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Comparing the effect of High Intensity Interval Training (HIIT) and Moderate Intensity Aerobic Training on serum levels of homocysteine and lipid profiles in overweight inactive men

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Abstract

Purpose: The aim of this study was compares the effects of 10 weeks High Intensity Interval training (HIIT) and moderate intensity aerobic training (MIAT) on serum levels of homocysteine and some cardiovascular risk factors in overweight inactive men. **Methods:** In this semi-experimental study, nineteen overweight men voluntarily participated in this study and were randomly divided to 2 Groups: High Intensity Interval training (HIIT) and moderate intensity aerobic training (MIAT). Subjects performed training programs for 10 weeks, 3 sessions per week. The levels of homocysteine and lipid profile were measured before and after 10 weeks of training programs. For statistical data analysis, independent and paired t tests were used and considered significant at a $p \leq 0.05$.

Results: The results of this study showed that both High Intensity Interval training and moderate intensity aerobic training caused a significant reduction of homocysteine levels ($P \leq 0.05$). After 10 weeks of high -intensity periodic exercise, cholesterol levels ($p = 0.001$), LDL ($p = 0.002$) decreased significantly and HDL levels were significantly increased ($p = 0.001$), In MIAT training group, only a significant reduction in cholesterol was found ($P=0.006$). **Conclusion:** According to the results of this study, it seems that both High Intensity Interval training and

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moderate intensity aerobic training have favorable effects in reducing body weight and some cardiovascular risk factors.

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

INTRODUCTION

Lifestyle changes have caused different societies to face a wide range of disorders, especially obesity and overweight, so that statistics show a significant increase in the prevalence of obesity in recent decades all over the world (Zhang et al., 2017). Obesity is a pathological condition that is considered as the main risk factor for various types of cardiovascular diseases (Ndumele et al.) and one of the major causes of death in developed and developing countries (Atashak & Ahmadi-Zad, 2017). So that the body mass index (Body Index Mass) is more than 25 kilograms per square meter, causing an increase in insulin resistance, excessive increase of insulin in the blood and hyperglycemia, and it leads to an increase in the risk of diabetes up to more than 60 times in women and 42 times in men (Lira et al., 2010). On the other hand, in inactive people, obesity and weight gain are strongly related to the spread of chronic diseases such as high blood pressure, blood lipids and insulin resistance, which are all risk factors for cardiovascular diseases (Gholizadeh, Kordi, & Akbarnejad, 2016).

Homocysteine is a sulphurous amino acid that is formed into cysteine in the course of methionine metabolism. The normal concentration of serum homocysteine in humans is 5-15 micromol/liter (Sohrvardi, Azmandian, Daryaee, Mohammadpoor, & Mehrabani, 2007). Homocysteine can cause arteriosclerosis through damage to the inner wall of arteries, interfering with blood clotting factors and oxidation of low-density lipoproteins (LDL) (Sütken, Akalin, Özdemir, & Çolak, 2010). According to paraclinical studies, hyperhomocysteinemia occurs if the serum homocysteine concentration increases by 5 micromol/liter from the normal state (Sohrvardi et al., 2007). Studies show that an increase in plasma homocysteine levels can increase inflammatory biomarkers (Herman, Krzoska, Łacka, Bugaj, & Dorszewska, 2013; Yun et al., 2011) and facilitate the process of blood clot production in vessels and the occurrence of thrombosis and atherosclerosis (Sütken et al., 2010). Therefore, increasing the level of homocysteine in the blood can lead to various vascular diseases such as ischemic stroke and high blood pressure (Dominguez et al., 2010;

KOOSHAVAR & Mahboob, 2013). One of the factors causing hyperhomocysteinemia that has been considered in recent studies is obesity. Most studies in this field have reported the relationship between obesity and increased homocysteine levels (Ercan & Konukoglu, 2008; Sadeghi, Maghsoudi, Nasiri, Khorvash, & Askari, 2014). If the main mechanism of obesity and hyperhomocysteinemia is not known, some studies emphasize the role of background factors. Obesity, especially abdominal obesity, is directly related to insulin resistance, as the lack of insulin function in the body can increase the production of homocysteine (Konukoğlu, Serin, Ercan, & Turhan, 2003).

On the other hand, obesity can be related to other risk factors such as high lipid cholesterol levels and high blood triglycerides (Abdolmaleki, Samavatisharif, NIKBAKHT, & Amini, 2014). It has been reported that for each unit increase in body mass index, the risk of cardiovascular diseases increases by 8% and on the other hand, with an increase in physical activity by one meter, (the amount of energy expended during complete rest increases compared to body weight. the intensity of physical activities is often expressed in units of met. One met is equal to 3.5 milliliters of oxygen consumed per kilogram of body weight per minute,) the probability of cardiovascular diseases is 18% decreases (Lira et al., 2010). One of the questions that has always occupied the minds of researchers is the effect of the type, duration and intensity of exercise on the reduction of cardiovascular risk factors and what intensity and duration of exercise can have a positive effect on weight loss and cardiovascular diseases? Some studies on short-term (>60 minutes) and moderate-intensity exercises have not observed any effect on cardiovascular risk factors (Khorramjah, Sarmadiyan, & Khurshidy, 2016). In this regard, Bahram et al. reported that 8 weeks of aerobic exercise had no significant effect on the homocysteine levels of non-athlete young man(Bahram, Najjarian, Sayyah, & Mojtahedi, 2013). Many researchers have suggested that high-intensity interval training burns more calories compared to moderate-intensity continuous training and increases fat oxidation after exercise, and also its energy cost is higher than monotonous exercise. in steady state) (King, Broeder, Browder, & Panton, 2002). In this regard, it has been reported that 12 weeks of high-intensity sports activity had a positive effect on the reduction of homocysteine and some anthropometric indicators related

to obesity and overweight (Ouerghi et al., 2022). Also, Hubner et al. reported that high-intensity speed training in elite wrestlers decreased homocysteine (Hübner-Woźniak & Ochocki, 2009). However, in a research, Keating et al. investigated the comparison of the effect of 12 weeks of high-intensity interval training and traditional continuous training on the lipid profile and fat distribution of overweight people and reported that high-intensity interval training was only time-related. Continuous training has advantages, but after 12 weeks of intervention, only improvements were observed in traditional aerobic training (Keating et al., 2014). Due to the fact that choosing the type of exercise protocol and its effect on risk factors can be one of the long-term solutions in preventing obesity and overweight and its complications and the factor of improving the health and public health of the society and reducing the costs of treating the disease, and that very few researches have investigated the effect of high-intensity interval training and moderate-intensity aerobic training on homocysteine levels and lipid profile, and it seems that more research should be done on the interaction of adaptation with Intensity of sports activity is required. Therefore, the aim of this research was to compare the effect of ten weeks of high-intensity interval training and moderate-intensity aerobic training on serum levels of homocysteine and fat profile in overweight young men.

METHOD

This research was a semi-experimental type with a pre-test and post-test design, which was conducted in the academic year of 2020-2021. The statistical population of the current research was made up of overweight male students of the University of ....., with an age range of 22 to 27 years. From the target statistical population, 18 qualified people were selected by the examiners and randomly divided into two groups of low-volume high-intensity interval training (9 people) and moderate-intensity aerobic training (9 people). All subjects completed the informed consent form before starting the exercise protocol.

The criteria for entering the present research is not having a history of suffering from certain diseases, including (diabetes, cancer, cardiovascular and pulmonary diseases, liver), not having a report of any type of physical or orthopedic injury that interferes with exercises, lack

of The relationship between their obesity and overweight with hypothyroidism, not having a history of regular physical activity during the two years prior to the research, not smoking, not using hormone therapy, and having the necessary physical fitness to start an exercise program, which was done using the medical history questionnaire was evaluated (Abasi & Nikseresht, 2018).

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. Standing straight and the heels, hips, shoulders and back of the head were in contact with the wall, it was done. The percentage of body fat was measured using a Yagami standard fat meter (made in Japan) and the heart rate of rest and activity was measured by a Polar heart rate monitor made in Sweden. Also, a three-day food record and self-report questionnaire were used to better evaluate conditions and status. The subjects' food was used.

Subjects of both groups participated in high-intensity interval training and moderate-intensity aerobic training for 10 weeks and three sessions per week (Saturday, Monday, Wednesday) under the supervision of the examiner. The exercises of each session consisted of three parts: warm-up, main stage and cool-down. In the warm-up phase, stretching and softening movements were used for 10 minutes. Then each group did their own specific exercises according to the following programs.

The program of the moderate intensity training group: The subjects performed two exercises in four 10-minute sessions with an intensity of 60-75% of the peak heart rate (or 50–65% maximal aerobic capacity) (Wewege, Van Den Berg, Ward, & Keech, 2017). Also, between the training phases, there was an active rest with an intensity of 45% of the

peak heart rate, and the cooling phase included 10 minutes, which was optional.

Program of the high-intensity training group: Each subject performed five 4-minute intervals with an intensity of 85-95% of the peak heart rate. It should be noted that the exercises started with an intensity of 85% of the peak heart rate and until it reached 95% of the peak heart rate, the intensity of the exercises was increased by 5% every three weeks (KHEDRI & ZILAEI, 2017).

In order to check the levels of homocysteine, cholesterol, triglycerides, LDL and HDL serum, blood samples in the amount of 5 cc 24 hours before the first training session and 48 hours after the last training session and after 12 hours of fasting from the brachial vein of the left hand of each Subject taken. All samplings were done at a certain time of the day (between 8 and 10 am). Homocysteine levels were measured using the ELISA method (Enzyme-linked immunosorbent assay) and the homocysteine laboratory kit manufactured by Axis-shield Diagonist, Germany. Cholesterol was also measured by enzymatic photometric method (Pars Azmoun Company, Iran), triglyceride by enzymatic calorimetric method (Pars Azmoun Company, Iran), LDL and HDL were also measured by enzymatic calorimetric method (Randox commercial kit, County Antrim Company, England) were placed.

Statistical Analysis

The resulting data were statistically analyzed using SPSS version 21 software. In order to check the normality of the data, the Shapiro-Wilk statistical test was used, the correlated t-test was used to check intra-group changes, and the independent t-test was used to compare the average of two groups at a significance level of $p<0.05$.

RESULTS

The mean and standard deviation of the general and physiological characteristics of the subjects of the two groups (medium-intensity exercise and high-intensity exercise) presented in Table 1. The results of the independent statistical test showed that none of the indicators measured in

the two groups had a significant difference in the baseline state (p>0.05). Based on the results obtained from the dependent t-test, after 10 weeks of training intervention, homocysteine levels in both groups of high-intensity interval training (P=0.044) and moderate-intensity aerobic training were significantly reduced (P=0.005), (Table 2). Also, in the high-intensity interval training group, cholesterol levels (p=0.001), LDL (p=0.001) significantly decreased, and HDL (p=0.001) increased significantly, and in the moderate-intensity aerobic training group, only Cholesterol decreased significantly (p=0.006), (Table 2).

Table 1: Comparison of the mean and standard deviation of the subjects' physical and physiological characteristics before and after the exercise program.

Group changeable	**Low intensity exercise group**			**High intensity exercise group**		
	Pre-test	**Post-test**	**P**	**Pre-test**	**Post-test**	**P**
age (years)	24.37±1.40			23.87±1.45		
Height (cm)	173.47±4.47			175.07 ± 6.75		
weight (kg)	82.75±5.36	78.12±4.94	0.001	83.75±7.10	82.62±6.39	0.094
BMI (kg/m2)	27.47±0.92	25.96±1.23	0.001	27.07±0.88	26.71±0.96	0.060
Fat (%)	28.00±0.88	25.62±0.93	0.001	27.55±1.73	26.20±1.30	0.039

Comparison of mean and standard deviation of dependent variables before and after 10 weeks of sports activity in 2 groups using independent t test and paired t test.

Table 2: Comparison of mean and standard deviation of dependent variables before and after 10 weeks of sports activity in 2 groups using independent t test and paired t test

Variable	**Training group**	**Pre-test**	**Post-test**	**Significant level p**
	Interval with high intensity	13.91±4.49	12.03±2.61	0.044

Homocysteine (micromol/L)	Moderate intensity aerobics	15.10±1.67	11.37±2.14	0.005
	P*	0.502	0.588	
Triglycerides (mg/dl)	Interval with high intensity	163.12 ± 48.44	138.62±31.46	0.065
	Moderate intensity aerobics	138.50±39.81	132.12±22.40	0.367
	P*	0.285	0.641	¬¬¬¬¬¬
HDL-C (mg/dL)	Interval with high intensity	32.75±11.04	46.62±8.01	0.001
	Moderate intensity aerobics	35.25±13.55	38.62 ± 9.03	0.097
	P*	0.692	0.082	
LDL-C (mg/dl)	Interval with high intensity	134.62±28.63	95.75±22.48	0.001
	Moderate intensity aerobics	120.25±32.73	108.75±17.16	0.108
	P*	0.366	0.460	
Cholestrol (micromol/L)	Interval with high intensity	213.12 ± 45.72	152.50±35.90	0.001
	Moderate intensity aerobics	192.25 ± 42.54	162.50±25.56	0.006
	P*	0.631	0.531	

DISCUSSION

In total, the results of this research showed that both types of high-intensity and moderate-intensity interval training after 10 weeks caused favorable changes in homocysteine serum levels and some anthropometric indicators related to obesity and overweight. Homocysteine levels decreased significantly after 10 weeks of training in both high-intensity and moderate-intensity interval training groups. According to the findings of the current research, Suri et al reported that 10 weeks of moderate intensity physical activity can have a significant effect on reducing serum homocysteine levels (Soori, Choopani, Falahian, & Ramezankhani, 2016). Tawfighi et al. reported that 8 weeks of aerobic exercise significantly reduced weight, fat percentage, LDL-c levels, cholesterol, triglycerides and homocysteine in obese women (Tofighi, Jamali, Babaei, & Amaghani, 2017). Also, Bahram et al. reported that 12 weeks of high-intensity interval training decreased serum levels of homocysteine and fat percentage in overweight men (Bahram & Pourvaghar, 2016). Hubner et al. reported that high-intensity training caused a significant decrease in homocysteine levels in young subjects (Hübner-Woźniak & Ochocki, 2009). Physical activity leads to a decrease in serum homocysteine through different mechanisms. Physical

activity probably helps to reduce homocysteine levels in the blood by increasing the absorption of vitamins effective in the homocysteine cycle, especially B vitamins in the intestine. Also, physical activity, by increasing antioxidants, moderates oxidative stress and ultimately reduces serum homocysteine concentration. Therefore, it can be said that physical activity, by increasing the effect of antioxidants, moderates oxidative stress and ultimately leads to a decrease in blood homocysteine concentration, which can reduce the risk of cardiovascular diseases (Selvin, Paynter, & Erlinger, 2007; Sütken et al., 2010). Which confirms the results of the present study. On the other hand, during sports activity, due to the increase in energy requirement, the catabolism of amino acids increases, and one of these amino acids is methionine, the decrease of methionine can lead to a decrease in serum homocysteine levels. In the current research, serum homocysteine levels in the moderate-intensity aerobic training group showed a greater decrease than in the high-intensity training group. Studies show that people with high levels of homocysteine are more affected by sports activities. In this connection, Okara et al. reported that people whose homocysteine concentration is higher than 15 micromol/liter will significantly decrease homocysteine concentration with regular aerobic exercises (Okura et al., 2006). It seems that one of the reasons for the greater decrease in homocysteine levels in the aerobic exercise group with moderate intensity is the high levels of homocysteine in these people in the baseline state.

In the present study, cholesterol and LDL values were significantly decreased and HDL increased significantly in the high-intensity interval training group. These changes are in line with the findings of Naibifar et al (Nayebifar, Afzalpour, Saghebjoo, Hedayati, & Shirzaee, 2011) According to the findings of the present study, Taravati et al. reported that eight weeks of high-intensity interval training produced favorable changes in the lipid profiles of overweight and obese people (Taravati, Irandoust, & Rahimi, 2017). In a research, Nikro et al. showed that an interval training course has more effective responses on body mass profile and body fat percentage than continuous aerobic training (Nikroo & Barancheshme, 2014). Regarding the changes of blood lipoproteins with exercise, the findings of some studies show that physical activity increases the activity of lipoprotein lipase and lecithin cholesterol acyltransferase. These two enzymes decrease LDL, triglycerides and cholesterol and increase HDL. On the other hand,

the lipoprotein lipase enzyme increases the catabolism of VLDL and LDL after exercise(Nikroo & Barancheshme, 2014).

On the other hand, in the moderate intensity aerobic exercise group, only cholesterol levels showed a significant decrease. Although the changes in other measured variables were significant, these changes were not statistically significant. In this regard, Abdulmaleki et al. reported that cholesterol and LDL levels showed a significant decrease after 12 weeks of traditional continuous training (Abdolmaleki et al., 2014). It has also been reported that among the two types of intermittent and continuous exercise, only intermittent exercise increased HDL levels in heart failure patients (Fu et al., 2013). Researchers believe that the intensity of physical activity is one of the most important factors affecting LDL and HDL levels (Stuifbergen, Blozis, Harrison, & Becker, 2006). Therefore, one of the reasons for the lack of significant reduction of LDL and HDL in the aerobic exercise group with moderate intensity can be due to the lack of this type of exercise.

In general, taking a comprehensive look at the research conducted in the field of the effect of sports activity on the lipid profile, several important points can be identified: First, by reviewing the research conducted in this field, it is determined that the duration of aerobic exercise in this field can be an important factor. Be So that the effectiveness of exercises that used long-term training programs (more than 12 weeks) is more than the studies that used short-term training programs. Secondly, it has been reported in many researches that physical activity without losing weight may also have a favorable effect on the blood lipid profile (Wharton & Nustad, 2006). Some researchers also believe that weight loss is important for the effect of exercise on blood lipids, but weight loss (body fat weight) does not require changes in plasma lipoproteins (Khorramjah et al., 2016). Thirdly, physical activities will not have much effect on the lipid profiles of people who have normal levels of these indicators (Zmuda et al., 1998). The small number of subjects and being limited to men with an age range of 22 to 27 years, the lack of full-time access of researchers to the subjects, the lack of complete control over their nutrition and the lack of examination of some factors affecting the results of the research such as smoking, the lack of examination of all Blood factors that indicate the increase of fat oxidation are among the limitations of the present research that can affect the results, so similar research with more samples, with nutritional intervention and

enzyme control is recommended. Effects on catabolism such as lipoprotein lipase, lipoprotein lipase and lestin cholesterol acyltransferase.

CONCLUSIONS

The results of the present study showed that 10 weeks of intermittent high-intensity exercise caused a significant decrease in weight, body fat percentage, body mass index, cholesterol, LDL and homocysteine serum levels and a significant increase in HDL. Also, in the aerobic exercise group with moderate intensity, fat percentage, homocysteine and cholesterol serum levels were significantly reduced.

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