Response of circulating levels of chemerin and some of cardio-metabolic risk factors in sedentary underweight men following a period of resistance training

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ABSTRACT

Introduction: A few data are available about effect of resistance training on serum concentration of chemerin, a new adipokine, and cardio-metabolic risk factors in sedentary underweight men. However, being underweight and sedentary, both independently influence on health. The purpose of this study was to survey response of circulating levels of chemerin and some of cardio-metabolic risk factors in sedentary underweight men following a period of resistance training.

Methods: In a semi-experimental study, nineteen subjects were selected from the sedentary underweight men of Boukan and Saghez cities and randomly placed in resistance training (and control) groups. Resistance training protocol consisted of twelve weeks weight training. ELISA and Chemiluminescence methods were used to measure levels of biochemical variables. Data analyzed by SPSS 16 software. Independent- and paired-samples t-test were used for analyzing data. Statistical significance was accepted at $P<0.05$.

Results: In training group, systolic blood pressure ($P=0.015$), diastolic blood pressure ($P=0.012$), serum concentrations of insulin ($P=0.019$), triglyceride ($P=0.030$), and HOMA-IR ($P=0.017$) were reduced, while serum concentrations of chemerin ($P=0.178$), glucose ($P=0.248$), TC ($P=0.329$), high-density lipoprotein ($P=0.388$), and low-density lipoprotein ($P=0.116$) didn't find significant changes. In the control group, none of measured variables showed significant changes ($P>0.05$).

Conclusion: Performing a twelve-week period of resistance training has no effect on the serum concentration of chemerin in sedentary underweight men, but by improving blood pressure, lipid profile, and glycemic control, it can result in useful cardio-metabolic effects for this population.

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Introduction:

Sedentary (inactivity) is associated with the development of chronic diseases such as obesity, diabetes type II, hypertension and atherosclerosis. In fact, regular physical activity reduces diabetes type II, coronary artery disease and the mortality rate. Sedentary is one of the main risk factors for cardiovascular (1).

In accordance with the categories of body weight based on body mass index (BMI), if a person's BMI will be less than 18.5 kilograms per square meter, he will be placed in Underweight category (2). Underweight is an abnormal condition such as obesity, because it is associated with problems and symptoms such as mental health weakness, loss of muscle strength, osteoporosis and cardiovascular and nutrition disorders (3,4).

Research results have shown that the rate of mortality among sedentary underweight women and men was likely more than active counterparts (5, 6). In addition, it has been shown that risk factors for cardiovascular disease profile in lean people who regularly practiced were independently associated with both diet and exercise (7). These findings show that physical activity and regular exercise can affect human health independently of BMI in the underweight (5,6).

Chemerin a Chemo attractant protein that is secreted in the form of 18 kDa Pro-Chemerin by adipose tissue and the extracellular serine protease of the C-terminal part of the protein will be modified produces active Chemerin (8,9).

Chemerin in its active form, regulate the immune system and participate in inflammation through the increased use of tissue macrophages and plasmacytoid dendritic cells (9). Chemerin also related to Adipogenesis and it is shown that while all tissues express the Chemerin and the mating receptor with protein G (CMKLR1), their expression is high particularly in the liver, kidney and adipose tissue (10). Chemerin may play a role in insulin resistance and its cardiovascular effects. Huh et al (2011) studied patients with coronary artery; they found that the serum level of Chemetin is associated with many cardio-metabolic risk factors such as fasting blood glucose, triglycerides (TG), total cholesterol (TC), low-density lipoprotein (LDL-C) and levels of C reactive protein (CRP) with high sensitivity (11). Buzaoglo et al (2009) also have reported on a study of Mexican-American population that Chemerin levels of blood circulating in obese were significantly higher than lean people in the control group and plasma levels of Chemerin had a positive correlation with BMI, fasting glucose, fasting insulin and TG levels and had a negative correlation with the level of high density lipoprotein (HDL-C) (12). Of course, other researchers such as Alfda and colleagues (2012) studied the adult men and women with different degrees of obesity and have found that although Serum levels of Chemerin was associated with BMI and HDL-C, but it was not associated with fasting glucose, TC, LDL-C, TG, insulin , CRP or adiponectin (13).

Little information is available about the effects of exercise training on circulating levels of Chemerin and in limited research; mainly the lowering effect of endurance training is shown in Chemerin levels (14-16). While the increasing tendency to resistance training, has made it to an important component of physical fitness program (17). In fact, according to a joint statement of the Diabetes Association in America and America College of Sports Medicine, resistance exercise can help to improve cardio-metabolic risk factors, reduce the amount of Mortality and quality of life same as endurance exercise (18). Therefore, investigating the role of resistance training on changes in circulating levels of chemerin also requires further study, according to the importance of resistance training and lack of findings in this area. On the other hand, previous studies have investigated the effects of exercise training on Chemerin levels of overweight / obese subjects (14-16) and no study was conducted on the effect of exercise training on Chemerin levels of underweight. While based on previous results, underweight is also an abnormal statue same as obesity that can be associated with cardiovascular and metabolic disorders (3,4). Accordingly, this study was aimed to determine the response of Chemerin circulating levels and some cardio-metabolic risk factors in sedentary underweight men for a period of resistance training

Methods:

The method of this study was a quasi-experimental, including experimental and control group pre-test and post-test and the population was sedentary underweight men of Bukan and Saghez cities. The research sampling was targeted (based on physical activity and BMI), but the placement of the subjects was randomized in groups. Among referring volunteers, those with a BMI less than 18.5 kg per square meter and had no history of

regular physical activity in a year before, were entered the study (1). All participants completed a questionnaire of health history. Volunteers with a history of cardiovascular disease, diabetes, thyroid disease and any known pathological condition or were taking any medication (with or without a prescription) or were under any type of diet or other treatments , were excluded. The total number of research eligible volunteers was 24 people that were randomly divided into two groups of exercise (n=12) and control (n=12), respectively. However, of this number, only 19 people completed the study steps and the final number of participants who were under studied, in the training group were 9 people and in the control group were 10 people. All volunteers completed the written consent form and the ready to participate in physical activity form (PAR-Q).

Before starting the exercise protocol, first during an acquaintance session at the Location of training (fitness club), objectives, training protocols and laboratory evaluation (eg, blood samples) and the research schedule for the volunteer were demonstrated. In addition, how to work with weights for trainings related to training group participants was taught and one repetition maximum (1RM) test was performed to determine the intensity (resistance) for each movement. 1RM was individually determined for each muscle group separately by the formula (19):

Predicted 1RM= lifted weight ÷ [1.0278 – (0.0278× Number of repetitions)]

The Participants' cardiorespiratory function was also evaluated by estimating the maximum oxygen consumption (VO2max). VO2max was estimated by using a submaximal bicycle test of Astrand-Ryhming and on the bicycle ergometer (Magnetic fixed Bike of rub IMAX, model ROBIMAX 7750, made in Taiwan (20). Participants' weight was measured by using digital weight meter (with a minimum accuracy of 0.1 kg, model WS 80, Switzerland) and their height was measured by using a stadiometer (with a minimum accuracy of 0.1 cm, model Machinen AG, Switzerland). BMI was calculated through dividing body weight (kg) by height squared (m^2). Body density was estimated by measuring the subcutaneous fat at three points of the body (chest, triceps and shoulders) by calipers (with a minimum accuracy of 1 mm, model Harpenden, made in English) and the body density calculation was estimated by using the formula of Jackson and Pollock (21):

The Density of the body = 1.1125025 – $0.0013125(X_1) + 0.0000055(X_1)2-0.0002440(X_2)$

X_1 = total fat of chest, triceps and sub scapular

X_2 = age

Then the percentage of body fat was calculated by using the Siri formula (22):

Percentage of body fat= (495/ body density)-450

Sitting and resting blood pressure after 10 minutes was measured by using a mercury sphygmomanometer, so that the measurement was performed twice and the average was calculated and was recorded.

A resistance training protocol in this study was the twelve-week weight training. In each week, 3 sessions training were performed just every other day. Weight training time was about 60 minutes per session. Weight training includes ten stations (biceps with barbells, triceps with a barbell, shoulder with dumbbells, armpit with dumbbell, bench press with a barbell, sit-ups, leg press with the machine, Scott Hawke, bend the knee, open the knee), that were done in each station 3 times 12-8 repetition with an intensity of 80-60% of 1RM. The amount of rest between sets was 1 minute and 2 minutes between stations. In the beginning (and end) of each practice session, participants performed about 10 minutes slow running and stretching exercises to become warm (or cold).

Before and after the training period, participants have been in a Healing Medical Laboratory of Bukan city and 10 ml of each serum sample was taken from the elbow vein to measure the serum concentrations of Chemerin, insulin, glucose and lipid profile (TC, TG, HDL-C, LDL-C). The participants' serum sample was kept to measure blood indexes at -20 ° C. Participants must prohibit over 12 hours before sampling from all foods and drinks. In order to control the participants' nutrition during the study period of three months, they were taught to feed before the start of the training so that

their percentage composition of macronutrients in the diet will be as much as possible in accordance with a standard diet (respectively 55, 30 and 15 % carbohydrate, fat and protein) (23,24). In addition, in order to estimate the total daily energy consumption of participants, the Harris-Benedict standard formula with the activity factor of 1.55 was used for the training group and 1.2 was used for the control group (23):

Basal Metabolic Rate $_{(kcal)}$ = 66 + (13.7× weight $_{(kg)}$)+(5×height $_{(cm)}$)-(16.8×Age $_{(Years)}$)

Total daily energy consumption $_{(kcal)}$ = Basal Metabolic Rate$_{(kcal)}$ ×(1.55 or 1.2)

The serum concentration of Chemerin was measured by (Human Chemerin ELISA Kit, CV within the assessment 5.1%, CV between the assessment 8.3%, made in BioVendor company in Czech Republic) by ELISA (Awernes stat fax 303 plus device, made in America) and serum insulin concentration was measured by (Insulin CIATM kit, CV within the assessment 6.8%, CV between the assessment 8.8%, made in MONOBIND, INC. company in America) by chemiluminescence method (Berthold device, made in Germany). Insulin resistance index was estimated by HOMA-IR formula (25):

HOMA-IR= [IF (μU/ml) × GF (mmol/l)]/22.5

That IF is fasting insulin and GF is fasting glucose concentration.

Descriptive statistics were used to describe data (mean±SD), to assess the normality of the population distribution, the Kolmogorov-Smirnov test was used, to compare the pre-test and post-test average in each group, the paired t-test was used and to compare the two groups pre-test averages with each other and to compare the post-test averages of two groups with each other, independent t-test was used. The significance level was set at 0.05. All statistical analysis was performed by using the Statistical Package for the Social Sciences SPSS 16.

Results:

General characteristics of the two subject groups are reported before and after the training period in Table 1. The results of the independent t-test to compare pre-test averages of two groups showed no significant differences in any of the measured variables between the averages of two groups ($P<0.05$). In addition, a paired t-test results in the training group showed that body weight ($P=0.020$), BMI ($P=0.011$) and VO_2max ($P=0.042$) increased, SBP ($P=0.015$) and DBP ($P=0.012$) decreased and body fat percentage ($P=0.244$) did not change. According to the paired t-test results in the control group, none of these indexes changed significantly ($P<0.05$).

Biochemical characteristics of the two groups' subjects before and after the training period are given in Table 2. Paired t-test results in the exercise group showed that the serum concentrations of insulin ($P=0.019$), TG ($P=0.030$) and HOMA-IR ($P=0.017$) decreased, but serum concentrations of Chemerin ($P=0.178$), glucose ($P=0.248$), TC ($P=0.329$), HDL-C ($P=0.388$) and LDL-C ($P=0.116$) did not change significantly. In addition, based on the paired t-test results in the control group, no significant change in these indexes was observed ($P<0.05$).

Independent t-test results to compare post-test averages of the two groups showed a significant difference in body weight, BMI, VO2max, SBP, DBP, serum insulin concentration, serum TG concentrations and HOMAI-R between the two groups ($P>0.05$), while for other measured variables, there were no significant differences between the two groups ($P<0.05$).

The total daily consuming energy for exercise group was 179.5±2241.8 kcal and for the control group was 143.9±1763.4 kcal, respectively

Table 1. General characteristics of both subject groups before and after the training period (mean±SD)

	Practice (n=9)		Control (n=10)	
	Pre-exam	Post-exam	Pre-exam	Post-exam
Age (years)	20.9±3.6	-	21.5±3.2	-
Weight	60.1±4.3	63.2 ±4.8*#	61.5±4.2	61.1±5.7
BMI[1] (kgm)	18.4±2.9	19.2 ±2.4*#	18.4±2.3	18.5±2.1
Body fat percentage	19.1±2.3	18.7±2.2	19.5±2.7	18.9±2.4
VO2max[2] (ml per kilogaram of body weight per minute)	31.2±4.3	35.4 ±4.6*#	31.6±5.6	31.2±4.9
SBP[3] (mm Hg)	123±8	199 ±8*#	125±9	127±9
DBP[4] (mm Hg)	81±6	77 ±7*#	82±7	84±8

1 body mass index, 2 maximum oxygen consumption, 3 systolic blood pressure, 4 diastolic blood pressure, * indicates a significant difference between the average of pre-test and post-test at level of P <0.05, # indicates a significant difference between the posttest average of two groups at the level of P<0.05

Table 2. The biochemical properties of two subjects groups before and after the training period (mean±SD)

	Practice (n=9)		Control (n=10)	
	Pre-exam	Post-exam	Pre-exam	Post-exam
Chemerin (ng per ml)	153.2± 18.3	148.6± 19.5	148.6± 17.3	150.6± 20.8
Insulin (micro international units ml)	10.7± 1.3	10.2 ± 1.4*#	10.6± 1.2	10.6± 1.3
Fasting glucose (mmol)	4.3± 0.4	4.2± 0.3	4.4± 0.4	4.5± 0.3
HOMA-IR	2.1± 0.1	1.9 ± 0.1*#	2.1± 0.1	2.1± 0.1
Lipid profile (milligrams per deciliter)				
TC1	141.5± 15.6	138.2± 16.4	137.4± 14.7	142.3± 15.2
TG[2]	83.5± 8.1	78.4 ± 7.2*#	82.7± 8.6	85.4± 8.0
HDL-C[3]	55.4± 6.7	58.5± 5.6	53.7± 6.4	56.3± 5.3
LDL-C[4]	83.6± 8.9	75.5± 8.0	84.4± 7.2	85.3± 8.1

1 total cholesterol, 2 triglycerides, 3 high-density lipoprotein, 4 low-density lipoprotein, * indicates a significant difference between the pre-test and post-test average at the level of P <0.05, # indicates a significant difference between the posttest average of two groups at the level of P<0.05

Conclusion:

The findings of this study indicate that after twelve weeks of resistance training, weight and BMI of sedentary underweight men increased, but the body fat percentage did not change. These findings are consistent with the study of Shaw et al (2006) that showed eight weeks of resistance training has increased the weight and body mass (26). However, the body fat percentage study decreased in the study (0.4 percent), but this decline was slight and was not statistically significant. Unlike the findings of this study, Kornelisen et al. (2011) expressed that resistance training in healthy adult reduced the body fat percentage without weight changing and BMI to the low amount of (0.55 percent) (27). Of course, in the study of Kornelisen et al (2011) the study subjects were mostly overweight (27), while in the present study, the subjects were underweight, and this difference in whole weight (and practice plasticity induced of it) may be the reason of the difference between the findings of the present study with the findings of Kornelisen et al (2011). It seems that the main reason for weight gain and BMI of participants in the resistance training is an increase in lean body mass (muscle mass) (28,29).

Also, in the present study after twelve weeks of resistance training, SBP and DBP of sedentary underweight men showed a decrease by an average of 4 mm Hg. However, the role of resistance

training on blood pressure changes in underweight people has less been studied, but the impact of resistance training on blood pressure in people with normal weight or overweight/obese has been studied more that the findings of this study are consistent with these studies (27,30). The results of observational studies in healthy subjects showed a direct, strong, independent and continuous relation between blood pressure and cardiovascular risk (31). In fact, the reduction as small as 3 mm Hg in SBP and DBP can reduce the risk of coronary heart disease, stroke and other causes of death, respectively, to 5, 8 and 4 per cent (31). Therefore, even small reductions in people with desirable blood pressure can also be of clinical importance (32).

After twelve weeks of resistance training, cardio-respiratory function index (VO2max) of sedentary underweight men recovered. In line with the findings of this study, Kornelisen et al (2011) also expressed that resistance training can lead to 10.6% increase in oxygen consumption peak (27). This finding is also consistent with the findings of Ho and colleagues (2004) and Baike et al (2000) (5,6). An increase in the maximum stroke volume and arterial-venous oxygen difference has been raised as the main adaptations from exercise training that leads to an increase in VO2max (33).

In addition, based on the findings of this study, a twelve-week period of resistance training through serum TG level reduction, resulting in an improved lipid profile, although it does not change in the other components of the lipid profile (TC, HDL-C and LDL-C). The findings of the study are consistent with the findings of Kornelisen et al (2011). However, Kelly and Koly (2009) have reported the reducing TC, LDL-C, and TG, the subsequent of resistance training (34). It seems that people with normal lipid profile, a stronger training stimulus and more consuming energy is necessary in order to influence the other components of the lipid profile (in addition to TG) (27). The mechanism, by which exercise reduces TG levels, is not yet known. It is reported that changes in TG levels are related because of training to changes in fat mass (35).

The mechanism by which exercise reduces TG levels, is not yet known. It is reported that in the present study, followed by twelve weeks of resistance training, the serum concentration of insulin and HOMA-IR of subjects showed a reduction, without a change in serum concentrations of glucose. In line with this study, Kornelisen et al (2011) also have referred to no change in circulating levels of glucose followed by resistance training (27). In addition, Andersen and colleagues (2003) found that resistance training like endurance training has increased the insulin action in young healthy subjects (37). Poleman and colleagues (2000) found that both endurance and resistance training have improved the glucose disposal in young non-obese women, although through different mechanisms (36). Exercise can reduce insulin resistance through insulin action improvement, an increase in the availability of glucose (because of an increase in lean mass) and an increase in glucose uptake in the muscle (37).

In addition, in accordance with the findings of this study, Chemerin circulating levels of sedentary underweight men did not change after twelve weeks of resistance training. Considering that Chemerin is a new Adipocytokine, few studies have examined the effect of exercise training (endurance or resistance) on its circulating levels (14-16). Venojarvy et al (2013) has studied in overweight and obese middle-aged men (65-40 years) with impaired glucose regulation and found that walking or strength training, both, lowers the serum levels of Chemerin (16). In studies conducted by saremi and colleagues (2010), Chakaron et al. (2012), Venojarvy, and colleagues (2013), the serum concentration of Chemerin reduction followed by the exercise or diet is attributed to reducing in body weight (14-16), while in the present study; the body weight of the subjects not only did not fall, but also showed an increase. In addition, in our study, the percentage of subjects' body fat was unchanged, and it is likely that no change in the serum concentration of Chemerin is associated with lack of change in body fat percentage. In addition, based on some proposed physiological relevance for Chemerin (11-13), it is possible that other factors, except weight loss or body fat percentage, are involved in the serum concentrations of Chemerin reduction following exercise training. However, the effect of exercise on the serum concentration of Chemerin and understanding and recognizing its mechanisms require further investigation.

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پاسخ سطوحِ در گردش کمرین و برخی عوامل خطر قلبی – متابولیکی مردان کم‌وزن کم‌تحرک به یک دوره تمرین مقاومتی

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چکیده

مقدمه: *اطلاعات اندکی در مورد تأثیر تمرین مقاومتی بر غلظت سرمی کمرین (یک آدیپوکاین جدید) و عوامل خطر قلبی – متابولیکی در مردان کم‌وزن کم‌تحرک موجود است. این در حالی است که کم‌وزنی و کم‌تحرکی هر دو به طور مستقلی بر سلامتی اثر می‌گذارند. هدف از مطالعه حاضر، بررسی پاسخ سطوحِ در گردش کمرین و برخی عوامل خطر قلبی – متابولیکی (فشارخون، مقاومت انسولینی، نیمرخ لیپیدی) در مردان کم‌وزن کم‌تحرک به یک دوره تمرین مقاومتی بود.*

روش کار: *در یک کارآزمایی نیمه‌تجربی، از میان مردان کم‌وزن کم‌تحرک شهرستان‌های بوکان و سقز، نوزده نفر انتخاب و به طور تصادفی به دو گروه و کنترل تقسیم شدند. پروتکل تمرین مقاومتی شامل دوازده هفته تمرین با وزنه بود. جهت اندازه‌گیری سطوح متغیرهای بیوشیمیایی از روش‌های الایزا و کِمی لومینسانس استفاده شد. تجزیه و تحلیل داده‌ها با بکارگیری نرم‌افزار آماری SPSS 16 صورت گرفت. جهت تجزیه و تحلیل داده‌ها از آزمون‌های t همبسته و t مستقل استفاده شد. سطح معنی‌داری $P<۰/۰۵$ در نظر گرفته شد.*

نتایج: *در گروه تمرین فشارخون سیستولیک (P=۰/۰۱۵)، فشارخون دیاستولیک (P=۰/۰۱۲)، غلظت‌های سرمی انسولین (P=۰/۰۱۹)، تری‌گلیسرید (P=۰/۰۳۰) و HOMA-IR (P=۰/۰۱۷) کاهش یافت، اما غلظت‌های سرمی کمرین (P=۰/۱۷۸)، گلوکز (P=۰/۲۴۸)، کلسترول تام (P=۰/۳۲۹)، لیپوپروتئین با چگالی بالا (P=۰/۳۸۸) و لیپوپروتئین با چگالی پایین (P=۰/۱۱۶) تغییر معنی‌داری نیافت. در گروه کنترل هیچ کدام از متغیرهای اندازه‌گیری شده تغییر معنی‌داری نشان ندادند (P>۰/۰۵).*

نتیجه‌گیری: *اجرای یک دوره دوازده هفته‌ای تمرین مقاومتی تأثیری بر غلظت کمرین سرم مردان کم‌وزن کم‌تحرک ندارد، اما می‌تواند از طریق بهبود فشارخون، نیمرخ لیپیدی و کنترل گلیسمیک، اثرات قلبی – متابولیکی مفیدی برای این افراد در پی داشته باشد.*

کلیدواژه‌ها: *کمرین، انسولین، فشارخون ، مردان*

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