Changes in Omentin-1 and Some Metabolic Parameters Following a Period of Aerobic Exercise in Middle-Aged Men

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Original Article

Abstract

Introduction: Studies have reported hyperlipidemia and its complications, such as diabetes, along with aging. Omentin-1, on the other hand, is a protein that is secreted in visceral adipose tissue and can increase insulin sensitivity. This study aimed at evaluating the effect of aerobic exercise on resting levels of omentin-1, C-reactive protein, and some metabolic parameters in middle-aged men.

Methods: A total of 30 volunteers were enrolled in the study. The subjects were randomly divided into two groups and their blood samples were collected. Those in the experimental group participated in an eight-week aerobic program of running with 35-40% of maximum heart rate for 10 minutes in the first week which augmented to 70% of maximum heart rate for 30 minutes in the eighth week. Blood samples were collected again from both groups (post-test) 48 hours after the eight weeks.

Results: The results showed that aerobic exercise for eight weeks led to a significant increase in resting levels of omentin-1 and high density lipoprotein (pvalue=0.001 and pvalue=0.001, respectively). The exercise resulted also in a significant decrease in resting levels of C-reactive protein and low-density lipoprotein (pvalue=0.001 and pvalue=0.003, respectively), and non-significant decrease in total cholesterol in middle-aged men (pvalue=0.082).

Conclusion: According to the results of this study, middle-aged men can prevent complications arising from decreased omentin-1 and HDL and increased levels of CRP, LDL, and TC by enjoying from aerobic exercise.

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Introduction:

Estimates suggest that the aging population will increase from 9% to 16% in the world and from 6.5% to 17.5% in Iran until 2030 (1). Unlike the past, adipose tissue is now known as an active endocrine organ which releases a large number of hormones known as adipokines (2). Omentin is a new adipokine expressed in visceral adipose tissue which is negatively correlated with insulin resistance and obesity. Omentin-1 is the main form of omentin in

human blood plasma and its most important role is to improve insulin sensitivity (3). Studies have shown that plasma levels of omentin-1 is negatively correlated with obesity, body mass index (BMI), waist circumference, body weight, fat mass, insulin resistance, glucose, total cholesterol, triglycerides, systolic blood pressure, tumor necrosis factor-a, interleukin-6, and leptin, and positively correlated with levels of adiponectin and high-density lipoprotein (HDL) (3-6). Cai et al. (2009) showed that expression of omentin mRNA in obese and overweight people is low, and when overweight and obesity are associated with type 2 diabetes, this amount is further reduced. Moreover, omentin-1, with a role in inflammation and insulin resistance, can be a more appropriate indicator for detection and treatment of diabetes and cardiovascular disease in middle-age (7). Previous studies have shown that omentin-1 performs its signaling role via AKt protein kinase in the presence and absence of insulin (3,8). In addition, the C-reactive protein is a sensitive, non-inflammatory, and non-specific inflammatory parameter. C-reactive protein is synthesized in the liver and has a role in the pathogenesis of many chronic disorders such as cardiovascular disease, diabetes, and cancer (9). Therefore, since CRP can be measured with a relatively inexpensive and high standard test, and given that the protein lacks daily and seasonal changes and provides more predicting information than lipid profile for detection of cardiovascular problems, its measurement is recommended as a clinical tool besides lipid levels in patients at risk for cardiovascular disease by the American Heart Association and Centers for Disease Control and Prevention (9,10). Research has shown that aerobic exercise results in physiological compatibility such as increased oxidative enzymes, reduced adipose tissue, reduced inflammatory factors, increased anabolic hormones, and increased maximum oxygen consumption and cardiovascular system performance (11). Moreover, although physical activity cannot stop the aging process, the capacity of each individual can be expanded at any age. So that, evaluation of the effects of exercise on physical fitness factors in middle-aged people shows the improved metabolic capacity, reduced abdominal fat (12), and improved aerobic strength and capacity (13,14). In this regard, Saremi et al. (2010) reported that 12 weeks of increasingly aerobic exercise significantly increase the plasma levels of omentin-1 and significantly reduce cardiovascular risk factors (6). In another study, Liu et al. (2011) examined the relationship between omentin-1 and atherosclerotic disease in patients with metabolic syndrome. The results showed that omentin-1 has an important role in atherosclerosis in these patients (4). In contrast, Fathi et al. (2011) concluded in their study that a session of aerobic exercise does not have a significant effect on the levels of omentin-1 (1). In connection with CRP inflammatory mediator, the results of Saremi et al. (2012) showed that 12 weeks of resistance exercise can significantly decrease the levels of CRP in adults (15). It was shown in a study by Kohut et al. (2006) that aerobic exercise can significantly reduce CRP levels (16). In a recent survey by Shibata et al. (2012), reduced plasma omentin was significantly related to the number of metabolic risk factors, such as blood pressure and insulin resistance (17).

In general, studies investigating the effect of exercise on omentin are limited so far, especially in Iran, and few studies have examined the changes of CRP and omentin in middle-aged people. Therefore, the present study aimed at evaluating the effect of eight weeks of aerobic exercise on resting levels of omentin-1, CRP, HDL, LDL, and TC in middle-aged men.

Methods:

Study type and research variables

The statistical population in this quasi-experimental study consisted of middle-aged men of 50-60 years old in Kermanshah Province, of which, 30 volunteer people to participate were included in the study and were assessed. They had not participated in any regular physical exercise program during the last year. The purpose and implementation method of the research were explained to all participants and they signed a written informed consent. After anthropometric measurements (height, weight, BMI) and ensuring of physical health and lack of history of certain diseases such as cardiovascular, respiratory, and renal diseases, determined by a specialist physician, as well as non-smoking in the past year, the subjects were randomly assigned to two groups of control (n=15) and experimental (n=15). The anthropometric characteristics of the subjects are presented in Table 1. In this study, changes in dependent variables (resting levels of omentin-1, CRP, HDL, LDL, and TC) were investigated after

exerting the independent variables (8 weeks of aerobic exercise, 3 times a week, with 35-40% of maximum heart rate for 10 minutes in the first week which augmented to 70% of maximum heart rate for 30 minutes in the eighth week).

Data collection method and measuring tool

The anthropometric characteristics including weight, standing height, and BMI were measured. As pre-test, 5mL blood was collected from all subjects through the brachial vein at 8 AM (after 12 hours fasting), and post-test blood samples were collected 48 hours after the last exercise at the end of the eighth week. Blood samples were centrifuged at 3000 rpm for 10 minutes to separate blood plasma. The biochemical parameters of HDL, LDL, and TC were measured by a Hitachi 747 analysis system using Pars-Azmoon kits, and omentin-1 and CRP through ELISA (Apotech Corporation, Switzerland).

Exercise protocol and procedure

Aerobic exercise was performed 3 times a week for 8 weeks, from simple to difficult (low intensity to medium intensity), considering overload (increasing exercise intensity and duration). First, the maximum heart rate of the subjects was estimated using the equation "220-age". The exercise program included running with 35-40% of HR_{max} intensity for 10 minutes (with 5 minutes rest between two running courses) in the first week, which was augmented to 70% of HR_{max} for 30 minutes (5 minutes rest between two running courses) in the eighth week. Each session began with 5 minutes of warm-up and finished with 5 minutes of cool-down. Exercise intervention was designed based on the latest recommendations of American Diabetes Association (18). The intensity of exercise was determined through monitoring heart rate using a polar stethoscope to ensure compliance with intensity. The ambient temperature was 14-22 °C and the relative humidity was 11-16% during exercise. This research was carried out at an altitude of 1322 meters above sea level in the city of Kermanshah in Shahid Beheshti Sport Complex.

The obtained data were analyzed through descriptive and inferential statistical methods using SPSS-18. Kolmogorov-Smirnov test was used to check the normality of data distribution and t-test to evaluate and compare the two groups. P-values of less than 0.05 were considered statistically significant.

Results:

Table 2 shows the mean and standard deviation of the measured parameters in both groups, in two stages of before and after the intervention. Statistical analysis revealed that aerobic exercise for eight weeks in the experimental group significantly increased omentin-1 at rest in middle-aged men (pvalue=0.001; t_{14}=-21.406). This was while the resting levels of omentin-1 did not change significantly in the control group (pvalue=0.094; t_{14}=-2.134). Independent t-test showed also a significant difference between the two groups, and the values of this parameter was higher in the experimental group (pvalue=0.001; t_{28}=-14.730) (Fig. 1).

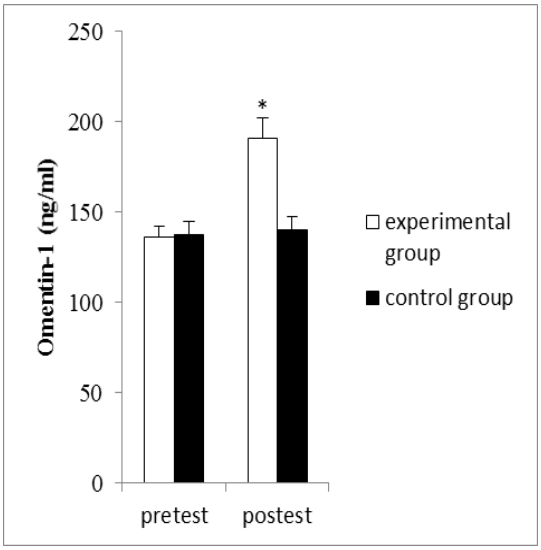

Figure 1- Variations Omentin-1;
* Significant difference to pre-test (pvalue <0.05)

The results of this study showed that after 8 weeks of aerobic exercise, resting levels of CRP significantly reduced in middle-aged men (pvalue=0.001; t_{14}=22.975), while CRP levels did not change significantly in the control group (pvalue=0.261; t_{14}=-1.172).

In addition, the comparison between the two groups using independent t-test showed a significant difference between the two groups and this value was higher in the control group (pvalue=0.001: t_{28}=15.511) (Fig. 2).

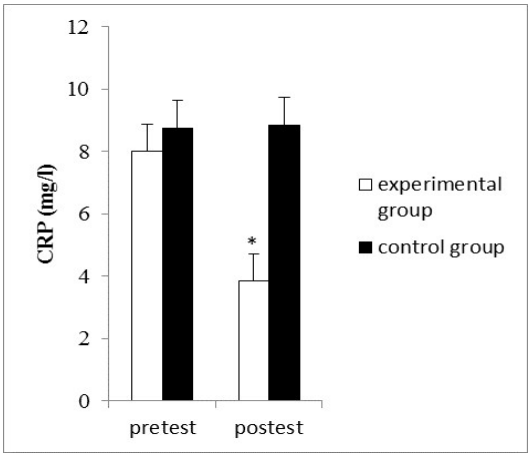

Figure 2- Variations in CRP
* Significant difference to pre-test (pvalue <0.05)

The obtained results showed a significant increase in the resting levels of HDL of middle-aged men (pvalue=0.001; t_{14}=-21.918) and no significant increase in those of the control group (pvalue=0.207; t_{14}=-1.286) after 8 weeks of aerobic exercise. Comparison of the two groups with independent t-test showed also a significant difference, with higher levels in the experimental group (pvalue=0.001; t_{28}=-7.983) (Fig. 3).

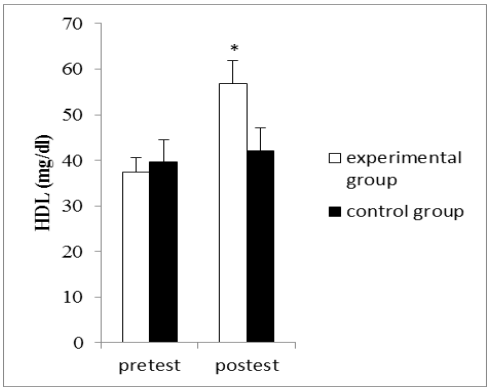

Figure 3- Variations in HDL
* Significant difference to pre-test (pvalue <0.05)

The results showed also a significant decrease in the resting levels of LDL (pvalue=0.003; t_{14}=19.127) and no significant change in those of the control group (pvalue=0.349; t_{14}=-1.088) after 8 weeks of aerobic exercise. Comparison of the two groups with independent t-test showed also a significant difference, with lower levels in the experimental group (pvalue=0.001; t_{28}=13.339) (Fig. 4)

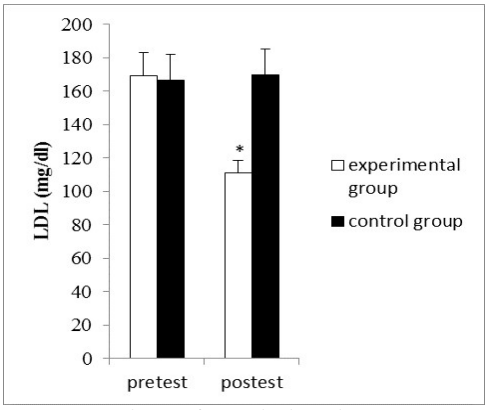

Figure 4- Variations in LDL
* Significant difference to pre-test (pvalue <0.05)

In addition, our results showed a statistically non-significant decrease the resting levels of TC of middle-aged men after 8 weeks of aerobic exercise (pvalue=0.082; t_{14}=7.325). This amount did not also change significantly in the control group (pvalue=0.135; t_{14}=-1.672). However, the results of independent t-test showed a significant difference between the levels of TC which was lower in the experimental group (pvalue=0.048; t_{28}=10.183) (Fig. 5).

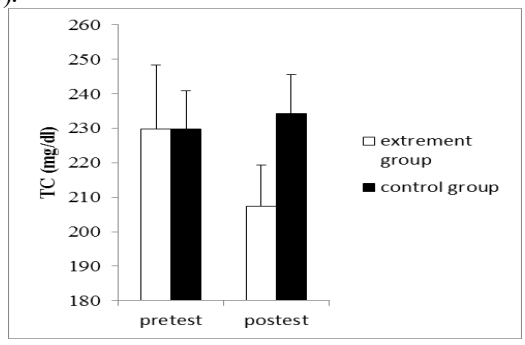

Figure 5- Variations in TC

Table 1- Demoghraphic charachteristics of the participants (n=30) (mean±SD)

Demoghraphic charachteristics		Mean±SD
Age (years)	Experimental group	55.5±2.40
	Control group	54.8±4.32
Height (cm)	Experimental group	172.5±5.7
	Control group	168.3±12.5
Weight (kg)	Experimental group	80±7.11
	Control group	80±7.4
BMI (kg/m^2)	Experimental group	25.98±2.75
	Control group	26.42±1.26

Table 2- Changes in measured parameters in both groups in pre-test and post-test

Variables	Time / Group	Pre-test	Post-test
Omentin-1 (ng/ml)	**Control group**	137.87±7.31	140.13±7.45
	Experimental group	136.4±5.71	191.13±11.14*
CRP (mg/l)	**Control group**	8.74±0.89	8.84±0.88
	Experimental group	8.01±0.87	3.86±0.8*
HDL (mg/dl)	**Control group**	39.6±4.82	42.06±4.96
	Experimental group	37.46±3.13	56.8±5.14*
LDL (mg/dl)	**Control group**	166.8±15.1	169.93±15.28
	Experimental group	169.2±13.82	111±7.69*
TC (mg/dl)	**Control group**	229.73±11.22	207.45±11.17
	Experimental group	229.73±18.57	234.33±11.81

Conclusion:

According to the results of this study, 8 weeks of aerobic exercise can significantly increase the resting levels of omentin-1 in the middle-aged men. This finding is not consistent with the results of Fathi et al. (2011) who examined the acute and delayed responses of aerobic exercise on plasma levels of omentin-1 in the male diabetic rats and observed that a session of aerobic exercise had no effect on omentin-1 (1). This inconsistency may arise from difference in the duration of the exercise protocol and characteristics of the subjects in these studies, because the subjects in this study were diabetic unlike the participants in our research. Although, lack of knowledge and careful evaluation of energy intake and the amount of sleep and rest of the participants during the study were notable limitations of the present study, our findings were consistent with those of Saremi et al. (2010). In fact, they evaluated the effect of 12 weeks of aerobic exercise on serum omentin-1 and cardiovascular risk factors in obese and overweight men and concluded that 12 weeks of aerobic exercise significantly increase plasma levels of omentin-1 (6). They also concluded that aerobic exercise in obese subjects improves cardiovascular risk factors, and this improvement is associated with increased concentrations of omentin-1; this is performed through increasing the expression of omentin gene (7).

Omentin has an anti-inflammatory role in vascular endothelial cells by inhibiting TNF-α-induced expression of COX-2 through inhibition of JNK signaling (19). Therefore, the fact that omentin systematically flows in the blood and strengthens insulin function in the subcutaneous fat may have physiological and pathophysiological importance (20).

Our results showed that aerobic exercise for 8 weeks significantly decreased the resting levels of CRP in middle-aged men. Although, in addition to the mentioned restrictions, hereditary factors cannot be easily ignored, our results were consistent with those of Dufaux et al. (1984) (21) who compared the baseline levels of CRP in athlete men and women with untrained men and women, and those of Saremi et al. (2012) (6) who evaluated the effects of 12 weeks of resistance exercise on CRP in old people. Our results were also consistent with the findings of Ford (2002) (22) who reported that physical activity is inversely related to the levels of CRP and the results of Borodulin et al. (2005) (23) who stated that physical fitness is negatively correlated with CRP. The results of our study were inconsistent with those of Wong et al. (2008) (24) who reported no change in CRP levels after 12 weeks of regular resistance-aerobic exercise in obese people. The findings were also inconsistent with those of Hammett et al. (2004) (25) who measured the effect of 6 months of exercise on serum levels of CRP and lipid in adults of 65-85 years and found no changes in lipid profile and CRP concentrations. Duration of exercise, workout intensity, nutritional status, and subjects' characteristics (older age) can be mentioned as the possible reasons for this inconsistency. In general, CRP can be pointed out as the highest acute phase protein and the most sensitive indicator of inflammation which increases in response to various physiological stresses and its production is stimulated by IL-6 (9,10).

The findings of this study regarding the significant impact of aerobic exercise on resting levels of HDL and LDL and insignificant decrease of TC in middle-age men are consistent with the results reported by Amini et al. (2010) (26) who evaluated the effect of 8 weeks of aerobic exercise on lipid profile and observed a significant decrease in LDL and TC and significant increase in HDL levels. The results are also in line with the findings of Baptista et al. (2008) (27) who stated that aerobic exercise significantly increase the levels of HDL and significantly reduce other parameters of lipid profile in rats.

However, these results were inconsistent with those of Takeshima (2004) (28) who investigated the effect of circular exercise of combination, aerobic, and resistance separately in the elderly and found no significant changes in HDL levels.

Our results were not consistent with those of Siahkoohan et al. (2003) (29) who reported a favorable, non-significant effect of 8 weeks of aerobic exercise with an intensity of 60-65% and 70-75% of reserve maximum heart rate on levels of HDL, LDL, TG, and TC. Younger age of the participants in the study of Siahkoohan and variables such as severity and type of exercise (continuous running), exercise duration, race, and level of physical activity before the study can be mentioned as the reasons for this inconsistency.

Regarding the mechanisms of increase in HDL, studies suggested that following aerobic exercise, the production of HDL is increased in the liver and the activity of different enzymes changes, such as increased activity of lipoprotein lipase (LPL) and lecithin-cholesterol acyltransferase (LCAT) and decreased activity of hepatic triglyceride lipase (HTGL) (30).

Extensive research has been performed regarding the effect of exercise on the levels of lipid profile, and a majority of the studies believe to its significant impact on the levels of these variables. However, few studies have been done on the impact of different exercises such as aerobic on the levels of CRP and omentin, and most of them confirm the significant influence of exercise on the levels of CRP and omentin, as anti-inflammatory factors and suitable parameters for diagnosis and treatment of diabetes and cardiovascular disease in middle-age. The results of this study showed that 8 weeks of aerobic exercise have a significant impact on the resting levels of omentin-1, CRP, HDL, LDL, and TC.

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بررسی تغییرات اومنتین–۱ و برخی شاخص‌های متابولیکی به دنبال یک دوره تمرین هوازی در مردان میانسال

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مجله پزشکی هرمزگان سال نوزدهم شماره چهارم ۹۴ صفحات ۲۵۹-۲۵۲.

چکیده

مقدمه: در بررسی‌های انجام شده افزایش چربی و عوارض ناشی از آن همچون دیابت را همزمان با افزایش سن گزارش کرده‌اند. از طرفی اومنتین–۱ یکی از پروتئین‌های می‌باشد که در بافت چربی احشایی ترشح می‌شود و می‌تواند حساسیت انسولینی را افزایش دهد. هدف از انجام این تحقیق، بررسی تأثیر هشت هفته تمرینات هوازی بر سطوح استراحتی اومنتین – ۱، پروتئین واکنشی –C و برخی دیگر از فاکتورهای متابولیکی مردان میانسال بود.

روش‌کار: بدین منظور تعداد ۳۰ نفر که به طور داوطلبانه در پژوهش شرکت داشتند، مورد مطالعه قرار گرفتند. نمونه‌ها به صورت تصادفی به دو گروه تقسیم شدند و نمونه‌های خونی از آنها گرفته شد. سپس افراد در گروه تجربی در برنامه هشت هفته‌ای هوازی، دویدن با شدت ۳۵ تا ٤٠ درصد ضربان قلب بیشینه به مدت ده دقیقه در هفته اول که به شدت ۷۰ درصد ضربان قلب بیشینه مدت ۳۰ دقیقه در هفته هشتم رسید، شرکت نمودند. ٤٨ ساعت پس از اتمام هفته هشتم تمرینات، مجدداً از هر دو گروه نمونه‌گیری خونی به عمل آمد (پس آزمون).

نتایج: نتایج نشان داد که تمرینات هوازی به مدت هشت هفته باعث افزایش معنی‌داری در سطوح استراحتی اومنتین–۱ و لیپوپروتئین با چگالی بالا می‌شود (به ترتیب pvalue=۰/۰۰۱ ; pvalue=۰/۰۰۱). همچنین این تمرینات منجر به کاهش معنی داری در سطوح استراحتی پروتئین واکنشی–C، لیپوپروتئین با چگالی پایین (به ترتیب pvalue=۰/۰۰۱ ; pvalue=۰/۰۰۳) و کاهش غیرمعنی‌داری در کلسترول تام مردان میانسال شد (pvalue=۰/۰۸۲).

نتیجه‌گیری: با توجه به نتایج برآمده از این پژوهش، می‌توان گفت مردان میانسال می‌توانند جهت جلوگیری از عوارض ناشی از کاهش اومنتین–۱ و HDL و همچنین افزایش در سطوح CRP، LDL و TC از تمرینات هوازی سود جویند.

کلیدواژه‌ها: اومنتین – لیپوپروتئین – میانسالی.

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