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Effect of Circuit Resistance Training on The Serum Levels of Myonectin and Lipid Profile in Young Men

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A B S T R A C T

Introduction: Myonectin is a key player in mediating lipid and glucose metabolism, and exercise training positively influences it by upregulating this myokine. However, the impact of different exercise regimens on myonectin levels is not well understood. This study aims to investigate the effects of three weeks of circuit resistance training on serum myonectin levels and lipid profiles in young men.

Material & Methods: Twenty sedentary young males (average age: 23.6 ± 3.2 years) participated, randomly assigned to circuit resistance training (n=10) and control (n=10) groups. Circuit resistance training, comprising nine sessions over three weeks with nine exercises per session at 60% of one-repetition maximum (1RM), was conducted. The control group maintained their daily routine. Blood samples, collected 48 hours post-training, underwent serum myonectin and lipid profile analysis using specialized kits. SPSS software version 24, ANCOVA tests ($p < 0.05$), were used for data analysis.

Results: The study revealed a significant increase in serum myonectin levels in the trained group compared to controls ($p = 0.027$). Additionally, the trained group exhibited a significant reduction in cholesterol and an increase in high-density lipoprotein (HDL) levels compared to controls ($p < 0.05$). Triglyceride and low-density lipoprotein (LDL) levels did not significantly change in the trained group compared to controls ($p > 0.05$).

Conclusion: This study demonstrates that short-term circuit resistance training (three weeks) significantly improves the lipid profile in sedentary subjects. The positive effect is partially attributed to the upregulation of myonectin levels induced by the training regimen.

Keywords: Exercise Training, Myokines, Lipid Profile

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Introduction

A sedentary lifestyle is widely recognized as a significant risk factor for various pathological conditions, including obesity, type 2 diabetes, cardiovascular diseases, cancer, osteoporosis, and premature death (1). Despite the association of physical inactivity with these conditions, exercise training plays a pivotal role in preventing and treating disorders such as type 2 diabetes and cardiovascular disease (2, 3).

Skeletal muscle, comprising approximately 40% of body weight in non-obese adults, adapts to mechanical, nervous, and hormonal stimuli, playing a crucial role in physical activity, energy consumption, and glucose availability and consumption (4). In response to exercise, skeletal muscles secrete cytokines and peptides collectively known as myokines (5). These myokines, including adipo-myokines produced by skeletal muscle or adipose tissue, are influenced by acute or chronic exercise. Consequently, changes in adipo-myokine profiles may contribute to the health benefits of exercise, while sedentary behavior may lead to altered adipo-myokine profiles, potentially linking it to various chronic diseases (6).

Skeletal muscle is identified as an endocrine organ capable of producing and secreting numerous myokines with autocrine, paracrine, or endocrine effects (7). Myokines such as transforming growth factor beta (TGF-β) superfamily, myostatin, activins, inhibins, follistatin, irisin, bone morphogenic proteins, interleukins, myonectin, and brain-derived neurotrophic factor (BDNF) have been characterized (8). A recently identified family of secreted proteins, the C1q/TNF-related proteins (CTRP1-15), includes myonectin (CTRP15), a myokine predominantly expressed in skeletal muscle (9, 10).

Myonectin is implicated in increasing fatty acid uptake in adipocytes and hepatocytes, contributing to lipid homeostasis in the liver and adipose tissue in response to changes in energy states (11). Exercise training has been shown to influence circulating myonectin levels, with some researchers attributing the positive effects of exercise in reducing insulin resistance in overweight and obese women to the upregulation of myonectin levels (12). However, the precise action mechanism of myonectin and the impact of different types of exercise training on myonectin levels remain unknown. Therefore, the present study aims to investigate the effects of short-term circuit resistance training on myonectin levels and lipid profiles in sedentary young men.

Materials and methods

Participants

The participants in the present study were sedentary overweight young Iranian men aged between 20 and 30 years (average age of 23.6±3.2 years), residing in Tehran, region 22. Inclusion criteria for participants included a body mass index (BMI) ranging from >25 kg/m² to <30 kg/m². Twenty subjects were randomly selected from volunteers to participate in the study, conducted in October and November of 2021 in Tehran.

Study Design

The research protocol received approval from the ethics committee of the Central

Tehran branch of the Islamic Azad University, Tehran, Iran. All stages of the study were conducted in accordance with the ethical guidelines of the Helsinki Declaration. This semi-experimental study utilized a pre-test and post-test design. Following the recruitment of sedentary overweight men and the selection of 20 participants, they were randomly assigned to two equal groups: control (10 men) and training (10 men). Baseline characteristics, including height, weight, and BMI, were measured, and pretest blood samples were collected. The training group's one-repetition maximum (1RM) was determined, and the exercise training protocol was performed accordingly. All participants provided informed consent and voluntarily took part in the study.

Inclusion and Exclusion Criteria

Inclusion criteria comprised physical inactivity over the past year, overweight participants (>25 kg/m²) without obesity (<30 kg/m²), no ingestion of dietary supplements during the intervention and three months prior, overall health without chronic disorders such as cardiovascular disease, hypertension, and type 2 diabetes, no history of stroke and heart failure, and no physical limitations hindering participation in the designated training program.

Exclusion criteria included irregular attendance in all designed training sessions, occurrence of injury during the training program leading to the inability to continue and complete exercise sessions, non-participation in pre-test or post-test blood sampling, the participant's unwillingness to continue the intervention, and the need to take medication within the intervention period.

Circuit Resistance Training Program

The present study implemented a circuit resistance training program, spanning nine sessions over three consecutive weeks, with three sessions per week. Each training session comprised three distinct parts: warm-up, the main training component, and cooling down. Participants initiated the session with a 7-8-minute warm-up involving dynamic exercises and stretching. Following the warm-up, the main training session commenced.

The circuit resistance training session consisted of nine exercises, performed continuously. These exercises included incline chest press, leg press, biceps curl, leg extension, chest press, leg curl, triceps extension, calf raise (machine), and seated rowing. Each exercise was executed for 25 seconds, with eight repetitions. Participants completed all nine exercises consecutively, constituting one circuit. The entire exercise session consisted of three circuits, with a one-minute rest interval provided between each circuit. The training intensity was set at 60 percent of the one-repetition maximum (1RM).

Simultaneously, the control group maintained their regular daily lifestyles throughout this period, without engaging in the prescribed circuit resistance training program.

Blood sampling, biochemical analysis

In the present study, blood samples were collected twice, both before and after the training program. In the posttest stage,

blood sampling was performed 48 hours after the last training session. For both blood sampling stages, participants fasted for 12 hours (night fasting), and 48 hours prior to blood sampling, they were instructed to refrain from strenuous physical exercise and ensure adequate rest, especially on the night before collecting blood samples.

After a 30-minute rest in the blood sampling environment, 5 ml blood samples were collected in the seated position from the right-hand forearm venous. The collected blood samples were then centrifuged at 3000 rpm for 10 minutes, and serum samples were extracted and stored in a freezer for subsequent analysis.

The lipid profile was assessed using a standard kit manufactured by Pars Azmon Co., Iran, employing an autoanalyzer. The measurement of serum levels of myonectin was conducted using the Elisa method (Aviscera Bioscience, Inc., USA; catalog number: SK00393-15).

Statistical Analyses

The normality of the data distribution was assessed using the Shapiro-Vilk test, and it indicated a normal distribution.

To assess the between-group differences, the Analysis of Covariance (ANCOVA) test was employed. Intragroup changes were determined using the paired t-test. The significance level for all analysis tests was set at $p < 0.05$. This criterion was applied to determine the statistical significance of the observed results.

Results

The levels of variables in the present study, including body weight, BMI, total cholesterol, triglycerides, LDL, and HDL, before and after completing a three-week circuit resistance training program in the control and circuit resistance training groups, are presented in Table 1 as mean ± standard deviation.

Table 1. Levels of Variables Before and After Three Weeks of Intervention in the Control and Circuit Resistance Training Groups (Mean±SD).

Variables	Stage	Control	Training	Between Group P Value
Body Weight (kg)	Pre-test	79.91±3.63	82.15±4.46	p=0.261
	Post-test	79.67±3.72	81.56±4.95	
BMI (kg.m2)	Pre-test	26.55±0.64	26.57±0.68	p=0.248
	Post-test	26.46±0.62	26.37±0.75	
Cholesterol (mg/dl)	Pre-test	181.56±16.89	188.49±15.49	p<0.001
	Post-test	185.54±12.04	171.14±11.10 #	
Triglyceride (mg/dl)	Pre-test	154.98±22.72	161.73±19.39	p=0.193

	Post-test	149.52±20.68	151.85±14.94	
LDL (mg/dl)	Pre-test	106.79±14.86	114.78±16.18	p=0.811
	Post-test	101.89±11.79	106.94±12.89	
HDL (mg/dl)	Pre-test	44.93±2.51	43.85±2.87	p<0.001
	Post-test	44.12±2.23	45.92±3.05 *	

Significant decrease compared to the control group
* Significant increase compared to the control group

According to the analysis of covariance test, cholesterol levels in the circuit resistance training group significantly decreased compared to the control group ($p < 0.001$), while HDL levels significantly increased in the trained group ($p < 0.001$). However, there were no significant differences between groups for LDL ($p = 0.811$), triglyceride ($p = 0.193$), and BMI ($p = 0.261$). Additionally, within the circuit resistance training group, paired t-tests showed a significant decrease in cholesterol levels ($p < 0.001$) and BMI ($p = 0.026$), as well as a significant increase in HDL levels ($p < 0.001$). No significant changes were observed for LDL and triglyceride levels ($p > 0.05$) (Table 1).

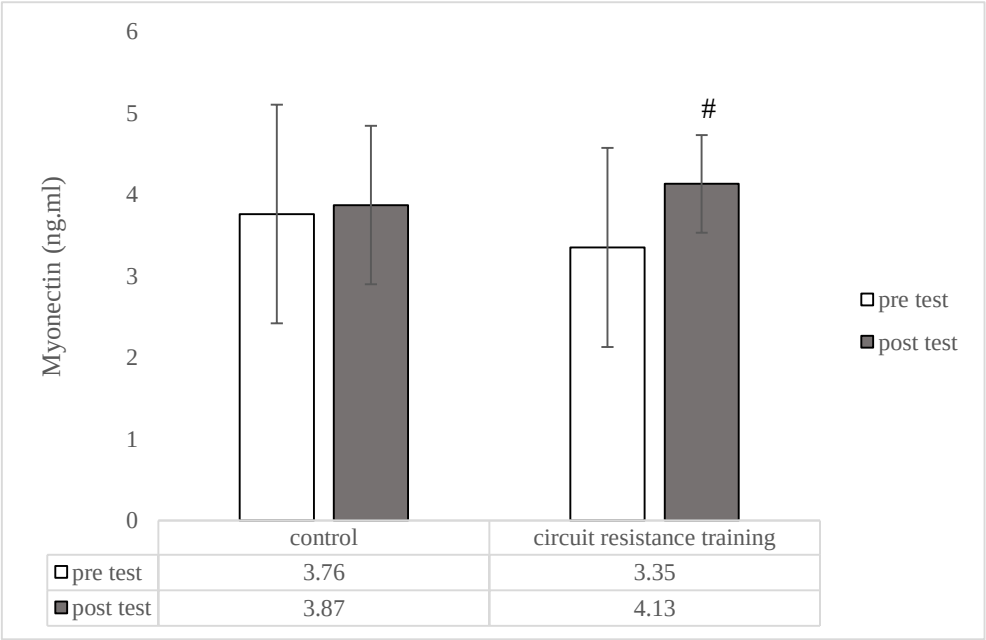

Figure 1. Serum Levels of Myonectin Before and After Three Weeks of Intervention in the Training and Control Groups. # Significant increase compared to the control group.

The analysis of covariance test revealed a significant increase in serum levels of myonectin in the circuit resistance training group compared to the control group ($p = 0.027$). Furthermore, the paired t-test demonstrated a significant increase in myonectin levels within the training group ($p = 0.006$), while no significant

changes were observed in the control group ($p = 0.577$) (see Figure 1).

Discussion

This study aimed to investigate the impact of short-term (3 weeks) circuit resistance training on myonectin levels and lipid profile in sedentary overweight young men. The primary finding of this research indicates a significant upregulation of myonectin levels following the 3-week circuit resistance training, correlating with a notable improvement in the lipid profile, characterized by reduced cholesterol levels and increased HDL levels.

Skeletal muscle, as the largest organ in the body, plays a crucial role in mediating overall metabolic homeostasis and insulin sensitivity. Exercise-induced adaptive changes in skeletal muscle involve the modulation of various bioactive factors, including myostatin, IL-6, IL-15, myonectin, and other myokines (13). Myonectin, in particular, holds a key role in lipid and glucose metabolism, exerting its effects in autocrine, paracrine, and/or endocrine manners to regulate metabolic, inflammatory, and other processes (11).

The present study observed the influence of exercise training on myonectin levels, noting contradictory results. Consistent with our findings, previous research has suggested an upregulation of myonectin gene expression in skeletal muscle and increased circulating levels with exercise training in both human and animal samples (14, 15). However, some studies have contradicted these results, proposing that long-term (eight weeks) combined exercise training may not significantly affect myonectin levels in elderly women (16). Additionally, others have reported a significant decrease in myonectin levels after eight weeks of resistance training in animal samples (17).

Choi et al. (2013) reported a statistically significant increase in myonectin levels after three months of combined training in middle-aged adults, with similar upregulation associated with lipid profile improvement (decreased cholesterol and LDL) (18). Our study aligns with these findings, demonstrating myonectin enhancement without changes in body weight and BMI. Another study reported a significant increase in myonectin levels in obese men after eight weeks of resistance training, independent of changes in body weight and fat mass, reinforcing our findings (15). Furthermore, this study highlighted a negative correlation between myonectin and cholesterol and LDL levels, consistent with our observations regarding myonectin's impact on the lipid profile.

In a study by Seldin and colleagues (2012), similar to our findings, short-term exercise training (two weeks) in male mice resulted in a significant upregulation of myonectin gene expression in specific muscles and increased circulating levels. Moreover, they demonstrated that recombinant myonectin administration reduced circulating levels of free fatty acids without altering adipose tissue lipolysis in mice. This aligns with the potential role of myonectin as a myokine in promoting fatty acid uptake in cultured adipocytes and hepatocytes.

Although this study did not investigate changes in myonectin gene expression in skeletal muscles due to ethical restrictions, our results, along with

previous studies, suggest that myonectin responds to various types of exercise training and may serve as a primary stimulator for alterations in its levels. However, it is crucial to note that myonectin's response to exercise training can vary – it may increase, decrease, or remain unchanged. Multiple factors, including the type, intensity, and duration of exercise training, as well as the gender, age, and physical fitness of participants, can influence myonectin changes following exercise training. Given the limited research on myonectin, further studies are needed to determine its diverse functions and the underlying mechanisms responsible for changes in myonectin levels following exercise training.

Conclusion

The current study reveals that a brief three-week circuit resistance exercise regimen in sedentary young males is linked to a notable increase in serum myonectin levels and an enhanced lipid profile. Consequently, it appears that the positive impact of circuit resistance training on lipid profile improvement can, in part, be attributed to the elevation of circulating myonectin.

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Conflict of interest

The authors declare that no conflict of interest exists.

Authors' contributions

AH and H AA designed and implemented the current training program. MP and H AA participated in data collection. AH and MP analyzed the study data. All authors contributed equally to the preparation of the manuscript draft and its final edition.

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