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Comparison the effect of three aerobic, resistance and combined (aerobic + resistance) training methods on serum levels of Irizin, Atherogenic Index of Plasma and some cardiovascular risk factors in Inactive Overweight Men

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Abstract

Purpose: The aim of this study was to compare the effect of eight weeks of aerobic, resistance and combination training on serum levels of irizin, atherogenic index of plasma (AIP) and some cardiovascular risk factors in inactive overweight men. **Methods:** In this quasi-experimental study, 32 inactive overweight men participated voluntarily and were randomly divided into 4 groups: aerobic training, resistance training, combination training and control. Serum levels of irizin, AIP and lipid profile of subjects were measured before and after eight weeks of exercise. **Results**: After eight weeks of exercise intervention, irizin levels increased significantly in all three experimental groups (P <0.05). Also, AIP decreased significantly in all three training groups (P <0.05). On the other hand, in examining the differences between groups, a significant difference was observed between the groups in AIP and irisin (P <0.05). **Conclusion:** The results of the present study showed that eight weeks of exercise training can possibly cause favorable changes in plasma irisin and biochemical parameters of the blood in overweight people. Also, combined training seems to have more favorable effects than other training methods.

***Keywords**:* Combined training, Resistance training, Fat percentage, Irisin, AIP.

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INTRODUCTION

Nowadays, obesity and overweight have become a public health problem all over the world, which can increase the risk of various diseases (Alm, Krook, & de Castro Barbosa, 2016). Obesity and inactive lifestyle have been identified as one of the top 10 health problems by the World Health Organization (WHO). Inactive lifestyle is the most important risk for cardiovascular diseases, which leads to disorders such as increased blood fat, high blood pressure, overweight and obesity (Abasi & Nikseresht). Most of the epidemiological studies show that the increase in body weight during middle age is associated with an increased risk of mortality (Abasi & Nikseresht, 2018). So that the risk of getting cardiovascular diseases in people whose body mass index (BMI) is between 25 and 28.9 kg/m2, compared to people whose BMI is between 18-21 kg/m2 It is two times and three times more in people whose BMI is more than 29 (Abbasi Soltani & Zehsaz). The risk of these complications can be checked by calculating the atherogenic index of plasma (AIP) using the Log10 (triglycerides/HDL-C) method (Acar & Eler). Increased TG along with low levels of HDL are strong indicators of cardiovascular diseases. Also, increased TG levels increase the amount of small and dense LDL, which ultimately increases the risk of cardiovascular diseases (Abasi & Nikseresht).

On the other hand, the vital importance of skeletal muscles in maintaining and developing health is considered. Skeletal muscles, as the largest endocrine organ, secrete a hormone known as myokine. Irisin is a myokine that is secreted by skeletal muscles during exercise and enters the blood circulation. In addition to regulating energy homeostasis and metabolism, irisin also plays a role in converting white adipose tissue into pseudo-brown adipose tissue and improves body composition (Ma et al., 2021; Son, Chae, Testroet, Du, & Jun, 2018). It also has enough potential to prevent and treat obesity and metabolic diseases (Pedersen & Febbraio, 2012; Yang, Yang, Li, & Han, 2019). The results of various researches show that the concentration of irisin in circulation changes in people with cardiovascular diseases compared to healthy people. Some studies have reported a significant relationship between irisin and cardiovascular diseases (Ardabili, 2017). Also, the use of irisin can affect the pathological process and cause the recovery of some cardiovascular diseases (Fan et al., 2020; Yang et al., 2019).

On the other hand, physical activity is widely recognized as a way to prevent chronic diseases (Organization, 2002). The results of studies show that regular exercise is effective in reducing people's weight in a way that reduces fat mass, visceral fat, and increases fat-free mass. Regular physical activity increases insulin sensitivity and high-density lipoprotein and decreases Glyceride and low-density lipoproteins lead to the improvement of glucose and lipid metabolism (Hernández-Reyes et al., 2020; Ortega, Sui, Lavie, & Blair, 2016). Compared to aerobic exercises, there is relatively little information on the effect of resistance and combined exercises on irisin levels as well as cardiovascular risk factors in obese and overweight people, and sometimes the results of research conducted are contradictory and the research in this field is based on It is necessary on obese people (Jafari & Ravasi, 2021).

Nevertheless, the results of animal research show that aerobic and resistance exercises increase irisin levels, decrease fasting blood sugar and HDL-LDL ratio in diabetic rats (Javadifar, Gaeini, Haddadi, & Ravasi, 2021). On the other hand, the type and intensity of sports activity, duration and level of physical fitness of people are important in irisin response (Ma et al., 2021). Based on this, the aim of this research was to compare the effect of three different training methods on serum levels of irisin, body fat percentage and some cardiovascular risk factors in overweight young men.

METHOD

In this semi-experimental research, 32 inactive overweight students with an age range of 22 to 27 years and an average body mass index of 31.17 kg/m2 were randomly selected and then randomly assigned to four aerobic exercise groups (8 people). resistance training (8 people), combined training (8 people) and control group (8 people) were divided. At first, the objectives and conditions of the research were explained to the subjects, and after agreeing, the subjects completed the informed consent form and the personal information questionnaire. Based on the questionnaire of personal information and medical history, none of the subjects had a history of cardiovascular, respiratory diseases or the use of drugs affecting the results of the study.

The criteria for entering the current research are being inactive, not having a history of suffering from certain diseases, such as (diabetes, cancer, cardiovascular and pulmonary diseases, liver), not having a report of any type of physical or orthopedic injury that interferes with exercises. have, the lack of connection between their obesity and overweight with hypothyroidism, no history of regular physical activity during the two years prior to the research, no smoking, no use of hormone therapy, and having the necessary physical fitness to start the exercise program Cases were evaluated using a medical history questionnaire. The training groups participated in training programs for each group for eight weeks and three sessions per week (Saturday, Monday, Wednesday).

Measurement of anthropometric characteristics

All people's weight was measured in a fasting state using a Seca model 813 digital scale made in Germany with an accuracy of 0.1 kg in a state without shoes and with minimal clothing. Height measurement in centimeters using a non-flexible tape measure with an accuracy of 0.1 cm and between 08:00 and 10:00 in the morning (at the same time as weight measurement) without shoes and socks while facing The wall was standing straight and the heels, hips, shoulders and back of the head were in contact with the wall.

Calculation of physiological variables

Heart rate activity

The maximum heart rate of the subjects was obtained using the formula (age - 220). Also, maximum reserve heart rate (HRR) of subjects was obtained from the difference between maximum heart rate and resting heart rate (Karbalamahdi, Abedi, Fatolahi, & Pazoki, 2019a).

Estimation of maximum oxygen consumption (VO2max)

The maximum oxygen consumption of the subjects was estimated using the Bruce test. This test starts with a low working pressure on the treadmill and gradually increases the working pressure and continues until the point where the subject is unable to continue the activity due to fatigue. This test is performed in six stages of 3 minutes on the treadmill, and in each stage the speed and percentage of the incline of the treadmill changes. The first stage starts at a speed of 2.7 km/h (1.7 miles) and a 10% gradient, and then the speed and gradient are added in a CLDL = CPlasma – CHDL – TG.

Plasma atherogenic index

The atherogenic index of subjects' plasma was calculated in the following way (Dobiasova, 2006).

AIP = Log (triglycerides/HDL-C)

Statistical Analysis

All collected data were analyzed through SPSS version 21 software. To check the normality of the data, the Shapiro-Wilk statistical test was used, to check the changes within the group, the correlated t-test was used, and to check the difference between the groups in the pre-test and post-test, the one-way ANOVA and the LSD post hoc test were used. . The significance level of the current research was considered less than 0.05.

RESULTS

According to the results, there was no significant difference between the variables of the general characteristics of the subjects participating in this research (Table 1) ($P<0.05$).

Table 1: Physical and physiological characteristics of the subjects before and after the exercise program (mean ± standard deviation).

Variables	Groups	Pre-test	Post-test,	P value
Weight (kg)	control	89.11±2.3	86.56±0.12	P = 0.05
	Aerobics	88.53 ± 9.13	85.57±6.26	
	Resistance	89.58±1.65	86.38±4.13	
	Combined	89.10±4.11	84.61±4.56	
Age(Year)	control	24.95	-	
	Aerobics	25.24	-	
	Resistance	26.11	-	
	Combined	25.10	-	
	control	174.01 ± 1.15	-	

Height (cm)	Aerobics	173.47±4.47	-	
	Resistance	174.16±8.36	-	
	Combined	173.98±4.13	-	
	Control	28.08± 4.24	28.68±4.18	
VO_2max(ml/kg.m2)	Aerobics	28.13 ± 8.26	32.61±5.12	P=0.01*
	Resistance	27.98 ± 4.97	28.16±5.06	
	Combined	28.49±5.11	32.15±4.26	

* $P \leq 0.05$

The results of the one-way statistical test showed that eight weeks of aerobic, resistance and combined training caused significant changes in all measured indicators in all three experimental groups compared to the control group (<0.05). P) (Table 2). Changes between groups showed a significant increase in the irisin variable post-test (P=0.002) in the experimental groups compared to the control group. Also, these changes show a significant decrease in low-density lipoprotein variables (P=0.001), triglyceride (P=0.015), plasma atherogenic index (P=0.001) and a significant increase in high-density lipoprotein (P=0.010). In the post-test, the experimental groups were compared to the control group (Table 2).

Table 2: Intra-group and inter-group comparison of dependent variables before and after 8 weeks of sports activity in groups using paired t-test and one-way ANOVA (mean ± standard deviation)

variable	Group	levels	Standard deviation ± mean	Intragroup P Value	between groups P Value	
					Pre-test	**post-test**
Irisin (mcg/ml)	Aerobic Exercise	Pre-test	3.55±0.56	0.029	0.827	0.002*
		post-test	3.78±0.47			
	Resistance training	Pre-test	3.56±0.44	0.22		
		post-test	3.71±0.47			
	Combined exercise	Pre-test	3.71±0.67	0.004		
		post-test	4.78±0.07			
	Control	Pre-test	3.47±0.42	0.351		
		post-test	3.38±0.45			
	Aerobic Exercise	Pre-test	163.75±41.95	0.006	0.809	0.015*
		post-test	145.10±31.50			

Tri glyceride (mg/dL)	Resistance training	Pre-test	74.46±168	0.011		
		post-test	146.25±33.56			
	Combined exercise	Pre-test	170.62±36.09	0.001		
		post-test	113.75±14.33			
	Control	Pre-test	166.25±38.89	0.668		
		post-test	168.50±37.79			
Low density lipoprotein (mg/dL)	Aerobic Exercise	Pre-test	136.88±21.37	0.042		
		post-test	136.50±37.79		0.504	0.001*
	Resistance training	Pre-test	130.00±19.45	0.004		
		post-test	107.50±11.33			
	Combined exercise	Pre-test	138.12±15.38	0.001		
		post-test	104.38±6.23			
	Control	Pre-test	125.62±17.81	0.285		
		post-test	128.50±18.32			
High density lipoprotein (mg/dL)	Aerobic Exercise	Pre-test	27.87±3.52	0.030	0.832	
		post-test	29.75±2.65			0.010*
	Resistance training	Pre-test	29.37±5.28	0.054		
		post-test	30.75±4.77			
	Combined exercise	Pre-test	30.37±6.50	0.001		
		post-test	37.00 ± 4.89			
	Control	Pre-test	29.62±6.20	0.516		
		post-test	29.32±5.99			
Plasma atherogenic index(AIP)	Aerobic Exercise	Pre-test	0.75±0.32	0.001	0.821	0.001*
		post-test	0.66±0.09			
	Resistance training	Pre-test	0.74 ± 0.14	0.002		
		post-test	0.66±0.12			
	Combined exercise	Pre-test	0.74±0.09	0.001		
		post-test	0.46±0.06			
	Control	Pre-test	0.73±0.18	0.309		
		post-test	0.74 ± 0.12			

* $P \leq 0.05$

The results of the LSD post-test showed a significant difference between the control and combined exercise groups in the indices of irisin (P=0.001), triglyceride (P=0.001), high-density lipoprotein (P=0.003) and Atherogenic index of plasma showed (P=0.001). Also, a significant difference was observed in the low-density lipoprotein index between the control and resistant groups (P=0.005), and the control and combined group (P=0.003). The results of this test showed that the amount of irisin and high-density lipoprotein in the combined exercise group increased more than the other groups, and the levels of irisin, triglyceride, low-density lipoprotein and atherogenic index of plasma in the combined exercise group compared to the aerobic and resistance groups and the control group. had a further decrease (Table 3).

Table 3: The results of LSD post hoc test of one-way analysis of variance of research variables

Variable	Group	Group	between groups P Value
Irisin (mcg/ml)	Control	Aerobic resistance	0.306 0.420
		Combined	0.001*
		Aerobic	0.152
Tri glyceride (mg/dL)	Control	resistance	0.176
		Combined	0.002*
		Aerobic	0.852
Low density lipoprotein (mg/dL)	Control	resistance	0.005*
		Combined	0.002*
		Aerobic	0.875
High density lipoprotein (mg/dL)	Control	resistance	0.556
		Combined	0.003*
		Aerobic	0.191
Plasma atherogenic index (AIP)	Control	resistance	0.166
		Combined	0.001*

* $P \leq 0.05$

DISCUSSION

The most important findings of the present study were the increase in the levels of irisin and high-density lipoprotein as well as the reduction of cardiovascular risk factors in all three training groups after eight weeks of exercise, which indicated the favorable effect of all three types of exercise on blood biochemical indices. On the other hand, in examining the difference between the groups, combined exercises had a more favorable effect on the measured variables than other exercise methods. After eight weeks of sports activity, irisin levels increased significantly in aerobic and combined exercise groups. In this connection, Huh et al. reported that irisin levels increased after all three types of intermittent, resistance, and aerobic training in inactive obese men (Huh, Siopi, Mougios, Park, & Mantzoros, 2015).

Pekkala et al. reported that an aerobic training session (exercise on a stationary bike with an intensity of 50% of maximum oxygen consumption for 60 minutes) leads to an increase in irisin, but a resistance training session (5 sets of knee extension with an intensity of 10 repetitions maximum) It did not change irisin levels (Pekkala et al., 2013). These results were also repeated in Nygaard et al.'s research (Nygaard et al., 2015). The concentration of irisin is directly related to the fat percentage(Nygaard et al., 2015) because probably in obese people, like leptin and insulin, they also have resistance to irisin, so in these people the concentration of irisin increases more than a compensatory mechanism to increase non-vibrating heat generation and decrease provide body weight(Tolson, Garcia, Delgado, Marooki, & Kauffman, 2016).

The main mechanism of irisin increase after sports activity is the increase of PGC1α. Participating in sports activity increases the expression of PGC1α gene in skeletal muscles, which leads to an increase in FNDC5 levels in the myocyte membrane. Then FNDC5 is degraded and irisin is released. Irisin enters the blood stream and binds to its receptors in the membrane of adipocytes, and by stimulating the expression of the UCP1 gene, it causes browning of white adipocytes and non-vibrating thermogenesis through the breakdown of fatty acids, which ultimately causes Weight loss, is achieved by reducing fat percentage and improving insulin sensitivity. Therefore, irisin has an inverse relationship with insulin resistance and metabolic syndrome (Jafari, Pouryamehr, Rabbani, & Heydari, 2020; Qian, Chen, Yang, & BU, 2017).

In the case of long-term exercises, the characteristics of the subjects and the duration, intensity, frequency and type of exercises can influence the response of Irisin to exercise, and the results of the findings are contradictory compared to acute exercises (Jafari & Ravasi, 2021).

In the group of aerobic exercises, the increase of irisin can be related to the process of browning white fat. The findings show that the external injection of irisin in mice causes the formation of brown fat in the subcutaneous fat through the activation of MAPK p38 and ERK1/2 (Hecksteden et al., 2013). On the other hand, overexpression of FNDC5 in obese mice increases the amount of lipolysis in adipocytes and thus decreases the serum level of fats(Hecksteden et al., 2013). In the investigation of the incremental changes of irisin after combined exercises, it has been reported that irisin affects muscle growth factors such as flustatin and myostatin and thereby improves metabolic conditions (Jafari & Ravasi, 2021). In elderly people, the decrease in muscle mass can decrease the irisin response. Because skeletal muscles are, the main tissue for producing irisin after exercise and irisin response is greater in young people due to having a large muscle mass. Also, the basal levels of irisin are lower in active people compared to inactive people, because these people need to call less muscle units in each intensity of exercise due to their higher exercise capacity than non-athletes. In this connection between irisin levels and maximum oxygen consumption an inverse relationship has been reported (Huh et al., 2014).

According to the findings of the current research, Shirzad et al. reported that 8 weeks of combined aerobic exercise increased irisin levels in obese men (Jafari & Ravasi, 2021). Kim et al. investigated the effect of 12 weeks of resistance training (2 sessions per week) on irisin levels and they reported no change of this substance after 12 weeks of resistance training

(Kim, So, Choi, Kang, & Song, 2015). Miyamoto et al. investigated the effect of 8 weeks of aerobic training on a bicycle on irisin levels in two groups of inactive young and elderly men, and after the training period, irisin increased significantly only in the elderly group (Miyamoto-Mikami et al., 2015).

In addition to the treatment of obesity and its metabolic complications, the increase in irisin due to exercise can have many other benefits through increasing the expression of the UCP1 gene. Irisin in skeletal muscle through MAPK and AMPK signals increases gene expression of proteins such as PYGM, PCK1, GLUT4, HK2, PPARα, UCP3, UCP1, which improves lipid and glucose metabolism and improves insulin sensitivity in skeletal muscle. Muscle is very effective (Gizaw, Anandakumar, & Debela, 2017). Boström et al. reported that the expression of irisin depends on the type and duration of exercise, so that three weeks of voluntary running in rats and ten weeks of endurance training in healthy adult men had different effects on irisin levels. Most likely, endurance training by changing the amount of access to fuel resources during sports activity and creating an energy deficit activates the metabolic pathways effective in the expression of this adipocyte gene, which, as a result, increases the secretion of irisin (Boström et al., 2012).

On the other hand, the intensity of exercise is also effective in the amount of irisin secretion. In this regard and according to the results of the present research, Pekala compared the level of irisin expression after intense aerobic training and moderate intensity combined training. The results showed that serum irisin increased immediately after both training protocols, but the effect of intense aerobic training was much greater, which indicates the effect of the intensity of exercise on the amount of irisin increase(Pekkala et al., 2013).

Also, Bostrom et al showed that three weeks of endurance running training in mice increased the amount of irisin in the serum by 65 times. These researchers stated that muscle contractions during training play an effective role in this increase (Löffler et al., 2015). These findings show that irisin is a sports myokine and its increase after intense training (Huh et al., 2015; Löffler et al., 2015) is more than low intensity training (Aydin et al., 2013; Norheim et al., 2014)

Another finding of the current research was a significant decrease in plasma atherogenic index in all three exercise groups. According to the results of the present study, high-density lipoprotein levels increased in all three training groups, but this increase was statistically significant in the combined and aerobic training groups. Triglyceride was also significantly reduced in all three training groups after 8 weeks of training intervention. Based on this, the greatest decrease in plasma atherogenic index was observed in the combined exercise group. So that in examining the difference between the groups, a significant difference was observed only between the combined exercise and the control group. In this connection, Adrian et al. and Hijazi et al. recently reported the positive effect of participation in sports activities in reducing plasma atherogenic index in obese people (Adrien & Felix, 2017; Hejazi, Ziaaldini, Attarzadeh Hosseini, & Fathi, 2020). Adrian et al. reported that the concentration of low-density lipoprotein, triglyceride and cholesterol significantly decreased after eight weeks of aerobic exercise (Adrien & Felix, 2017). Hejazi et al. checked after eight weeks of training intervention, the levels of LDL-C, TG, TC and atherogenic index in the high and medium intensity training groups decreased significantly more than the control group. They concluded that eight weeks of aerobic training at both moderate and high intensity may regulate signaling pathways for the activation of PGC-1a protein (i.e., the master regulator of energy metabolism and mitochondrial biogenesis) in skeletal muscle (Hejazi et al., 2020). It has been reported those 8-14 weeks of aerobic exercise leads to a 4-37% decrease in fasting TG levels and a 4-18% increase in HDL-C concentration (Durstine, Grandjean, Cox, & Thompson, 2002). Also, exercising for more than 120 minutes a week causes a significant increase in HDL-C concentration, which is not affected by the intensity of exercise (Kodama et al., 2007).

The results obtained were consistent with the research of Yetgin et al. In this research, it was shown that eight weeks of simultaneous aerobic and resistance training on serum lepton levels, lipid profiles and body composition of inactive overweight men, the amount of variables such as triglyceride levels, total cholesterol, low-density lipoprotein cholesterol and lipoprotein A after All three types of intermittent, continuous and strength aerobic exercises with sauna showed a significant decrease and a significant increase in the level of high-density lipoprotein cholesterol compared to the pre-test, but in this research, the comparison of the results between the three studied groups showed that there was a significant difference. It does not exist among the three groups(Yetgin et al., 2020).

A possible mechanism for reducing triglyceride levels after participating in sports activities can be the activity of lipoprotein lipase (LPL); So that doing sports by increasing the amount of lipoprotein type I, increases the activity of LPL enzyme and may be the cause of TG reduction. It seems that the duration of exercise is also effective in reducing the level of triglycerides, on the other hand, LPL causes catabolism of the lipid part of LDL-C, therefore, LDLC is expected to decrease (Karbalamahdi, Abedi, Fatolahi, & Pazoki, 2019b; Ramezankhany, Nazar Ali, & Hedayati, 2011). Some researchers have suggested that subjects' initial body composition or changes in their body composition could be largely responsible for the observed change in blood lipids as a result of exercise programs (Azarbayjani, Abedi, Peeri, Rasaee, & Stannard, 2014).The decrease in body fat percentage is related to important changes in the fat profile, especially the decrease in triglyceride, cholesterol and low-density lipoprotein cholesterol in obese people, and on the other hand, dyslipidemia index and risk factors for coronary heart disease by evaluating blood lipid levels (cholesterol, triglyceride and cholesterol-lipoprotein) with low density) takes place. Previous studies have shown that elevated blood cholesterol levels can lead to secondary cardiovascular disease. While high levels of high-density lipoprotein cholesterol can prevent atherosclerosis and heart disease. Also, protection against cardiovascular risk factors by reducing low-density lipoprotein cholesterol and increasing high-density lipoprotein cholesterol can be facilitated by this exercise program(Foroutan, Pehpoor, Tadibi, & Danashyar, 2019). The limitations of the current research include the small number of samples examined in each group, the lack of full-time access to the subjects, and the lack of control over the subjects' caloric intake.

CONCLUSIONS

In general, according to the results of the current research and previous studies in this field, it can be concluded that all three types of sports activities can probably be useful in reducing cardiovascular risk factors as well as increasing irisin levels. But it seems that combined exercises have more effect than other training methods. However, more research with a large sample size is needed to determine the exact mechanisms of the effect of this training method in reducing the investigated factors.

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