The aim of the present study was to compare the effect of the type of exercise on lipid profile and adiponectin level in sedentary young men by 24-hour follow up exercise. Thirty young males with normal body mass index (BMI) were selected randomly and assigned to three groups: aerobic (30 min activity with 60 to 70% maximum oxygen uptake), resistance (3 sets of 10 repetitions at 70% of one maximum repetition), and concurrent (aerobic exercise for 20 min and resistance exercise for 2 sets) exercise. Lipid and adiponectin profiles were measured before and 24-hour after exercise. Results indicated that the type of exercise had an effect on the lipid response but did not have an effect on the concentration of adiponectin. The concentrations of cholesterol and high density lipoprotein cholesterol (HDL-C) in resistance group reduced significantly 24-hour after exercise in comparison to the basic values (p<0.05). Moreover, the low-density lipoprotein cholesterol (LDL-C) concentration also reduced but it was not significant. The type of exercise had no effect on triglyceride (TG) response. However, when group's data combined, there was a significant reduction in TG concentration. Based on the results, it is concluded that the adiponectin responses to exercise are independent of the type of exercise but resistance exercise has more positive effects on changes in lipid profile than aerobic and concurrent exercises.

**Keywords:** Adiponectin, lipid profile, sedentary men, type of exercise,

Cilj ovog istraživanja bio je usporediti utjecaj vrste vježbanja na lipidni profil i razinu adiponektina u sedentarnih mladića od 24-sata nakon treninga. Trideset mladih muškaraca s normalnim indeksom tjelesne mase (BMI) odabrani su nasumično i razvrstani u tri skupine: aerobnu (30 min aerobnih aktivnosti sa 60 do 70% od maksimalnog primitka kisika), skupinu treninga snage (3 serije po 10 ponavljanja na 70% od 1RM), te mješovitu (aerobna vježba kroz 20 min i trening snage sa 2 serije) Lipidni i adiponektinski profili su mjereni prije i 24 sata nakon vježbanja. Rezultati su pokazali da vrsta vježbe ima utjecaj na lipidni odgovor, ali nema utjecaj na koncentraciju adiponektina. Koncentracije ukupnog kolesterolola i HDL-C kolesterolola u grupi treninga snage je značajno smanjena 24-sata nakon vježbanja u usporedbi s osnovnim vrijednostima (p<0.05). Osim toga, kolesterol niske gustoće (LDL-C) se također smanjio, ali ne značajno. Vrsta aktivnosti nije imala utjecaj na trigliceride (U skupini mješovitih aktivnosti uočeno je značajno smanjenje koncentracije triglicerida). Na temelju dobivenih rezultata zaključuje se da adiponektinski odgovor ovisi o vrsti vježbe, ali vježbe snage imaju pozitivnije učinke na promjene lipidnog profila od aerobnih vježbi.

**Keywords:** adiponektin, lipidni profil, sedentarna populacija, vrsta aktivnosti

**SAŽETAK**

**ZAKLJUČAK**

**SUMMARY**

**THE EFFECTS OF THE TYPE OF EXERCISE ON LIPID PROFILES AND ADIPONECTIN LEVEL IN SEDENTARY MEN**

**UTJECAJ VRSTE AKTIVNOSTI NA LIPIDNI PROFIL I KONCENTRACIJU ADIPONEKTINA U SEDENTARNIH MUŠKARACA**

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INTRODUCTION

World health organization (WHO) has proposed sedentary life style as obesity as two of ten prominent health complications. This lifestyle is a risk factor for cardiovascular diseases which are caused by many factors such as hyperlipemia, hypertension, obesity, fat related hormones, and sedentary life. This multi factorial event has both genetic root and lifestyle basis. Lack of proper physical activity and improper diet are considered as the main reasons of obesity and cardiovascular disease in developed countries (6).

Recently, it has been indicated that adipose tissue secretes bioactive proteins called adipocytokines which may regulate the metabolism of glucose, lipids and vascular function (10). Adiponectin is an adipocytokine that is exceptionally produced from adipocytes. This protein has antidiabetic, antiatherosclerotic and anti-inflammatory properties (10). Meanwhile, having no similarities with other adipocytokins, the level of serum adiponectin reduces in fat people, diabetics and patients with cardiovascular disease (10). The relation between adiponectin and lipid may also be different based on the size of adipocytes. Two studies reported this relation independent of body mass index or body fat percentage (28,37). Asayama et al. (1) found that the relation between adiponectin and triglycerides is independent of extra weight and body fat percentage, but in fat children and adolescents, it depends on visceral adipose tissue and subcutaneous adipose tissue (1).

Exercise training has a strong effect on preventing and treating the obesity and diabetes (12). It is logical to suppose that such effects may be mediated by regulating the hormones derived from adipose tissue such as adiponectin (16,30,34). The effects of chronic exercise on lipids have been recognized (5,31). However, there are few reports on short-term effects of acute exercise but with contradictory results. Resistance exercises have been proposed as an integral part of physical activity plan for health and preventing skeletal-muscular diseases (23). There is less information about the effect of resistance and combined exercise on lipid profile (24) in comparison with endurance training. It has been reported that resistance exercise will properly reduce LDL-C concentration and increase HDL-C concentration (9,17). There are also contradictory results in this case (21,26). Existing methodological differences, such as exercise methods, test specifications, nutrition control and sampling time after activity may also change the results in exercises (14,38). Therefore, the aim this study was to compare the influence of three types of aerobic, resistance and concurrent exercise on lipid profile and adiponectin of serum in sedentary men with normal body mass index.

SUBJECTS AND METHODS

In a quasi-experimental research model, 30 voluntary men (without any regular exercise history, no body weight changes more than 2kg, no specific disease, and no smoking habit for at least the 6 past months were randomly selected from 100 participants with age range between 18 to 25, and were assigned into three exercise categories: aerobic, resistance, and concurrent. Subjects were informed of the objective, benefits and probable risks of test plan and then completed the agreement form before starting the test. The biochemical and common properties of subjects indicated in table 1.

Test Design

Subjects came to physiological lab, in the morning from 8:00 to 10:00 a.m. in fasting mode to be measured for their body composition and to become familiar with exercise plan and sports equipments. Techniques for proper use of treadmill and weightlifting were taught to the subjects. Then, they began their activity to know and determine a one maximum repeat (1RM) to estimate the maximum oxygen uptake (VO2max) by Bruce maximal exercise testing after 10min special warming up. Three days later determining the one repeat maximum test (1RM) and test for estimating the VO2max, subjects came to the laboratory at 8:00 a.m. in fasting conditions for measuring adiponectin and serum lipids. After sampling their blood, they ate the same breakfast containing 550 kcal and one hour later began their activity. After 24-hour activity, they came to the lab for the second time to be measured for blood factors. The specialist collected their blood samples in the same temporal and spatial conditions (12).

Physiological Evaluations

Body weight was measured using Digital Glass Scale, GES-07, USA with accuracy of ±0.1kg, without shoe and minimum clothing cover. Their height was measured by wall height meter, model 44440, made by Kaveh Co., Iran, ±0.1cm, in standing mode next to the wall without shoes while their shoulders were in normal conditions. Waist size was measured in the thinnest part when subjects were ending their expiration. For measuring the hip size, the most projected part was selected. Waist and hip size were measured by non-tactile tape meter without forcing pressure. Body mass index (BMI) was obtained by dividing the weight (kg) by square height (m²). For measuring the percentage of fat body, Harpenden's caliper model, (the technique of pinching in three regions, pectoral, abdomen and mid-thigh in the right side of body and it was done fro three times with 20 second intervals between any time for returning back to its initial state and then the average was registered), and Jackson and Pollock's (15) formula and Siri (4) equation were used. For removing the individual errors, all measurements were conducted by the same person.

Maximum muscular power for subjects was determined by maximum weight they could lift for once (12). Estimating the maximum used oxygen (VO2max) and maximum heart beat for subjects were measured by Bruce Maximal Exercise test 10 min after warming up (12).

Diet Records

Subjects were prescreened prior to entry into the exercise study to ensure compliance with the typical American Heart Dietary intake recommendations (i.e.,
50–60% carbohydrate, <30% fat, 10–15% protein) (7). Threeday (two weekday and one weekend day) dietaryrecalls were used for this analysis. Subjects were alsogiven standard dietary instructions for nutrient intake during the 3 days prior to the exercise trial. Intakeinstructions were based on American Heart AssociationGuidelines. Total megajoule (MJ) (total kilocalories/238.95) intake range recommendations werebased on age, gender and body weight and from estimatedresting metabolic rate Harris and Benedict (13). Information from physical activity questionnaires (high, low, moderate activity) was also used to aid in thecalculation of total MJ intake to ensure that subjects werein energy balance prior to the exercise trial (7). Foodexchange lists with serving sizes were used for nutrientrecommendations (Health Management Resources, Boston, Mass., USA). Subjects were asked to complete dietary records for all 3 days prior to the exercise trial. Nutrient intake and distribution (total MJ intake, % fat, %carbohydrate, and % fat) was completed using SoftwareDorosty Food Processor (NШ, FP2).

One session aerobic, resistance and concurrent exercise

One session of aerobic, resistance and concurrent exercise included general warming up (10min), specialwarming up (3 to 5min), related exercise and strainexercise and cooling down (5min). Aerobic exerciseincluded running on treadmill for 30 minutes in 60-70%VO_{2max} resistance exercise with intensity of 70% of IRMwith 10 repeats per each movement for 3 sets with30-second resting time between stations and 2 minutesbetween each round of exercise, and concurrent exerciseincluding aerobic exercise, running on treadmill for20minutes in 60- 70% of VO_{2max} and resistance exercisewith intensity of 70% of IRM with 10 repeats per eachmovement for 3 sets with 30-seconds resting timebetween stations and 2minutes between each round. Resistance exercises include 10 station movements in circle form. Stations included: (1) leg flexion, (2) leg extension, (3) leg press, (4) squat, (5) lat pull down, (6) bench press, (7) cross movement by dumbbell, (8) biceps curl,(9) triceps push-down, (10) sit-up, respectively.

Collecting and analyzing the blood

After 8 to 10 hours of fasting in two stages, i.e. beforebeginning the activity (pre-exercise) and 24 h postexercise, 5ml of venous blood was collected from eachsubject in sitting and rest mode and immediatelycentrifuged in 3000rpm and stored in -70°C. For blood sampling, subjects were asked not to have any activities two days before the test.

The level of serum adiponectin was measured byELISA from sandwich competitive method type(adipogen kit, made in Korea, sensitivity 1ng/ml, and intraand inter assay changes 3.99 and 2.89, respectively).

Total serum cholesterol level was measured byenzymatic colorimetric method, and triglyceride levelwas measured by enzymatic colorimetric method in thepresence of glycerol phosphate oxidase and HDL-C levelwas measured by enzymatic method and after precipitating remaining lipoproteins containing Apo-B byphosphotangenic acid solution and magnesium chloride.In all cases, the kit derived from Pars Azemion Tehran Co.,Iran was used. Serum level of LDL-C was measured byusing Friedewald formula (8) for samples with theirtriglyceride level less than 400mg/ml. subjects withtriglycerides higher than 400mg/ml were omitted from thestudy.

Statistical Analysis

Initially, all data were tested to determine theirnormal distribution by using Shapiro- Wilk method. For determining the basic differences and effects of type of exercise on blood factors, one-way analysis of variance (ANOVA) was used and for determining the difference between groups Bonferroni post hoc test was used. Paired t-test was also used for determining the difference before and after exercise in the groups. In all cases, a p-value less than 0.05 were considered for indicating the statisticalsignificance. All data were analyzed by using SPSS12 software.
RESULTS

Table 1 shows the results of ANOVA test for all variables (pre-exercise). The results indicated that there is no significant difference between three groups, aerobic, resistance and concurrent (p<0.05). These results also indicated that three groups were very homogenous. The rates of received calorie in three groups were also compared using repeated measures ANOVA test and it was revealed that there is no significant difference in the rate of calorie absorption among three groups (data were not indicated).

Table 1 shows common properties of subjects. Data analysis indicated that the type of exercise influenced the short-term response of lipids’ profile, but it is ineffective for serum adiponectin (p< 0.05) (figure 1). The concentrations of HDL-C (48.7±2.05 before vs. 47.3±1.6 after) and TC (170.5±10.08 before vs. 166.1±7.65 after) were significantly reduced 24 hours after exercise in resistance group (figure 2). The concentration of triglyceride (TG) regardless of the type of exercise (92.3±9.14 before vs. 90.43±8.9 after) considerably reduced 24 hours after exercise. The concentration of LDL-C reduced in resistance group but not significantly (figure 3).

![Graph 1](image1.png)

Figure 1. Changes in serum adiponectin concentration before and after exercise. Information has been reported based on mean and standard deviation.

![Graph 2](image2.png)

Figure 2. Changes of HDL-C and total cholesterol concentration before and after exercise. Information has been reported based on mean and standard deviation.

Slika 1. Promjene u koncentraciji serumskog adiponektina prije i poslije aktivnosti.

Slika 2. Promjene u koncentraciji HDL-C prije i poslije aktivnosti.

* Indication of significance level, p< 0.05
DISCUSSION

Results indicated that acute exercise could change the lipid profile response. Concentrations of both TC and LDL-C reduced 24 hours after resistance exercise while there was a slight increase in lipids for two other groups of aerobic and concurrent exercise. LDL-C reduction following the resistance exercise was not significant. In most studies, significant reduction has been observed in TC and LDL-C following acute exercise in trained subjects who performed endurance exercise of long-duration that required a large expenditure of calories (6,24). Reduction in TC and LDL-C in untrained subjects with normal level (9) and hypercholesteremia (2) following low size and short-term exercise has also been indicated. Crouse et al. (2) observed initial reduction in TC and LDL-C in untrained men with hypercholesteremia immediately after acute exercise (450 kcal). The concentration of these lipids frequently increased to such extent that LDL-C concentration was significantly increased 24 hours after and TC 48 hour after short-term exercise in comparison basic values (2). In addition, Kantor et al. (19) reported slight increase in TC and LDL-C concentration, although it was not significant after 24 hours after training for one hour of cycle ergometer exercise in untrained men (9). Therefore, in this study, due to TC and LDL-C reduction by resistance exercise, it is recommended that probably these subjects used more energy or their exercise size was higher than previous studies.

In this study, significant reduction in HDL-C concentration in acute resistance exercise was observed while such a reduction was not observed in aerobic and concurrent exercises. Jurimae et al. (18) reported that HDL-C concentration in untrained subjects did not significantly change after 5min of acute exercise 30min of resistance circle exercise (18). Wallace et al. (36) reported no significant change in HDL-C concentration immediately after one acute resistance exercise with low and high volume in trained men (7). While an increase in the concentration of HDL-C after 24 hours was indicated in acute resistance exercise (800 kcal) with high volume (32). Generally, it was determined that specific volume of exercise is needed to increase the concentration of HDL-C (4). Reports in untrained men with high and normal cholesterol indicate that one session of aerobic exercise consuming 350 to 500kcal energy results in a significant increase in the concentration of HDL-C 24 hours after exercise bout (6). Data of this study propose that regardless of the type of exercise, a significant increase in HDL-C depends on the rate of energy consumption and activity in healthy people.

In this study, the mode of exercise had no effect on the short-term response of TG in healthy and sedentary men. When three exercise groups were combined, a significant reduction in TG 24 hours after exercise was indicated. The same result was observed for the untrained people with hypercholesteremia and normal cholesterol (2,4,11,18,23,36). In comparison with other studies, a reduction in TG concentration following acute endurance exercise in sedentary subjects was observed (9). It has been proposed that people with maximum initial TG tend to show more reduction after exercise (2,9,18). While this study, like some others (2) that used sedentary subjects, indicated that natural concentration of initial TG did not make considerable reduction following acute exercise.
Another study indicated significant difference in the rate of serum adiponectin level due to obesity and visceral fat accumulation in children. Obesity Research, 2003;11(9):1072-9.


