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Effects of Endurance and Circuit Resistance Trainings on Lipid Profile, Heart Rate, and Hematological Parameters in Obese Male Students

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ABSTRACT

Studies have shown that different exercise ways are of the most important factors that affect cardiovascular risk factors and hematological parameters. This present paper aims to study the effects of two methods of endurance and resistance training on lipid profiles, heart rate, and hematological parameters in obese male students. 36 obese students were purposefully selected and randomly divided into three groups of 12 including endurance exercise, resistance exercise, and control. Exercise program was performed 3 times a week for 8 weeks, with a specific duration and intensity in both endurance and resistance exercise groups. Blood sampling was done after 14 fasting before the trial and 48 hours after the last training session. Results showed that both resistance and endurance exercises significantly increased HDL-C, Hct, and Hb and significantly decreased TC, TG, and resting heart rate ($P<0.05$). Also, Resistance exercise significantly increased the PLT and decreased LDL-C ($P<0.05$). However, WBC and RBC showed no significant change in the resistance and endurance exercise groups ($P>0.05$). In addition, no significant difference was observed between endurance and resistance exercise ($P>0.05$). In general, both endurance and resistance exercises can affect the lipid profile and hematological parameters and also reduce the resting heart rate. Therefore, they can be considered as an appropriate and non-medication approaches to prevent and reduce the incidence of cardiovascular diseases and obesity-related disorders in obese male adolescents.

Key Words: Endurance Exercise, Resistance Exercise, HDL-C, LDL-C, TC, TG, PLT, Hct, and Hb.

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INTRODUCTION

Diseases threatening human health are of the issues that have occupied the minds of researchers. A group of these diseases are cardiovascular ones that take the lives of about 12000000 people annually, according to the existing reports (1). One of the main risk factors of cardiovascular diseases is obesity, a medical condition in which body fats are unusually increased (2). In fact, obesity is an unusual phenomenon in children and there is no evidence that obesity in childhood also continues until adulthood and affects a long period of one's life. However, recent studies have demonstrated that dramatic changes have occurred in the health status of children and adolescents because of wrong nutrition and lifestyle (3, 4). For these reasons and as overweight is an index of inactivity, inactive children and adolescents should participate more in exercise. Almost in all the approaches presented, sport and exercise play an important role in the treatment of obesity (5).

Lipid profile has always been introduced an index of cardiovascular diseases and increased LDL-C (Low Density Lipoprotein) and decreased HDL-C (High Density Lipoprotein) are considered as the main risk factors of cardiovascular diseases. Control of risk factors of lipid profile, obesity, and overweight is one of the most important strategies for improving human health and any disorder in these parameters can lead to the development of cardiovascular diseases (1). Several reports suggest that regular endurance exercises improve the lipid profile, that is to say, reduced total cholesterol, triglyceride, and LDL-C and increased HDL-C (6, 7). By contrast, some other studies have reported no change in these parameters following the endurance exercises (8, 9). Benz *et al*. (2003) compared the advantages of endurance and resistance exercises and concluded that endurance exercises lead to improved performance and have useful effects on individuals susceptible to cardiovascular diseases and endurance exercises with the proper intensity and duration are more effective than resistance exercises in increasing the levels of HDL-C (10). In a study conducted by Elliott, Sale, and Cable (2002), lipid profile showed no significant change after 8 weeks of resistance exercises (11). Heart rate is one of the most important indicators of health and physical fitness in many sports. Several studies conducted on the impact of exercise on heart rate (12-16) have shown that regular exercise reduces the resting heart rate. Dashti (2011) reported that 8 weeks of selective endurance exercise decreased the resting heart rate (12). Naimi (2003) showed that endurance exercises have no significant effect on heart rate (17). On the other hand, some other studies have found a relationship between hematological parameters and Body Mass Index (BMI) in obese adolescents (18, 19). Hematological parameters, especially red blood cells and hemoglobin are responsible for carrying nutrients and oxygen to active tissues and excretion of waste and carbon dioxide from tissues to lungs. The number of red blood cells (RBC) and amount of hemoglobin (Hb) and hematocrit (Hct) are effective in increasing or decreasing the capacity of oxygen transport to tissues and excretion of carbon dioxide (20). Reports suggest that exercise and sport can cause significant changes in the hematological parameters. Fujitsuka *et al*. (2005) observed an increase in hemoglobin and red blood cells and no significant change in platelets (PLT) in a 12-week trial (21). Mousavizadeh, Ebrahimi, and Nikbakht (2009) found that 8 weeks of endurance exercise caused significant reduction in Hct, Hb, and RBC (9). Tayebi *et al*. (2010) reported an increase in white blood cells (WBC) as a result of resistance exercise (22). Another study reported no change in WBC and an increase in PLT following 4 weeks of exercise (23).

According to previous studies, firstly, inconsistency between the findings is evident and secondly, most previous studies have examined the effects of endurance exercises. Hence, as there was no available study about the effect of different ways of exercises on lipid profile, heart rate, and hematological parameters in obese male students, the present study was carried out in order to determine the effect of 8 weeks of endurance and resistance exercises on these indices in obese male students.

MATERIALS AND METHODS

Participants. Statistical population included all male students of guidance schools aged 12-16 in Iranshahr, Sistan & Baluchestan Province, Iran in the academic year 2012-2013, 50 of whom with a BMI of more than 30 kg/m^2 were selected as the sample. Firstly, height and weight of subjects were measured and their physical condition was examined by a physician. Then, parents were asked to declare their consent with the participation of their children in the trial. Finally, 36 of subjects were selected and randomly divided into three groups of endurance exercise, resistance exercise, and control.

Exercise Protocol. Resistance training program with weights included circuit exercise (8 stations) with one minute rest between stages. The objective of this exercise was the use of different muscles at different stations. In addition, these exercises were aimed to strengthen the muscles and improve cardiovascular endurance (24). This exercise program was performed 3 times a week for 8 consecutive weeks. In each session, about 15 minutes warm-up through stretching motions in the body's major muscles and 45-50 minutes resistance exercise were done. Procedure of training program was as follows: Squat, biceps curl with barbell, bench press, knee extension, seated row, standing calf raise with dumbbells, military press, and knee curl.

To determine the amount of weight used in training, 60%-80% of one maximum repetition was considered for all actions. For this purpose, the maximum weight that each subject would once lift (a maximum repetition) was determined by Brzycki's equation (25):

1RM = displaced weight (kg): 1.0278 - (number of repetition to exhaustion × 0.0278)

Training was based on increasing overload principle. Therefore, the subjects were asked to add to their repetitions in each session and increase the weight after reaching the limit of 10 reps (24).

Endurance training program included 15 minutes warm-up with stretching motions, walking, running, and then continuous running at a constant rate for 10 minutes with 65-75% of maximum heart rate (220-age). In order to observe the principle of overload, training was planned in a way that 30 seconds was added to the running time in each session, as this time reached 20 minutes in the last sessions. At the end of each session, cooling was performed through slow running and stretching motions for 10 minutes (24).

Exercise intensity was calculated according to Karvonen formula as follows:

Exercise hear rate = [(A-B) × desired intensity] + B

Where, *A* represents maximum heart rate (220-age) and *B* denotes resting heart rate (average of three measurements in the morning).

Blood Sampling and Assessment. In order to study biochemical parameters, blood sampling was done 24 hours before the exercise and 48 hours after the last session in all three studied groups. For the first time of blood sampling, the subjects were asked to avoid any strenuous activity from two days before the trial. Ten ml of blood was taken from the right brachial artery after 14 hours of fasting. The second stage of blood sampling was done 48 hours after the last training session with the same conditions.

The resulting serums were kept in a freezer at a temperature of -80°C. Plasma triglyceride was measured by enzymatic colorimetric method using a kit made by Pars Azmoon Company (Sensitivity: 1 mg / dl, Intra-assay CV%: 1.6). Total cholesterol was also measured by enzymatic colorimetric method using a kit made by Pars Azmoon Company (Sensitivity: 3 mg/dl, Intra-assay CV%: 1.4). To measure HDL-C, enzymatic photometric method and a kit made by Pars Azmoon Company (Sensitivity: 1 mg/dl, Intra-assay CV%: 1.5) were used. Finally, LDL-C was determined by the equation proposed by Friedewald, Levy, and Fredrickson (1972) (26) as follows:

$$\boxed{\mathbf{LDL = TC - HDL - TG/0.5}}$$

The resting hear rate was measured by a stethoscope (Hi-tec, made in Canada) in the morning after asking the subjects to take a seat and stay inactive for 5 minutes. This was done three times for each subject and the mean value was recorded as the resting heart rate. To measure CBC, 5 ml of venous blood was taken and poured in plastic vials containing 20 ml of an anti-thrombotic substance and quickly transferred to the laboratory in 30 minutes. Blood parameters were measured by Sysmex K800 device (made in Japan) with an accuracy of 10^7 cells per ml.

Statistical Analysis. Descriptive statistic was used to calculate mean and standard deviation. Distribution normality of variables was tested by Kolmogorov-Smirnov test. Also, ANOVA and dependent t-test were used for studying the difference between the groups and comparison of intragroup pretest and posttest, respectively. All statistical analyses were done in SPSS 17 software at a significance level of $\alpha<0.05$.

RESULTS

Table 1 presents the general characteristics of subjects in three studied groups. Based on the results, there is no significant difference between subjects of three groups in terms of age, weight, and height. Mean weight and body mass index increased in the control group but showed a significant decrease in the endurance and resistance exercise groups.

The results showed that 8 weeks of endurance and resistance trainings caused a significant increase in HDL-C and a significant decrease in TC, TG, and resting hear rate ($P<0.05$). In addition, resistance exercise led to significant decrease of LDL-C ($P<0.05$) (table 2). Also, the results showed that 8 weeks of endurance and resistance trainings caused a significant increase in Hct, Hb ($P<0.05$). In addition, resistance exercise led to significant increase of PLT ($P<0.05$). However, none of endurance and resistance exercises had no significant effect on the amounts of RBC and WBC ($P>0.05$) (table 3).

DISCUSSION

The results of the present study showed that8 weeks of endurance and resistance exercises caused a significant increase in Hct, Hb, and HDL-C and a significant decrease in TC, TG, and resting hear rate. However, no significant difference was observed between the two training methods. This result is consistent with the findings of previous reports indicating that regular exercise is followed by reduced lipid profile (6, 7, 27-30) and resting heart rate (12-16) and increased hematological parameters (31, 32). By contrast this is inconsistent with the findings of some other studied (11, 33-35). Habibzadeh and Rahmaninia (2011) studied the effect of two months of walking exercise on lipid profile and body mass index in obese girls and their results indicated that body mass index and risk factors of lipid profile decreased significantly but HDL-C showed a significant increase. They suggested that a regular physical activity like walking can change the metabolism of lipoproteins and reduce the risk factors of cardiovascular diseases (30). Balas-Nakash *et al*. (2010) studied the effect of 12 weeks of endurance exercise with two methods of 20-minute and 40-minute two days a week on risk factors of cardiovascular diseases in adolescents and showed that the first method only affects blood pressure, while the second one causes significant decrease in body mass index, blood pressure, and lipid profile. The came to the conclusion that longer aerobic exercises lead to improved health status of people and reduction of some of the risk factors of cardiovascular diseases (28). Atashk *et al.* (2012) studied the effect of 10 weeks of long-term resistance exercise on lipid profile in obese men and showed that resistance exercise causes significant reduction in TC of obese men and resistance exercise can be an effective treatment for making favorable changes in lipid profile in obese men (27). It has been shown that the body's endocrine system, during exercise, can use fatty acids as fuel to increase lipolysis through increasing the level of epinephrine, norepinephrine, cortisol, and growth hormone.

Table 1. General characteristics of subjects (Mean ± SD)

Group	**Height (cm)**	**Age (years)**	**Weight (kg)**		**BMI (kg/m^2)**	
			Pretest	**Posttest**	**Pretest**	**Posttest**
Control	146 ± 3.85	14.6 ± 0.31	65.67 ± 12.51	67.70 ± 0.31	30.41 ± 1.31	31.60 ± 1.26
Endurance exercise	143 ± 3.46	14.32 ± 0.27	63.16 ± 8.58	60.66 ± 8.80*	30.75 ± 1.21	29.50 ± 1.31*
Resistance exercise	152 ± 0.15	13.71 ± 0.29	68.50 ± 6.97	65.30 ± 6.94*	29.50 ± 0.79	28.00 ± 1.00*

*Significant level at $p < 0.05$.

Table 2. Analysis of covariance for Lipid Profiles and HRrest

Variable	Group	Pretest	Posttest	Intergroup p-value			Covariance p-value
				Control	Endurance	Resistance	
TC (mg/dL)	Control	210.17 ± 38.43	211.42 ± 43.11		< 0.001**	< 0.001**	F = 3.13 p < 0.001**
	Endurance	192.68 ± 12.45	184.23 ± 15.25			0.962	
	Resistance	183.8 ± 9.33	176.08 ± 9.62				
TG (mg/dL)	Control	114.20 ± 11.90	118.60 ± 10.70		0.033*	0.041*	F = 4.68 0.05*
	Endurance	114.30 ± 9.58	107.41 ± 11.13			0.877	
	Resistance	112.69 ± 7.96	102.77 ± 7.96				
LDL-C (mg/dL)	Control	104.50 ± 10.60	107.70 ± 13.40		0.13	0.005**	F = 4.68 0.017*
	Endurance	103.40 ± 7.50	100.73 ± 11.66			0.131	
	Resistance	100.82 ± 6.28	94.99 ± 5.42				
HDL-C (mg/dL)	Control	41.08 ± 6.89	40.83 ± 5.00		< 0.001**	< 0.001**	F = 11.184 < 0.001**
	Endurance	40.50 ± 2.60	44.00 ± 3.30			0.711	
	Resistance	43.80 ± 5.00	42.20 ± 4.70				
HRrest (b/min)	Control	74.60 ± 4.70	75.60 ± 4.60		< 0.001**	< 0.001**	F = 50.56 < 0.001**
	Endurance	76.40 ± 3.91	69.75 ± 4.45			0.512	
	Resistance	76.50 ± 4.70	70.33 ± 4.51				

*Significant level at $p < 0.05$. **Significant level at $p < 0.01$.

Table 3. Analysis of covariance for Hematological Parameters

Variable	Group	Pretest	Posttest	Intergroup p-value			Covariance p-value
				Control	Endurance	Resistance	
RBC (10^6/μL)	Control	5.44 ± 0.60	5.55 ± 0.86				F = 1.04 0.365
	Endurance	4.90 ± 0.60	4.77 ± 0.72				
	Resistance	4.80 ± 0.60	4.99 ± 0.39				
WBC (10^3/μL)	Control	6.37 ± 0.94	6.40 ± 0.75				F = 2.561 0.095
	Endurance	6.07 ± 0.34	6.94 ± 0.34				
	Resistance	5.98 ± 0.50	7.04 ± 0.82				
Hb (g/L)	Control	14.35 ± 1.62	13.85 ± 1.75		0.01**	< 0.001**	F = 10.609 < 0.001**
	Endurance	14.92 ± 0.67	15.14 ± 0.64			0.516	
	Resistance	14.53 ± 0.92	14.91 ± 0.65				
Hct (%)	Control	42.70 ± 3.60	41.80 ± 5.14		0.029*	0.021*	F = 3.629 0.039*
	Endurance	46.50 ± 3.60	47.30 ± 2.95			0.886	
	Resistance	45.25 ± 3.98	47.08 ± 3.70				
PLT (1000/μL)	Control	228.16 ± 35.74	228.50 ± 35.51		0.459	0.013*	F = 3.833 0.033*
	Endurance	256.50 ± 46.60	262.00 ± 51.30			0.058	
	Resistance	237.80 ± 32.70	260.30 ± 41.70				

*Significant level at $p < 0.05$. **Significant level at $p < 0.01$.

The present study showed that resistance exercise can significantly reduce LDL-C. It is known that at least two key enzymes in the metabolism of lipoproteins are associated with physical activities; Lipoprotein lipase plays a major role in the conversion of LDL-C to HDL-C and its level and activity increases following exercise. In addition, it seems that increased HDL-C as a result of endurance exercises is due to its increased production by liver enzymes and changes in different enzymes such as increase in lipoprotein lipase and lecithin cholesterol acyl transferase and decrease in hepatic lipase activity. Hepatic lipase enzyme plays a major role in the conversion of LDL-C to HDL-C. The amount of this enzyme is less in active individuals and exercise can decrease it more and maintain HDL-C concentration in larger amounts. These enzymatic changes, which are caused by exercise, improve the lipid profile (6, 7).

According to the study findings, 8 weeks of resistance and endurance exercises caused a significant change in heart rate compared with the control group. This is consistent with the results of Ravasi *et al.* (2003), Naimi (2003), Dashti (2011), and Lee *et al*. (2010) (12, 15-17). Ravasi *et al*. (2003) studied the impact of breath control exercises on peak aerobic power (Vo2max), resting heart rate, and erythropoietin in male physical education students. The subjects were under the treatment of interval and hypoxic interval running for 8 weeks. The results showed that 8 weeks of exercise in both groups caused significant decrease in heart rate (16). Dashti (2011) studied the effect of selective exercise on body composition and heart rate in male students aged 11-13 and observed that 8 weeks of exercise was associated with a significant reduction in resting heart rate (12). Lee *et al*. (2010) studied the effect of exercise on physical characteristics, metabolic condition, and cardiovascular parameters in obese children and the results showed that heart rate significantly decreased after the exercise compared with the control group (15). The results of the present study are inconsistent with the findings of Khashef (2002) who studied the effect of one session of strenuous physical activity and active and passive recovery on systolic and diastolic blood pressure and heart rate in young men and showed that resting heart rate significantly increased after exercise in all groups (14). Therefore, given the 8 weeks of exercise in the present study, it seems that the intensity was high enough to cause significant changes in resting heart rate. This can explain the partial effect of intensity and duration of exercise on resting heart rate. Heart rate recovery capacity after exercise depends on the capacity of the cardiovascular system to reverse the autonomic nervous system stimulants and adjustments of pressure receptors that are involved during exercise. The initial decrease in heart rate is due to the efforts of parasympathetic nerves for reactivation, with delayed decrease due to continued activity of parasympathetic nerves and reduced influence of sympathetic nerves (21).

The results showed that 8 weeks of resistance and endurance exercises do not make a significant difference in RBC, which is consistent with the findings of Ravasi *et al.* (2005) and Karakoc (2005). Ravasi *et al.* (2005) studied the effect of 8 weeks of hypoxic interval exercise on blood parameters in male physical education students and concluded that interval exercise causes no significant change in RBC (32). Karakoc (2005) studied the impact of a 90-minute standard football training session on hematological parameters in young men and showed that standard football training has no significant impact on RBC (36). On the other hand, this result is inconsistent with the findings of Mirsasan and Sari Saraf (2001), Mousavizadeh, Ebrahimi, and Nikbakht (2009), and Arazi, Damirchi, and Mostafaloo (2011) and Arazi *et al*. (2012). Mirsasan and Sari Saraf (2001)studied the effects of intense aerobic activity on RBC indices of male athletes and found that 7 stages of 3-minute Bruce exercise can cause a significant decrease in RBC (37). Arazi, Damirchi, and Mostafaloo (2011) studied the changes in hematological parameters following the repeated sessions of concurrent endurance and resistance exercises for 90 minutes two times a day (morning and afternoon) in male students of physical education and observed that RBC significantly decreased 3 hours after exercise (33).

The findings of the present study also showed that 8 weeks of resistance and endurance exercises do not make a significant difference in WBC. This is consistent with the findings of Ghanbari-Niaki and Mohammadi (2010) who studied the impact of 4 weeks of separate kickboxing and RAST test on hematological parameters in30 young male boxers and concluded that 4 weeks of exercise has no effect on WBC (23). However, this result is inconsistent with the findings of Arazi, Damirchi, and Mostafaloo (2011), Arazi *et al*. (2012) and Satarifard, Gaeini, and Choobineh (2012). Arazi, Damirchi, and Mostafaloo (2011) studied the changes in hematological parameters following the repeated sessions of concurrent endurance and resistance exercises for 90 minutes two times a day (morning and afternoon) in males students of physical education and observed that WBC significantly increased 3 hours after exercise (33). Arazi *et al*. (2012) also studied the response of hematological parameters to different intensities (low, medium, and high) of a resistance circle exercise in male athlete students and found that resistance circle exercise significantly increased WBC in in the high-intensity group (31). Satarifard, Gaeini, and Choobineh (2012) conducted a clinical trial in which 10 young male endurance athletes performed the same exercise for 1 hour with 60% of maximum oxygen uptake in three normal, cold, and warm environment. The results revealed that endurance exercise lead to significant increase in WBC in all three environments (38). This difference may be due to the characteristics of subjects and duration, intensity, and type of exercise.

Study findings also showed that8 weeks of resistance and endurance exercises caused significant increase in hemoglobin in endurance and resistance groups. This result is consistent with the findings of Ravasi, Gaeini, and Elmieh (2005) and Arazi *et al.* (2012) (31, 32). Arazi *et al.* (2012) studied the response of hematological parameters to different intensities (low, medium, and high) of a resistance circle exercise in male athlete students and found that resistance circle exercise caused significant increase in Hb in two medium-intensity and high-intensity groups (31). However, this result is inconsistent with the findings of Mirsasan and Sari Saraf (2001), Mousavizadeh, Ebrahimi, and Nikbakht (2009), Arazi, Damirchi, and Mostafaloo (2011), and Karakoc *et al*. (2005) (9, 33, 36, 37). Mirsasan and Sari Saraf (2001) observed significant decrease in hemoglobin following 7 stages of 3-minute Bruce exercise (37). Mousavizadeh, Ebrahimi, and Nikbakht (2009) studied the effect of an 8-week selective aerobic exercise course on hematological parameters in female students and observed a significant reduction in Hb (9). Arazi, Damirchi, and Mostafaloo (2011) studied the changes in hematological parameters following the repeated sessions of concurrent endurance and resistance exercises for 90 minutes two times a day (morning and afternoon) in male students of physical education and observed a significant decrease in Hb three hours after the exercise (33). Karakoc *et al*. (2005) studied the impact of a 90-minute standard football training session on hematological parameters in young men and showed that that standard football training causes a significant decrease in hemoglobin (36). Thus, given the 8 weeks of exercise in the present study, it seems that the intensity was high enough to cause significant changes in hemoglobin. In addition, some researchers have reported no change in Hb after exercise (32, 39). In this study, Hb showed a significant decrease in the control, significant increase in the resistance group, and insignificant increase in the endurance group. This indicates the partial effectiveness of duration and intensity of resistance exercise on Hb.

The results of the present study also showed that 8 weeks of resistance and endurance exercises caused a significant increase in Hct (hematocrit). This is consistent with the findings of Ravasi, Gaeini, and Elmieh (2005) and Arazi *et al*. (2012) (31, 32). Ravasi, Gaeini, and Elmieh (2005) studied 8 weeks of hypoxic interval exercise on blood parameters in male physical education students and concluded that hypoxic interval exercises can cause an increase in Hct (32). Arazi *et al*. (2012) the response of hematological parameters to different intensities (low, medium, and high) of a resistance circle exercise in male athlete students and found that resistance circle exercise caused significant increase in Hct in all three intensities (31). However, this result is inconsistent with the findings of Mirsasan and Sari Saraf (2001), Mousavizadeh, Ebrahimi, and Nikbakht (2009), and Arazi, Damirchi, and Mostafaloo (2011) (9, 33, 37). Mirsasan and Sari Saraf (2001) studied the effects of intense aerobic activity on RBC indices of male athletes and found that 7 stages of 3-minute Bruce exercise can cause a significant decrease in Hct (37). Mousavizadeh, Ebrahimi, and Nikbakht (2009) studied the effect of an 8-week selective aerobic exercise course on hematological parameters in female students and observed a significant reduction in hct (9). Therefore, given the 8 weeks of exercise in the present study, it seems that the intensity duration was not high enough to cause significant changes in Hct.

In terms of PLT, 8 weeks of resistance and endurance exercises caused a significant increase only in the resistance group, which is consistent with the findings of Arazi, Damirchi, and Mostafaloo (2011), Karakoc *et al*. (2005), and Ghanbari-Niaki and

Mohammadi (2010) (23, 33, 36), but inconsistent with the findings of Fujitsuka *et al*. (2005) who found no significant change in PLT in men following 12 weeks of heavy physical exercise (21).

Generally, it can be interpreted that regular exercise through hemolysis resulting from mechanical or oxidative damages of red cells, also known as hemolysis induced by exercise, causes loss of old cells in small eddy currents and a transfer towards younger cells occurs in RBC indices. Although the exact mechanism of WBC changes in sport is unknown, some mechanical factors such as increased cardiac output and changes in capillary endothelial cells are probably involved in this process, because, as we know, less than half the body's mature leukocytes circulate in the vascular system when we are resting. In addition, there is strong evidence that emphasizes on the role of hormones, as the regulators of exercise-induced changes, in leukocyte count and distribution of its subpopulations. It is clear that hormones such as epinephrine and cortisol affect the distribution of leukocytes between blood circulation system and various parts of the body such as liver, spleen, and bone marrow. Additionally, increased leukocyte count during exercise is controlled by epinephrine. Increase in epinephrine and cortisol, which is influenced by the intensity of activity and exercise capacity of individuals, is observed on the threshold of 60% of maximal oxygen uptake. Number of platelets increases after exercise which is due to the release of new platelets from the vascular bed of spleen, bone marrow, and other platelet deposits in the body. Secretion of epinephrine causes a strong contraction in the spleen where about one-third of body's platelets is deposited there. This mechanism could explain the reason for the dramatic increase in the number of platelets during exercise. In addition, in the acute phase of platelet activation, increase in the volume of platelets may be because of deformation of megakaryocytes parts in the cytoplasm (9, 21, 22).

CONCLUSION

The study findings show that both ways of regular exercise including resistance (60-80% of 1RM) and endurance (65-75% of HRmax), with favorable effects on risk factors of lipid profile and hematological parameters and also reducing the resting heart rate, are appropriate and non-medication approaches to prevent and reduce the incidence of cardiovascular diseases and obesity-related disorders in male obese adolescents.

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تازه‌های علوم کاربردی ورزش
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اثر تمرینات استقامتی و مقاومتی دایره‌ای بر نیم‌رخ لیپیدی، ضربان قلب و عوامل هماتولوژیک دانش‌آموزان پسر چاق

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چکیده

مطالعات نشان می‌دهند که شیوه‌های گوناگون تمرین از مهمترین عواملی هستند که می‌توانند پاسخ عوامل خطرزای قلبی- عروقی و هماتولوژیک را تحت تأثیر قرار دهند. هدف این پژوهش تأثیر دو شیوه تمرین استقامتی و مقاومتی دایره‌ای بر نیمرخ لیپیدی، ضربان قلب و عوامل هماتولوژیک دانش‌آموزان پسر چاق بود. به این منظور ۳۶ نفر دانش‌آموز پسر چاق به طور هدفمند انتخاب و به صورت تصادفی به سه گروه ۱۲ نفری تمرین استقامتی، مقاومتی دایره‌ای و کنترل تقسیم شدند. برنامه تمرینی به مدت ۸ هفته و هفته‌ای ۳ جلسه، با مدت و شدت مشخص در دو گروه تمرین استقامتی و مقاومتی به طور جداگانه اجرا شد. خون‌گیری در شرایط ۱۴ ساعت ناشتایی و در دو مرحله قبل از شروع تمرین و ۴۸ ساعت بعد از پایان آخرین جلسه تمرین به عمل آمد. نتایج نشان داد، تمرین استقامتی و مقاومتی باعث افزایش معنی‌دار هماتوکریت، هموگلوبین، لیپوپروتئین پرچگال و کاهش معنی‌دار کلسترول تام، تری‌گلیسرید و ضربان قلب استراحتی شد ($p < ۰/۰۵$). همچنین، تمرین مقاومتی دایره‌ای سبب کاهش لیپوپروتئین کم‌چگال و افزایش معنی‌دار پلاکت‌ها شد ($p < ۰/۰۵$). با این حال، هیچ یک از تمرینات استقامتی و مقاومتی دایره‌ای بر روی مقادیر گلبول‌های قرمز و سفید تأثیر معنی‌داری نداشت ($p > ۰/۰۵$). بعلاوه، هیچگونه تفاوتی بین تمرین استقامتی و مقاومتی دایره‌ای مشاهده نشد ($p > ۰/۰۵$). به طور کلی، تمرینات استقامتی و مقاومتی دایره‌ای می‌توانند با تأثیر مطلوب بر عوامل خطرزای نیمرخ لیپیدی و هماتولوژیک و ضربان قلب استراحتی، راهکاری مناسب و غیردارویی برای پیشگیری و کاهش بروز بیماری های قلبی- عروقی و اختلالات مرتبط با چاقی در نوجوانان پسر چاق باشند.

واژگان کلیدی: تمرین استقامتی، تمرین مقاومتی، هماتوکریت، هموگلوبین، لیپوپروتئین پرچگال، کلسترول تام، تری‌گلیسرید، ضربان قلب استراحتی.

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