, knee bending, lateral stretching, overhead press, each exercise with 10 repetitions and 3 sets with an intensity equal to 40-60% of repetition maximum. The resting time between each set was 60-90 seconds. Step 2: This step consisted of a 5-minute warm-up and then resistant exercises for 30 minutes. Resistance exercises started with a halter flat chest press, followed by crunches, leg press, opening chest, knee bending, lateral stretching, overhead press, each exercise with 10 repetitions and 3 sets with an inten-

sity equal to 40-60% of repetition maximum. The resting time between each set was 60-90 seconds.

Heart rate during endurance training was controlled using a heart rate monitor (POLAR / Finland). Karvonen formula was used to calculate HRR as in equation 2:

Equation 2: [(max HR - resting HR) × % intensity] + resting HR

To determine the 1-repetition maximum (1RMmax), Brzycki equation 3 was used [16]:

Equation 3: 1RM = rep wt / [102.78 – 2.78(reps)]

Endurance-continuous resistance. Step 1: This step consisted of a 10-minute warm-up and then 30-40 minutes of continuous running on a treadmill. Step 2: This step consisted of a 5-minute warm-up and then resistant exercises for 30 minutes. Resistance exercises started with a halter flat chest press, followed by crunches, leg press, opening chest, knee bending, lateral stretching, overhead press, each exercise with 10 repetitions and 3 sets with an intensity equal to 40-60% of repetition maximum. The resting time between each set was 60-90 seconds. At the end of each session, cool-down exercises were done for 10 minutes. At the end of the program (after 8 weeks), all measurements were performed again, and the data were collected according to the pre-test conditions. Moreover, the control group had no exercises and was inactive during the study period (Tab. 1).

Data analysis

The collected data were analyzed using SPSS software version 25. After confirming the normality of the theoretical distribution of the data using the Shapiro-Wilk exploratory statistical test and the homogeneity of variances by the Levene's test, paired sample t-test and repeated measures (ANOVA) were used to compare between- and within-group variance changes. The level of significance was set at less than 0.05.

Results

The characteristics of the experimental and control groups are shown in table 2. At the end of an 8-week period of training, body mass, body mass index, levels of triglycerides, total cholesterol and low-density lipoprotein cholesterol of both training groups were reduced. However, high-density lipoprotein

Table 1. Endurance-intermittent and resistance training and Endurance-continuous and resistance training

Weeks	Session	Endurance-intermittent and resistance training	Endurance-continuous and resistance training
		Length, intensity of running Set, repetition, intensity	Length, intensity of running Set, repetition, intensity
1	1	30 minutes, 50% HRR + 3 sets, 10 repetitions, 40% 1-RM	30 minutes,× 4 min intermittence 70% HRR + 3 sets, 10 repetitions, 40% 1-RM
	2	30 minutes, 50% HRR + 3 sets, 10 repetitions, 40% 1-RM	31 minutes,× 4 min intermittence 70% HRR + 3 sets, 10 repetitions, 40% 1-RM
	3	30 minutes, 50% HRR + 3 sets, 10 repetitions, 40% 1-RM	32 minutes,× 4 min intermittence 70% HRR + 3 sets, 10 repetitions, 40% 1-RM
2	4	32 minutes, 50% HRR + 3 sets, 10 repetitions, 40% 1-RM	33 minutes,× 4 min intermittence 70% HRR + 3 sets, 10 repetitions, 40% 1-RM
	5	32 minutes, 50% HRR + 3 sets, 10 repetitions, 40% 1-RM	34 minutes,× 4 min intermittence 70% HRR + 3 sets, 10 repetitions, 40% 1-RM
	6	32 minutes, 50% HRR + 3 sets, 10 repetitions, 40% 1-RM	35 minutes,× 4 min intermittence 70% HRR + 3 sets, 10 repetitions, 40% 1-RM
3	7	34 minutes, 55% HRR + 3 sets, 10 repetitions, 45% 1-RM	36 minutes,× 4 min intermittence 75% HRR + 3 sets, 10 repetitions, 40% 1-RM
	8	34 minutes, 55% HRR + 3 sets, 10 repetitions, 45% 1-RM	37 minutes,× 4 min intermittence 75% HRR + 3 sets, 10 repetitions, 40% 1-RM
	9	34 minutes, 55% HRR + 3 sets, 10 repetitions, 45% 1-RM	38 minutes,× 4 min intermittence 75% HRR + 3 sets, 10 repetitions, 40% 1-RM
4	10	36 minutes, 55% HRR + 3 sets, 10 repetitions, 45% 1-RM	39 minutes,× 4 min intermittence 75% HRR + 3 sets, 10 repetitions, 40% 1-RM
	11	36 minutes, 55% HRR + 3 sets, 10 repetitions, 45% 1-RM	40 minutes,× 4 min intermittence 75% HRR + 3 sets, 10 repetitions, 40% 1-RM
	12	36 minutes, 55% HRR + 3 sets, 10 repetitions, 45% 1-RM	40 minutes,× 4 min intermittence 75% HRR + 3 sets, 10 repetitions, 40% 1-RM
5	13	36 minutes, 60% HRR + 3 sets, 10 repetitions, 50% 1-RM	40 minutes,× 4 min intermittence 75% HRR + 3 sets, 10 repetitions, 40% 1-RM
	14	36 minutes, 60% HRR + 3 sets, 10 repetitions, 50% 1-RM	40 minutes,× 4 min intermittence 75% HRR + 3 sets, 10 repetitions, 40% 1-RM
	15	36 minutes, 60% HRR + 3 sets, 10 repetitions, 50% 1-RM	40 minutes,× 4 min intermittence 75% HRR + 3 sets, 10 repetitions, 40% 1-RM
6	16	38 minutes, 60% HRR + 3 sets, 10 repetitions, 50% 1-RM	41 minutes,× 4 min intermittence 80% HRR + 3 sets, 10 repetitions, 40% 1-RM
	17	38 minutes, 60% HRR + 3 sets, 10 repetitions, 50% 1-RM	42 minutes,× 4 min intermittence 80% HRR + 3 sets, 10 repetitions, 40% 1-RM
	18	38 minutes, 60% HRR + 3 sets, 10 repetitions, 50% 1-RM	43 minutes,× 4 min intermittence 80% HRR + 3 sets, 10 repetitions, 40% 1-RM
7	19	40 minutes, 60% HRR + 3 sets, 10 repetitions, 55% 1-RM	44 minutes,× 4 min intermittence 80% HRR + 3 sets, 10 repetitions, 40% 1-RM
	20	40 minutes, 60% HRR + 3 sets, 10 repetitions, 55% 1-RM	44 minutes,× 4 min intermittence 80% HRR + 3 sets, 10 repetitions, 40% 1-RM
	21	40 minutes, 60% HRR + 3 sets, 10 repetitions, 55% 1-RM	44 minutes,× 4 min intermittence 80% HRR + 3 sets, 10 repetitions, 40% 1-RM
8	22	40 minutes, 60% HRR + 3 sets, 10 repetitions, 60% 1-RM	45 minutes,× 4 min intermittence 80% HRR + 3 sets, 10 repetitions, 40% 1-RM
	23	40 minutes, 60% HRR + 3 sets, 10 repetitions, 60% 1-RM	45 minutes,× 4 min intermittence 80% HRR + 3 sets, 10 repetitions, 40% 1-RM
	24	40 minutes, 60% HRR + 3 sets, 10 repetitions, 60% 1-RM	45 minutes,× 4 min intermittence 80% HRR + 3 sets, 10 repetitions, 40% 1-RM

1-RM – One-Repetition Maximum; HRR – Heart Rate Reserve.

cholesterol levels and VO2max increased significantly in both training groups (Tab. 3).

According to the results of Tukey's post-hoc test (the intra-group differences), there is no difference between the eight weeks of endurance-intermittent + resistance training and endurance-continuous + resistance training in the body mass, body mass index, levels of total cholesterol, high-density lipoprotein cholesterol and VO2max in overweight women. However, the differences in these variables were significant between endurance-intermittent + resistance training and control groups, as well as between endurance-continuous + resistance training and control groups.

Table 4 shows that PT, PTT, fibrinogen and platelet count of both training groups decreased significantly. However, d-dimer levels increased significantly in both training groups.

According to the results of Tukey's post-hoc test (the intra-group differences in mean), there is no significant difference between the eight weeks of endurance-intermittent + resistance training and endurance-continuous + resistance training in PT (between endurance-continuous + resistance training and control groups; p = 0.14), PTT (between endurance-intermittent + resistance training and endurance-continuous + resistance training; p = 0.09), d-dimer (between endurance-intermittent + resistance training and endurance-continuous + resistance training; p = 0.29) and fibrinogen (between endurance-intermittent + resistance training and endurance-continuous + resistance training; p = 0.34 and between endurance-continuous + resistance training and control group; p = 0.13) in overweight women.

There is a significant difference between the levels of PT (between endurance-intermittent + resistance training and endurance-continuous + resistance training; p = 0.01 and

Table 2. The characteristic of volunteers in this study

	Variations (M ± SD)			
	Age (year)	Height (cm)	Body mass (kg)	Body mass index (kg/m^2)
Endurance- intermittent resistance	53.08 ± 2.23	156.58 ± 3.14	66.17 ± 1.79	27.02 ± 1.47
Endurance-continuous resistance	55.08 ± 2.67	156.83 ± 1.99	66.25 ± 1.66	26.94 ± 1.01
Control	55.08 ± 2.60	156.08 ± 1.88	66.44 ± 1.91	27.29 ± 1.21

Table 3. The variation of body composition and lipid profile in overweight women

Variables	Groups	Variations				
		Stages		P-Value**		P-Value***
		Pre-training Mean ± SD*	Post-training Mean ± SD*	P	F	P
Body mass (kg)	1	66.17 ± 1.79	65.40 ± 2.06	0.001‡	7.08	0.003‡
	2	66.25 ± 1.66	65.67 ± 1.77	0.001‡		
	3	66.44 ± 1.91	66.91 ± 1.50&$	0.21		
Body mass index (kg/m^2)	1	27.02 ± 1.47	26.71 ± 1.49	0.001‡	7.11	0.003‡
	2	26.94 ± 1.01	26.71 ± 0.99	0.001‡		
	3	27.29 ± 1.21	27.29 ± 1.09&$	0.21		
TG (mg/dl)	1	129.25 ± 2.22	126.83 ± 2.28	0.04‡	0.82	0.44
	2	129.16 ± 2.69	126.16 ± 2.28	0.001‡		
	3	130.58 ± 1.62	129.08 ± 1.92&$	0.07		
TC (mg/dl)	1	188.75 ± 1.54	184.75 ± 3.69	0.007‡	4.20	0.02‡
	2	184.00 ± 3.33	180.58 ± 2.74	0.006‡		
	3	185.41 ± 4.35	185.00 ± 4.51&$	0.26		
LDL-C (mg/dl)	1	94.50 ± 2.77	90.41 ± 3.08	0.004‡	2.39	0.10
	2	94.00 ± 2.08	92.58 ± 2.87	0.02‡		
	3	93.75 ± 2.13	92.08 ± 3.52&$	0.14		
HDL-C (mg/dl)	1	45.25 ± 1.28	46.50 ± 1.50	0.017‡	5.18	0.001‡
	2	45.25 ± 0.86	46.91 ± 0.99	0.004‡		
	3	45.16 ± 1.11	45.00 ± 0.73&$	0.63		
VO2max (ml/kg/min)	1	44.50 ± 0.79	46.08 ± 0.79	0.001‡	4.08	0.02‡
	2	45.08 ± 1.08	45.91 ± 1.16	0.01‡		
	3	44.41 ± 0.99	44.16 ± 2.51&$	0.72		

* – Data presented as mean ± standard deviation; ** – Paired sample t-test; ‡ – The mean difference is significant at the 0.05 level; *** – P-Value between group; 1 – Endurance-intermittent resistance; 2 – Endurance-continuous resistance; 3 – Control; & – Difference between endurance-intermittent resistance with control group; $ – Difference between endurance-continuous resistance with control group; TC – total cholesterol; LDL-C – low-density lipoprotein cholesterol; HDL-C – High-density lipoprotein cholesterol; TG – Triglyceride; VO2max – maximal oxygen. consumption.

Table 4. The variation of coagulation factors in overweight women

Variables	Groups	Variations				
		Stages		P-Value**	P-Value***	
		Pre-training Mean ± SD*	Post-training Mean ± SD*	P	F	P
PT (s)	1	13.50 ± 0.24	12.77 ± 0.35	0.001‡	9.17	0.001‡
	2	13.29 ± 0.21	13.00 ± 0.44#	0.001‡		
	3	13.35 ± 0.28	13.30 ± 0.34&	0.59		
PTT (s)	1	38.75 ± 0.86	37.50 ± 0.90	0.001‡	11.33	0.001‡
	2	39.91 ± 0.90	38.00 ± 1.59	0.001‡		
	3	39.50 ± 1.31	39.41 ± 0.79&$	0.77		
D-dimer (ng/ml)	1	91.50 ± 1.08	93.50 ± 0.67	0.001‡	3.43	0.04‡
	2	91.41 ± 0.79	92.66 ± 1.66	0.03‡		
	3	91.00 ± 0.95	91.16 ± 2.03&	0.78		
Fibrinogen (mg/dl)	1	277.83 ± 13.16	272.16 ± 12.82	0.001‡	1.27	0.29
	2	272.91 ± 10.24	269.33 ± 7.86	0.02‡		
	3	279.16 ± 9.88	276.91 ± 9.60&	0.25		
Platelet count (per µl)	1	197.91 ± 2.64	194.41 ± 4.20	0.001‡	0.71	0.49
	2	199.16 ± 1.64	196.08 ± 2.90	0.001‡		
	3	193.58 ± 2.02	191.91 ± 3.70	0.26		

* – Data presented as mean ± standard deviation; ** – Paired sample t-test; ‡ – The mean difference is significant at the 0.05 level; *** – P-Value between group; 1 – Endurance-intermittent resistance; 2 – Endurance-continuous resistance; 3 – Control; & – Difference between endurance-intermittent resistance with control group; $ – Difference between endurance-continuous resistance with control group; # – Difference between endurance-intermittent resistance with Endurance-continuous resistance; S – second; Mg/dl – Milligrams per deciliter; PT – Prothrombin time; PTT – Partial thromboplastin time.

between endurance-intermittent + resistance training and control group; p = 0.001), PTT (between endurance-intermittent + resistance training and control group; p = 0.005 and between endurance-continuous + resistance training and control group; p = 0.001) and d-dimer levels (between endurance-intermittent + resistance training and control group; p = 0.01). The levels of PT were significant (between endurance-intermittent + resistance training and endurance-continuous + resistance training, p = 0.01, endurance-intermittent + resistance training and control group).

Moreover, according to the results presented in tables 3 and 4 (the between-group differences in mean), there is a significant difference between body mass (F(7.08) = 0.003), body mass index (F(7.11) = 0.003), total cholesterol (F(4.20) = 0.02), high-density lipoprotein cholesterol (F(5.18) = 0.001), VO2max (F(4.08) = 0.02); PT (F(9.17) = 001), PTT (F(11.33) = 0.001) and d-dimer (F(3.43) = 0.04).

Discussion

The aim of this study was to evaluate the effect of eight weeks of combined training (endurance-intermittent resistance and endurance-continuous resistance) on coagulation, fibrinolytic and lipid profiles of overweight women. Based on the results of the present study, fibrinogen, PT, PTT and platelet count decreased significantly at the end of the eight weeks; on the other hand, the levels of D-dimer increased significantly in both training groups. These results are consistent with the findings of Bargharar et al. [17]. But it does not agree with the findings of Rezaeimanesh et al. and Koehler et al. [18, 19]. Bargharar et al. examined the effect of 12 weeks of aerobic exercise (three sessions per week, for 30 minutes per session with an intensity equivalent to 70 to 85% of maximum heart rate) and concluded that the levels of fibrinogen, reactive protein C and white blood cells decreased significantly [17]. Rezaeimanesh et al. studied the effect of eight weeks of training, 3 sessions per week with an intensity equivalent to 90% of maximum heart rate on some fibrinolytic, dimer and fibrinogen factors in 24 men with type 2 diabetes and concluded that the level of rest TAFI antigen decreased, while the t-PA / PAI-1 complex increased. D-dimer and fibrinogen levels were significantly reduced in the training procedure [18]. When examining the effect of simulated sailor training on 42 high-performance sailors, Koehler et al. concluded that no significant change in d-dimer levels was noted [19]. Several mechanisms could explain decreased fibrinogen in the participants of this study. Fibrinogen has a direct association with stress, obesity, and LDL-C, and an indirect association with HDL-C. Therefore, increased HDL-C and decreased LDL-C, stress, and body fat percentage resulting from physical exercise could decrease fibrinogen [20]. Moreover, regular exercise leads to the decreased serum concentration of fibrinogen through decreased catecholamine stimulation, increased muscular blood flow, and increased total blood volume [21]. Decreased body fat percentage leads to reduced interleukin-6 in fat tissue, and given that interleukin-6 is a fibrinogen synthesis stimulator, reduced amounts of it could lead to decreased fibrinogen [21, 22]. In general, excess fat leads to inflammation in the body, which is a stimulation factor for increased blood fibrinogen. Decreased fibrinogen synthesis due to long-term physical exercises is another mechanism for decreased fibrinogen levels [23]. Therefore, the decreased fibrinogen of the participants of the current study could be due to anti-inflammatory and anti-oxidative adaptations. In general, it can be deduced that regular aerobic exercises and weight loss lead to decreased fibrinogen

through a reduction in adipokines, such as leptin and interleukin-6.

According to the results of the present study, in both groups of endurance-intermittent resistance and endurance-continuous resistance training, weight variables, body mass index, triglyceride level, total cholesterol, low-density lipoprotein cholesterol decreased significantly, while high-density lipoprotein cholesterol level saw a significant increase. These results are consistent with the findings of Shin et al. and Kumar et al. [24, 25]. However, it does not agree with the findings of Bijeh et al. [26]. Shin et al. examined the effect of 12 weeks of resistance training on damaged muscle and blood lipids in 30 elderly women and concluded that the levels of total cholesterol and low-density lipoprotein cholesterol decreased significantly but HDL-C levels increased significantly [25]. Kumar et al., by examining the effect of resistance training with three intensities, i.e. low (30-50% maximum repetition), medium (50-70% maximum repetition) and high (80-100% maximum repetition), resistance (body weight) and a combination of the two on the variables of high-density lipoprotein cholesterol, low-density lipoprotein cholesterol and total protein performed by forty men concluded that eight weight training exercises significantly increased HDL-C blood concentration, and total protein partially in the control group, while LDL-C levels decreased significantly [24]. Bijeh et al. reported that six months of aerobic exercises (three sessions of 60 minutes per week, aerobic exercises with 55 to 65% reserve heart rate) performed by 19 middle-aged women led to significant changes in serum TG, HDL-C, glucose and insulin levels [26]. Lecithin-cholesterol acyltransferase (LCAT) is produced in the liver and secreted into plasma, and the major part of it adheres to HDL-C. This enzyme is involved in the production of cholesteryl ester transfer protein and transportation of it to VLDL and sometimes LDL-C. LCAT, in combination with apolipoprotein A (cofactor), produces free cholesterol. A deficiency in this enzyme could be due to genetic disorders, or lack of apolipoprotein A. LCAT enzyme leads to reduced cholesteryl ester transfer protein and HDL-C. The liver absorbs chylomicron remnants, including cholesterol, cholesteryl ester, phospholipid, and apolipoprotein, and divides them through endocytosis. Dietary fatty acids or those produced in the liver are formed into 3-acylglycerols and, together with cholesterol and packaged cholesterol ester, enter the bloodstream as VLDL particles [27, 28]. Regular physical exercise increases lipoprotein lipase (LPL). It has been reported that this enzyme has a significant role in the conversion of VLDL to HDL-C. Moreover, it has been determined that physical exercise increases LCAT, which increases the stratification of intracellular cholesterol to HDL-C, which could be another reason for increased HDL-C [27, 29]. Increased HDL-C after physical exercise is similar to decreased 3-acyl glycerol accumulation (around a day after activity) and their disappearance (around three days after activity). The association between these contradicting effects probably increases the activity of LPL, accelerates the decomposition of glycerol in VLDL, and leads to the removal of lipoprotein particles; this leads to excess lipid (free cholesterol and phospholipid), which is transported to HDL-C. Moreover, physical activity produces the LCAT enzyme, which nourishes HDL-C particles [27]. Triglycerides in the serum are hydrolyzed by lipoprotein, a lipase in the capillary endothelium of muscles, and produce free fatty acids. These free fatty acids are not directly absorbed in the lipolytic process of absorption [30]. According to the conducted research, the facilitated mechanism of transport of these fatty acids through skeletal muscles could be explained by increased capacity of muscles in absorption and lysis of lipids through increased capillary density in the muscles, and increased surface for absorption of free fatty acids from the blood facilitates increased activity of enzymes in the movement and metabolism of fats. Moreover, catabolism of lipids could be due to factors such as increased oxidation of lipids compared to carbohydrates, increased use of intracellular triglycerides, and decreased intracellular glycogen [31].

Among the limitations of the present study are the lack of complete control of the participants' diet, their lack of control over emotion and anxiety, individual differences in genetic and hereditary characteristics concerning the measurement of some indicators, individual differences regarding their mental state in training sessions and the impossibility of complete control of the risk of disease or injury during the study.

In conclusion, based on the results, fibrinogen level, prothrombin time, partial thromboplastin time and platelet count decreased significantly at the end of the eight-week endurance-intermittent resistance and endurance-continuous resistance training in overweight women. However, serum levels of D-dimer increased significantly in both training groups. Also, the levels of triglycerides, total cholesterol, and low-density lipoprotein cholesterol decreased significantly, while the levels of high-density lipoprotein cholesterol increased significantly. Therefore, endurance-intermittent resistance and endurance-continuous resistance training can be used as a way to improve some indicators related to promoting the health of overweight women and it can be considered as a safe and fun method for them. This factor can reduce the potential risk of obesity-related diseases, and can be used as an effective non-pharmacological treatment to prevent these diseases. The results of this study indicate that physical exercises (endurance -intermittent resistance and endurance-continuous resistance) led to a significant reduction in menstrual symptoms in women compared to the control group. Physical activity is one of the best ways for women to reduce pressure and balance the chemical secretions in the brain. Physical activity seems to improve the symptoms of menstrual syndrome, increase pain tolerance, reduce anxiety, depression and other problems by increasing endorphins and decreasing adrenal cortisol.

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