EFFECT OF SIX WEEKS OF HIGH INTENSITY INTERVAL TRAINING ON LEPTIN LEVELS, LIPID PROFILE AND FAT PERCENTAGE IN SEDENTARY YOUNG MEN

Javad Tolouei Azar[1], Mohammad Hemmatinafar[2] and Javad Nemati[3]

[1]Urmia University, Urmia, Iran
[2]Shiraz University, Shiraz, Iran

Original scientific paper

Abstract
The purpose of this study, determine effect of six weeks high intensity interval training (HIIT) on in Levels of Leptin and Lipid Profile in sedentary young men. Eighteen inactive young men voluntarily participated in this study and randomly divided into two groups: Experimental (n: 9, age: 24.33±1.41, height: 176.22±4.91, weight: 72.27±6.59) and Control (n: 9, age: 23.27±2.01, height: 180.22±6.88, weight: 76.27±7.33) groups. Experimental group performed three HIIT sessions per week for 6 weeks. Each session consisted of either four to six repeats of maximal sprint running within a 20 m area with 20–30 s recovery. Fasting blood samples were collected 24 hours before and 48 hours after exercise protocol. Data were analyzed by dependent t test and results showed that, following of six weeks HIIT, levels of leptin was significantly reduced in the experimental group compared to control group (P<0.05). Although serum concentrations of triglycerides, low-density lipoprotein, total cholesterol and the ratio of total cholesterol to high-density lipoprotein decreased and high-density lipoprotein levels increased, but these changes were not statistically significant (P>0.05). However, present study showed significantly decreased of body fat percent in experimental group compared with control group (P<0.05). According to the results of this study, HIIT seems to be a time-dependent strategy with a relative improvement in the lipid profile reduces body fat and leptin levels, could lead to the prevention of obesity in sedentary individuals.

Key words: *leptin, lipid profile, high intensity interval training, sedentary young men.*

Introduction

Obesity defined as excess body fat is the main health problem in Western societies and is primarily correlated with low-mobility and senescence lifestyle [1]. Obesity is closely associated with coronary artery disease, and is an independent risk factor [1]. Also, obesity has significant side effects on different risk factors of coronary heart disease including: Hypertension, increased left ventricular hypertrophy, increased insulin resistance, adverse effect on plasma lipids, particularly increased triglycerides levels, reduced levels of HDL and ultimately more sedentary lifestyle [2]. In this context, studies have shown that HDL levels of blood is inversely related to the prevalence of coronary artery disease. On the other hand, the reduction of LDL leads to a further reduction in the incidence of heart attack, ischemic stroke and re-angiogenesis [3]. For each mmol per liter decrease in LDL, the incidence of cardiovascular disease is reduced to one-fifth. 2 to 3 mmol per liter increase in HDL, reduces the risk by approximately 40 to 50 percent. A number of observational studies have shown that decrease in LDL, leads significant reduction in cardiovascular disease and mortality [3]. Leptin is the product of Ob gene primarily expressed in adipose tissue and is considered as a tonic Siri message [4]. In the absence of leptin, obesity resulted from binge eating and metabolic dysfunction is inevitable, released leptin into the bloodstream, rather than be set by short-term feeding is a function of fat mass [4]. It seems, leptin acts as an indicator of fuel storage. As leptin is an appetite reducing agent, reasonably it can be assumed that the increase in plasma leptin in obese individuals facilitates inhibition of appetite and food intake. However, obesity is associated with severe leptin resistance [5]. Today, physical activity and exercise have shaped a large part of human life to prevent chronic diseases such as obesity and fitness and aerobic exercise such as walking, jogging and aerobics are introduced as a means of reducing total cholesterol, LDL, triglycerides and increasing HDL [6]. However, still an optimal training dose to improve the lipid profile has not been identified. Also, researchers have reported that physical activity is one of the factors contributing to the homeostasis and energy balance. In this regard, the results of past studies on the effect of exercise on leptin levels are not the same which are as follows: Zilaei Bouri et al (2013) showed a significant decrease in leptin after moderate-intensity exercise compared to high-intensity exercise [7], Irandoust et al (2011) showed a decrease in leptin after aerobic exercise [8], Haghighi et al (2011) indicated an insignificant changes in leptin levels after aerobic exercise [9], Patrick et al (2010) showed no significant changes in leptin levels after resistance exercise [10]. On the other hand, despite the many potential health benefits of traditional endurance training, but most people do not participate in these trainings due to lack of sufficient time. Therefore, the study of alternative training programs with similar metabolic adaptations without considerable time commitment are required. One of the protocols of sport activity that has recently been of interest to researchers of exercise physiology is high-intensity interval training (HIIT).

HIIT includes frequency of high-intensity exercise and active rest time with very low intensity [11]. Since HIIT training philosophy lies in getting the best results by spending the last time. Hence, the aim of the study was to investigate changes in leptin levels and lipid profiles after is six weeks of HIIT in sedentary young men.

Methods

In this semi-experimental study, the study population consisted of sedentary male students in Tehran University Dormitory. A total of 18 volunteers aged from 21 to 26 years were enrolled in the study. Initially, the objective and procedure of the study was explained to the subjects. Then information about physical activity and health status of the subjects was obtained using a questionnaire. When the written consents were obtained from the subjects they were randomly assigned into two control (n = 9) and experimental (n = 9) groups. All subjects' diet was based on the dining plan offered by Tehran University dormitory. Moreover, the subjects were requested to avoid tobacco, alcohol, caffeine supplements, dietary and medication supplements intake a week before the beginning of the six-week training program until the end of the study.

None of the subjects had regular exercise such as high intensity interval training within the last six months. Two weeks before the start of training, initial assessment such as the determination of height, body weight, body fat and body mass index (BMI) was performed. The subjects' weight was measured using standard medical scales (SECA, Germany). To measure height, the subjects stood straight up with their back directly against the wall without shoes such that the heels, buttocks and shoulders touched the wall and they were asked to look straight-forward. Their height was measured using the stadiometer and recorded in centimeters. BMI was calculated by dividing weight (in kilograms) by height in meters square. To measure body fat percentage, Harpenden calipers and three-point method (chest, abdomen and thigh) were used. The subjects in the experimental group performed the training protocol over a distance of 20 meters marked by three cones, 3 sessions per week for 6 weeks as follows (Figure 1).

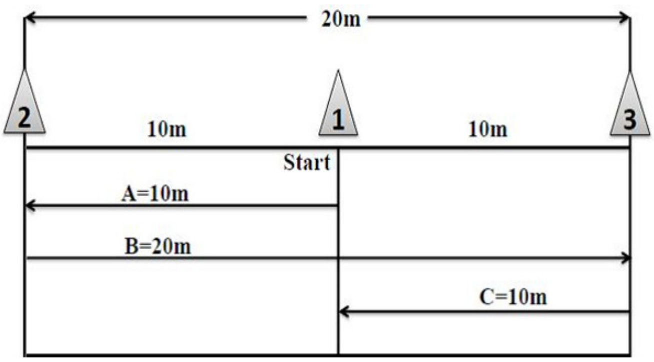

Figure 1. The schematic of HIIT protocol.

With the start of the training protocol, the subjects with their maximum speed from the starting point (Cone number one) ran toward the second cone (route A), then returned and in the opposite direction (20 meters) ran toward the third cone with maximum speed (route B). Finally, they returned and ran toward the starting point (cone 1) with maximum speed (route C) to complete the distance of 40 meters. The subjects continued this trend with a maximum speed to complete 30 seconds time period of training protocol, and after 30 seconds of rest, they repeated this protocols. The training progressed by increasing the number of 30 seconds repetitions from 4 times per session in the first and second weeks to 5 times per session in the third and fourth weeks to 6 times per session in the fifth and sixth weeks. Before the start of training protocol and at the end of each session proper warm-up and cool down movements was performed for five minutes (e.g., jogging, stretching and brief period of low-intensity exercise). Training protocol derived from 40 meters' sprint (sweep) testing, which is a valid test for assessing non-aerobic performance (12). During the six-week training protocol the subjects in the control group had no regular exercise. To determine the intensity of the training, the maximum heart rate (age - 220 = HRmax) were used and in all stages of HIIT the training intensity was over 90 percent of HRmax, which was calculated for each subject separately (heart rate monitor from Beurer (Germany) was attached to all subjects during 30 second maximum speed runnings to control the intensity of training according to their heart rate). In order to check the effect of training on plasma homocysteine and lipid profile, 24 hours before the first training session and 48 hours after the last session 5 cc of fasting blood was obtained from antecubital of all subjects in both groups (at 8:30 am). Blood samples were transferred immediately into tubes containing EDTA anticoagulant. All blood samples were centrifuged at 3000 rpm for 10 minutes at a temperature of 4 °C and the obtained plasma were kept at -80°C for further assessments. Serum homocysteine levels were measured by ELISA kit (axis-shield, UK) with sensitivity of 1 micromole per liter. Also, the values of lipid profile were measured using Pars test kit (Iran) by Noor Pathobiology laboratory in Tehran. The data collected was analyzed using SPSS 18 statistical software. The normal distribution of data was confirmed using the Kolmogorov-Smirnov test. To investigate the inter-group changes of data, independent t-test was used. P value less than 0.05 was considered statistically significant.

Results

The results of the characteristics of the subjects have been presented in Table A that, a significant difference between the two groups after the exercise intervention in weight, BMI and waist-hip ratio were not observed, but the percentage of body fat in the training group significantly decreased and a significant increase was observed in VO2max in the experimental group (Table 1).

Table 1. The average and standard deviation of anthropometric variables and VO2max subjects before and after intervention.

Variables	Control Group		Experimental Group	
	Pre-test	Post-test	Pre-test	Post-test
Age (Year)	23.27 ± 2.01	-	24.33 ± 1.41	-
Stature (Cm)	180.22 ± 6.88	-	176.22 ± 4.91	-
Weight (Kg)	76.27 ± 7.23	77.30 ± 8.00	72.27 ± 6.59	72.11 ± 6.88
BMI (Kg/m^2)	23.54 ± 2.60	23.85 ± 3.24	23.32 ± 2.29	23.18 ± 2.44
WHR	0.84 ± 0.00	0.85 ± 0.02	0.84 ± 0.04	0.84 ± 0.05
Body Fat (%)	12.34 ± 3.19	13.02 ± 2.11	10.52 ± 2.12	*8.87 ± 2.22
VO_{2max} (ml.kg.min)	41.81 ± 2.51	41.2 ± 3.03	42.2 ± 2.85	*46.3 ± 2.01

*P≤0.05

As presented in Table 2 independent t-test results showed that, 6 weeks of HIIT decreases leptin levels significantly in the experimental group compared to the control group (P=0.02, 29 percent of reduction). However, six weeks of HIIT had no significant effect on the values of total cholesterol (P=0.12, 3.64 % of reduction), triglycerides (P=0.40, 8.14 % of reduction), HDL-C (P=0.55, 1.41 % of increase), LDL-C (P=0.12, 3.62 % of reduction), VLDL (P=0.41, 8.12 % of reduction), and the ratio of TC to HDL-C (P=0.14, 4.76 % of reduction).

Table 2. Changes homocysteine and lipid profile parameters before and after the intervention in the control and experimental groups.

Variables	Groups	Pre-test	Post-test	T	P-value
Leptin (μmol/l)	Control	2.45 ± 1.14	2.48 ± 1.14	2.43	0.02
	Experimental	1.64 ± 1.40	1.15 ± 1.16		
Total cholesterol (mg/dl)	Control	137.33 ± 16.80	138.55 ± 17.08	- 1.68	0.12
	Experimental	140.11 ± 18.63	135.00 ± 12.66		
Triglyceride (mg/dl)	Control	79.77 ± 39.22	81.22 ± 35.74	0.81	0.40
	Experimental	76.33 ± 21.22	70.11 ± 28.19		
HDL-C (mg/dl)	Control	39.00 ± 3.77	38.77 ± 2.72	0.60	0.55
	Experimental	39.44 ± 4.53	40.00 ± 4.47		
LDL-C (mg/dl)	Control	84.42 ± 13.06	85.22 ± 12.46	- 1.69	0.12
	Experimental	85.97 ± 13.67	82.85 ± 11.13		
VLDL (mg/dl)	Control	16.80 ± 7.38	17.01 ± 6.04	0.84	0.41
	Experimental	15.26 ± 4.24	14.02 ± 5.63		
TC/HDL-C	Control	3.57 ± 0.77	3.60 ± 0.63	- 1.54	0.14
	Experimental	3.57 ± 0.53	3.40 ± 0.47		

Discussion and conclusion

Results of this study showed that the implementation of the six-week HIIT leads to developed lipid profile, but this change is not statistically significant. These results showed that serum leptin levels decreased 29 percent for the implementation of the six-week HIIT. Weight loss in obese people reduces all risk factors for coronary artery disease associated with type 2 diabetes mellitus and develops hyperglycemia [13]. However, available data indicate that if weight loss is combined with treatment with diet or exercise, it develops lipid profile and increases HDL-C and decreases insulin resistance [14], but in patients with varying degrees of physical activity, lipoprotein values according to the type and mode of exercise are different. Previous studies have shown that the distance of run per week is best predictor of HDL-C levels among the runners [15]. Rotkiss et al. have compared 90 middle-distance runner running 13, 27 and 58 miles per week with 19 non-runner subjects and reported that, the average HDL-C was 47 milligrams per deciliter in 28 runners, 53 milligrams per deciliter in 30 runners, and 60 milligrams per deciliter in 32 runners. The average HDL-C levels in 19 non-runner subjects were 34 mg per DL [16]. Anaerobic trained athletes have lower HDL-C and HDL-C ratio to total cholesterol compared with endurance-trained subjects such as with endurance runners [17]. Nikila has shown that, in anaerobic sprinters, whose most of training programs include short-term efforts, serum lipid and lipoprotein did not increase and significant differences in total cholesterol or triglycerides between skaters fast, weightlifting, and inactive men were not observed [18]. According to the results of Rotiks and Nikila and comparing it with the results of this study it can be said that, because HIIT in this study has been used as a training protocol and distance is very small compared to endurance trainings, therefore the amounts of the lipid profile in sedentary young men have not had significant changes. However, little changes are positive and in the clinical point of view it seems that, the HIIT with minimum time spent leads to the relative improvement in the lipid profile in men. However, in people with high aerobic fitness compared with low aerobic fitness total cholesterol levels are lower, but it has not been conclusively proven that the practice of physical activity reduces cholesterol. Shop & Doestin have shown resistance training does not increase the conversion of HDL-C to HDL-2 and HDL-3 subunits [19]. This also applies in the case of LDL-C. Although it has been shown, endurance training reduces LDL-C, but there is not much information about the biochemical mechanism. However, the initial VO2max values are associated with changes in serum lipids and lipoproteins. Participants with higher VO2max values due to exercise show less changes in lipids and lipoproteins of serum compared to those with lower initial VO2max. Therefore, it is possible that people with regular extreme aerobic exercise have changes in blood lipids and lipoproteins and it decreases the risk of cardiovascular disease in them [20]. So, given that a significant 8 percent increase was observed in VO2max amounts, it can be said that one possible reason for the relative improvement in the lipid profile is the increase in aerobic fitness after six-week HIIT.

Since the subjects in this study were healthy sedentary young men and lipid profile indices at the pre-test were in normal range, so that small changes caused by HIIT implementation is important from the clinical perspective. Many studies have shown that overweight is one of the independent markers for diabetes and heart disease in humans [21]. Most of environmental impacts of leptin represents a conflict of leptin on glucose and lipid metabolism, production of clotting and blood pressure [22]. Recently, it has been shown that increased levels of leptin in the blood mainly created due to an increase in fat mass and other factors is along with increased insulin resistance, blood pressure and heart disease.

Although the exact mechanism of leptin production is not well known, but the relationship between this hormone with negative energy balance, sympathetic activity, other hormones and substances produced by metabolism has been observed [22]. Physiological stress caused by exercise is one of the important regulators of leptin secretion from adipose tissue [23]. Many studies have been done in the field of effect of exercise on leptin. There are many possible mechanisms in this field that, one of them is the reduction of fat mass and lipid profiles [23].

Thus, according to the central operation of leptin in the hypothalamus, which reduces food intake, increases energy and facilitates the metabolism of glucose and lipids and since in this study the values of body fat percentage (15%), total cholesterol (3.64 percent), triglycerides (8.14%), LDL (3.62 percent), VLDL (8.12 percent) and the ratio of TC to HDL (4.76 percent) decreases and amounts of HDL (1.41 per cent) have increased; it seems that HIIT with reduced body fat and improved lipid profile leads to reduced amount of leptin. In this regard, Bahram et al (2014) reported on a study that, implementation of 12 weeks of HIIT significantly decreases leptin levels and fat in overweight girls, which was consistent with the results of the present study [24]. The main difference of the current study and Bahram's study is the duration of training intervention and this shows that, even 6 weeks of HIIT decreases the amount of leptin and fat.

In a study Rasil et al (2016) compared the effect of 12 weeks of HIIT and moderate-intensity interval training (MIIT) on levels of leptin in obese women and reported that both forms of exercise lead to a significant decrease in leptin levels, percentage body fat and significantly increased VO2max [25]. Results of this study confirmed the findings of Rasil et al. and shows that interval training, especially HIIT type can decreases leptin levels and body fat percentage to help health. As the study of McMurray et al. (2000) showed, leptin plasma levels after a period of exercise training is associated with VO2max [26]. So, given that in this study VO2max has a significant increase of 8 percent, it can be said that one of the possible causes of reduced leptin levels is the increase in aerobic fitness after a six-week HIIT. Overall, the implementation of the six-week HIIT reduced leptin levels and the relatively improved the lipid profile parameters in sedentary young men. It seems that HIIT exercises as a temporal strategy with a relative improvement in the lipid profile, reduced body fat and leptin levels, could lead to the prevention of obesity in sedentary individuals.

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Correspondence to:
Mohammad Hemmatinafar,
Shiraz University, Shiraz, Iran.
E-mail: m.hemmatinafar@shirazu.ac.ir