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THE EFFECT OF RESISTANCE TRAINING ON SERUM CHEMERIN IN PATIENTS WITH TYPE 2 DIABETES

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ABSTRACT

Background & Objectives: Chemerin is a novel adipokine that play an important role in regulating lipid metabolism and adipogenesis. There is limited information available regarding the effect of exercise training on serum chemerin concentrations. The purpose of this study was to investigate the effect of resistance training on serum chemerin levels and lipids of plasma in overweight women. here is little data on the effect of exercise on Chamerin levels in patients with type 2 diabetes. The purpose of this study was to investigate the effect of resistance training on Chamyr levels and lipid profile in in adult women with type 2 diabetes. Methods: 24 adult women with type 2 diabetes were randomly assigned to resistance training groups (12 subjects) and control (12 subjects). The resistance training program was 3 sessions per week for 8 weeks. Resting levels of plasma chemerin and lipid profiles were measured before and after the intervention. Results: After 12 weeks of resistance training, levels of plasma chemerin and LDL-c were significantly decreased in experimental resistance trained group compared to control groups ($p<0.05$). Concurrently, levels of HDL-c were significantly increased ($p<0.05$) whereas, levels of cholesterol, TG and LDL-c, showed no significant changes ($p> 0.05$). Conclusion: Regarding the results of this study, after 12 weeks of resistance training, there was a significant decrease in Chamirin and LDL-c levels as well as an increase in HDL-c levels.

Keywords: *Chemerin, Lipid Profile, Resistance Training, Obesity.*

INTRODUCTION

Aging brings about a decline in skeletal muscle mass termed sarcopenia. This loss of muscle mass increases the risk of developing glucose intolerance and diabetes due to the fact that muscle tissue is the primary site of glucose disposal (Woods et al., 1998). Also, along with reductions in lean mass, older individuals often experience increases in adipose tissue (Hah et al., 2011). Increased visceral adiposity is associated with insulin resistance and type 2 diabetes (T2D) (Rhee, 2011). Hyperglycemia increases the risk of microvascular complications, while dyslipidemia is a major risk factor for macrovascular complications in patients with T2D. Elevated low density lipoprotein (LDL)-cholesterol is a major risk factor for cardiovascular disease. As such, management of LDL is the primary goal of therapy for diabetic dyslipidemia (Narayani, Sudhan, 2010). Besides having the important function of storing energy, adipose tissue is also recognized as an endocrine gland (Matthew et al., 2010). Adipose tissue secretes a number of pseudo-hormonal compounds like adipokine (Matthew et al., 2010). It seems that adipokines exert

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systematic effects on brain, liver, muscles, beta cells, lymphocytic organs and veins (Matthew et al., 2010). Better recognition of the adipokines can contribute to the understanding of the great many of adiposity symptoms (Rhee, 2010). Chemerin is a new adipokine discovered recently. It is a chemical adsorbent that acts as a ligand for g-coupled CMKLR1 (chemokine-like receptor-1). Chemerin plays a considerable role in innate and adaptive immunity (Bozaoglu et al., 2007). It is also conjectured that chemerin has localized effects on adipogenesis. Chemerin is produced during adipocytes' differentiation and stimulates insulin secretion and glucose adsorption in adipocytes (Dong et al., 2011). Chemerin expression and secretion is substantially increased with adipogenesis. Researches have shown that chemerin levels are correlated with adiposity and metabolic syndrome. Thus, it has been suggested that it is a factor giving rise to metabolic syndrome (Sell et al., 2009). The elevation of chemerin levels has been found connected with coronary artery disease in individuals with metabolic syndrome (Dong et al., 2011). The researches have demonstrated that chemerin secretion is increasingly higher in adipose tissue of the obese women as compared to their thin counterparts (Bozaoglu et al., 2007). It is postulated that there is a positive correlation between plasma concentration of chemerin and TC and LDL-c levels; contrarily, there is a negative relationship between chemerin levels and HDL-c but it is yet to be clearly elucidated and further research is still needed in this regard. Therefore, chemerin is more likely to have subtle effects on hemostasis and inflammation.

Moderation of the lifestyle through increasing physical activity is an effective method in controlling health in diabetics (Hajer et al., 2008). It is assumed that sport activity, particularly resistance training, causes an improvement in the quality and moderation of the symptoms resulting from diabetes (Hajer et al., 2008) through reducing triglycerides, LDL-c, increasing HDL-c, decreasing body weight and improving cardiovascular indices (Hajer et al., 2008; Wozniak et al., 2009) as well as reducing reductive stress (Wozniak et al., 2009). However, there is not much information available on the effect of sport activities on the plasma levels of chemerin in individuals with Type 2Diabetes. Resistance training in obese diabetics leads to the reduction in chemerin levels and improvement of the cardiovascular indices (Hajer et al., 2008). According to the importance of diabetes and the potential role of resistance training in the reduction of diabetes-induced symptoms as well as the scarcity of the research on the effect of the sport activity, especially resistance training, on plasma chemerin level, the current research paper aims at investigating the effect of a resistance training program on plasma chemerin levels and plasma lipids in women with type 2 diabetes.

METHODOLOGY

The study was a quasi-experimental design with a pre-test and post-test design. Twenty-four adult women with type 2 diabetes in Zanjan city participated in the study. The inclusion criteria of subjects included having at least one-year history of type 2diabetes and blood glucose higher than 100 mg / ml, and no history of cardiovascular, renal, and hepatic disease, infection, surgery, injuries, and not taking alcohol and tobacco agents. During the study period, the subjects consumed metformin and chlorpropamide capsules twice per day, based on prescription of physicians, which due to ethical considerations, there was no possible to discontinue medications. After the examinations, written consent was taken from the participants. Then, subjects were randomly divided into experimental and control groups (age = 47.75 ± 7.04

years, weight = 90.9 ± 9.6 kg, n = 10) and control group (age = 49.08 ± 6.48 years, weight = 84.12 ± 5.86 kg, n = 12).

The experimental group exercises for 12 weeks, 3 days per week, one session per day for 60 minutes, with intensity of 50-80% of a maximal repeat. Accordingly, the subjects of the experimental group exercised with intensity of 50-70% of a maximal repeat for 6 weeks and 10-15 repetitions for each movement, and in the 6th week to the end of the exercise period. Since second 6 weeks up to end of exercise period, they exercises with intensity of 70-80% of a maximal repeat and with 8 to 10 repetitions for each movement. The program of each session included 3 turns and each turn also included 8 stations. The activity time at each station was 45-60 seconds, the rest time between stations was 30-60 seconds and the rest time between two turns was 120-180 seconds (Ibanez et al., 2005; Hordern et al., 2012; Dunstan et al., 2002). The specifications of the exercise protocol are presented in Table 1.

Table 1: Specifications of the resistance exercise protocol

Time	Number of sessions per week	Exercise intensity (One maximum repetition)	Number of period	The number of repetitions at each station	Time of each station	Rest time between each station (Second)	The rest time between each period (Second)
The first 6 weeks	3 sessions	50-70%	3	10-15	45-60	30-60	120-180
The second six weeks	3 sessions	70-80%	3	8-10	45-60	30-60	120-180

Stations include breast press, knee opening, knee flexion, Lat Pull Down, arm bending, seated rowing, heel lifting, and arm opening. The principle of overload was designed in such a way that, after four weeks of practice, one maximal repeat test was performed for each person at each station and the weight was adjusted accordingly. It should be noted that these movements were performed with circular bodybuilding equipment in circular (Hordern et al., 2012; Dunstan et al., 2002). The total time of each exercise session included warming up very light and without resistance for 10-15 minutes, an exercise program with weight and cooling for 10 minutes.

In order to determine one maximal repeat of considered movements, the subjects were first invited to the test site a few days before the main exercise to be acquainted with the desired movements and one maximal repeat of the movements to be obtained. Subjects first performed each movement with 8 to 10 repeats and 50% of their maximal expected repeat. Then, the subjects rested for one minute. Then, the subjects performed the considered movements with 3 to 5 repeats and 75% of their maximal expected repeat. Then, they rested for a minute. After performing the above steps, the subjects increased the weight from 1.25 to 4.5 kg to reach a maximal expected repeat. This process was performed until voluntary fatigue time. The weight through which the subjects reached voluntary fatigue was determined as a maximal expected repeat of the considered movements (Kwon et al., 2010).

Blood sampling was performed 48 hours before the first exercise session and 48 hours after the last exercise session. Subjects were asked to avoid using these foods for 12 hours before blood sampling. To simulate the sampling time in order to control circadian rhythm, sampling was performed at the beginning and the end of the study at 8 am. In this study, 10 cc of blood was taken from arm vein of right hand of the subjects and the samples were collected in tubes containing Ethylene Diamine Tetra Acetic Acid (EDTA) and centrifuged (at 2000 rpm for 10 minute) and the plasma was stored at freezing temperature at -80 ° C. Serum concentration of chemerin and lipid profiles was determined by ELISA method and by using human specific kits. After confirming the normal distribution of the data using the Kolmogorov-Smirnov test, dependent t-test was used for statistical analysis and intra-group comparison of the variables, and independent t-test was used for the comparison of the variables among the groups. In addition, Pearson correlation coefficient was used to determine the relationship between vaspin and other measured variables. All data are presented in mean and standard deviation. The calculations were performed using SPSS20 statistical software and the significance level of the tests was considered as $P \leq 0.05$.

RESULTS

A. Results of physical and functional indices

The results of examining the physical and functional characteristics of the experimental and control group are presented in Table 1.

Table 2: Mean comparison of physical and functional characteristics of the experimental and control groups after the resistance exercise period

Variables	Group	Baseline	8 weeks	dependent t	P value	P value
Age (years)	Experimental	47.75±7.04	-	-	-	-
	Control	49.08±6.48	-	-	-	
Anthropometric measurement						
Height (cm)	Experimental	169.9 ± 7.39	-	-	-	-
	Control	171.7 ± 5.76	-	-	-	
Weight (kg)	Experimental	90.9±9.6	83.2 ± 14.6	2.40	0.03*	0.87
	Control	84.2±5.86	81.3 ± 7.5	1.60	0.03*	
BMI (kg/m^2)	Experimental	28.1±4.4	26.7 ± 3.9 *	4.41	0.18	0.43
	Control	27.5±3.6	27.8 ± 3.2	1.13	0.28	

The values are presented as mean ± standard deviation. Cm: centimeter. kg/m^2: kilogram per square metre. Kg: kilogram. BMI (Body mass index): calculated by dividing weight (kg) by height squared (m^2).
* Significant difference in compare to Pre values ($p \leq 0.05$).

B: Results of paraoxonase-1 and insulin resistance index

The results of examining the concentration of measured variables are presented in Table 3. The serum concentration of chemerin decreased by 7.27% in the experimental group, while it decreased by 3.89% in the control group. The intra-group analysis showed that after 12 weeks of resistance exercise, serum chemerin concentration in the experimental group was significantly different from that of the control group ($p < 0.50$). Intra-group study examination showed that the mean LDL levels decreased by 16.45% in the experimental group and the decrease in the experimental group wAS statistically significant ($P = 0.04$). The results of intra-group analysis showed that after 12 weeks of resistance exercise, HDL levels increased significantly in the experimental group in the post-test stage compared to those in pre-test ($p = 0.01$). Moreover, after 12 weeks of resistance exercise, no significant difference was seen between cholesterol and TG levels of experimental group and those of control group.

Table 3: Comparison of the mean biochemical indices of the experimental and control groups before and after the resistance exercise period

Variables	Group	Baseline	8 weeks	P value
chemerin (ng/ml)	Experimental	203.91 ± 20.74	189.08 ± 16.47	0.002**
	Control	248 ± 35.38	189.08 ± 16.47 *	
TC (mg/dL)	Experimental	187.08 ± 53.13	170 ± 34.73	0.14
	Control	176.91 ± 25.56	178.08 ± 13.45	
TG (mg/dL)	Experimental	195 ± 50.91	180.28 ± 74.81	0.80
	Control	184.83 ± 61.98	182.83 ± 25.20	
HDL-C (mg/dL)	Experimental	39± 8.75	42.75 ± 8.03 *	0.40
	Control	39.16 ± 10.46	40.29 ± 7.47	
LDL-C (mg/dL)	Experimental	109.08 ± 44.86	91.13 ± 23.78	0.04**
	Control	100.78 ± 22.10	101.22 ± 13.25	

The values are presented as mean ± standard deviation. TC: cholesterol. TG: triglycerides. HDL-c: high density lipoprotein cholesterol. LDL-c: low density lipoprotein cholesterol. * $P < 0.05$; *Significant difference in compare to Pre values ($p \leq 0.05$). ** $P \leq 0.05$, Significantly different between groups.

DISCUSSION

It was found out in the present study that plasma chemerin concentration of the exercise group testees was significantly reduced in contrast to that of the control group following 12 weeks of resistance training. There are discrepancies regarding the effects of sports on plasma chemerin concentration and its relationship with other metabolic parameters (Kim et al., 2014; Stefanov et al., 2014). Some of the researchers have observed significant reductions in chemerin levels which is consistent with the results of the present study. Since there is a scarcity of information and chemerin functioning mechanism is yet to be clearly determined, it is not possible to appropriately justify the contradictory results obtained in different research papers. It is suggested that chemerin levels in diabetics might be applicable as an indicator of inflammation (Kim et al., 2014). The present study showed that 12 weeks of resistance training leads to the significant reduction in plasma chemerin levels following weight loss in the obese individuals. The reduction in plasma chemerin levels indicates that the changes in abdominal fat, BMI, WHR after 8 weeks of resistance training can play an important role in the improvement of the macrophage secretion into the adipose tissue and the inflammatory indicators like chemerin and metabolic syndrome. Because chemerin is produced in larger amounts in adipogenesis process, the reduction in its secretion might be due to the decrease in the speed of fat synthesis and its entry into a metabolic cycle (Stefanov et al., 2014). Fatty acid oxidation in exercises featuring intermediate intensities and long periods and performed with 50% of the maximum oxygen consumption might account for 90% of the oxidative metabolism. There are several reasons stated for the reduction in fats' oxidation amongst which the reduction in musculoskeletal lipoprotein lipase activity can be pointed out. The programs that enhance the musculoskeletal capacity for the use of fats might play an important role in controlling the weight of the individuals and reducing the risky cardiovascular factors. The results of the prior studies indicated that chemerin is an adipokine influencing the adipogenesis and hemostasis of glucose in fat cells and it is increased with the increase in BMI in humans. Therefore, it seems that the reduction in chemerin levels as observed herein can be attributed to BMI reduction.

Another finding of the present study was the significant increase in HDL-c levels and significant reduction in LDL-c levels in the experimental group. The most common lipid disorders in these individuals were TG increase and HDL-c level reductions. The latter parameter is recounted as cardiovascular diseases risk factor. While TG increase is accompanied with the increase in LDL-c particles that are altogether realized as atherogenic factors, dyslipidemia is followed by increase in body fat, particularly abdominal fat. There are credible evidences indicating that the high-intensity sport exerts considerably positive effects on the plasma lipid levels. The intragroup investigations performed in the current research paper demonstrated that HDL-c levels have undergone significant increases and LDL-c levels have been significantly decreased in the experimental group. The study results obtained for plasma lipid levels of the obese individuals are conflicting (Thompson, Rader, 2001; Crouse, 1997). Some study results are in compliance with the findings of the present study (Thompson, Rader, 2001; Crouse, 1997). The mechanism of sport effect on lipoproteins is not vividly clarified. It seems that regular resistance training can generally bring about notable improvements in lipoprotein specifications (Kraus et al., 2002). TG levels are inversely associated with HDL-c. The increase in TG and LDL-c is considered as a cardiovascular risk factor. A general look at the research extant on the effect of resistance training on lipid profile indicates that sport exercises rarely influence TG and LDL-c levels as believed by some researchers; unless, they are carried out in conjunction with a proper dietary regime and weight loss (Yin et al., 2009). Significant reduction in LDL-c in the present study can be attributed to the lipoprotein lipase (LPL) response to sport exercises. LPL is amongst the regulators of lipoprotein and it is known to hydrolyze the glyceride existent in the lipoproteins rich in triglycerides. The studies have shown that the hepatic lipase is reduced and controlled after regular sport training activities. Therefore, there is brought about a reduction in the making of triglyceride extant in VLDL-c and LDL-c. It seems that the exercise duration is closely correlated with the LDL-c reduction (Yin et al., 2009). The researchers believe that HDL-c and LDL-c can barely be influenced by the exercise. The researchers have also shown that the mechanism of HDL-c variation following exercise is rather complicated. Such enzymes as lipoprotein lipase (LPL), hepatic triglyceride lipase (HL) and cholesteryl ester transfer protein (CETP) play important roles in HDL-c changes. LPL is the most important factor contributing to HDL-c concentration variations for its hydrolyzing of plasma triglyceride. LDL-c concentration changes following a period of exercise might be related to the increase in CETP concentration/activity. CETP is responsible for fat transfer in HDL-c molecule and other lipoproteins (Kraus et al., 2002).

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