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Effects of exercise intervention to improve body composition and chemerin in middle-aged overweight women

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Abstract

Introduction: There is well documented evidence that obesity are serious worldwide public health problems which result an increased risk of developing diseases such as, cardiovascular diseases and diabetes mellitus and regular exercises can be effective in preventing and treating such diseases. Chemerin, is a recently identified adipose tissue secreted hormone that has been shown to be elevated in obese individuals and associated with some components of the metabolic syndrome, including: the waist circumference, body mass index (BMI), fat percent, triglycerides and high-density lipoprotein. Thus, the aim of current study was to analyze the effect of rhythmic aerobic exercise training on serum chemerin and body composition components in overweight women.

Material & methods: Twenty-four overweight women (BMI between 25 to 30 kg/m^2) voluntarily participated in the study (12 subjects in each groups). Training groups participated in a rhythmic exercise training program for eight weeks, three times a week with 50-70 heart rpm for 60-90 minutes. The chemerin levels and body composition components were measured in the both groups pre and post training duration.

Results: The serum chemerin levels were significantly decreased from 218.7±7.6 to 190.3±9.2 ng/mL ($P<0.01$) after training program. Weight and BMI, also, in exercise group was significantly decreased in compare with control after 8 weeks of exercise.

Conclusions: Rhythmically exercise training were found to improve the serum chemerin levels and some components of body composition; thus, it could be effective in preventing obesity-related diseases and enhancing body composition of middle aged overweight women.

Keywords: Chemerin, Body composition, Rhythmic exercise, Overweight women

1. Introduction

Obesity is a global health problem that affects individuals of every age, sex, ethnicity, race, and socioeconomic status and can be defined as an excessive amount of fat that increases the risk of medical illness, such as diabetes, hypertension, cardiopathies and premature death (1). In the past, adipose tissue was thought only to act as an energy reservoir or an inert depot for fat storage (2,3). However, in recent years, adipose tissue has emerged not only as an energy storage depot but also a hormonally active endocrine organ that secretes more than 600 bio-active molecules, called adipokines, which have biological impact on health and disease (4,5). Adipokines such as adiponectin, leptin, and tumor necrosis factoralpha (TNF-α) are now well known, but new adipokines are constantly being detected, such that studies are needed to define their roles. Among newly identified adipokines, visfatin, chemerin and apelin are reported to be associated with obesity and type 2 diabetes mellitus (6).

Chemerin is a chemoattractant protein secreted from adipose tissue and the liver that recently added to the family of adipokines. It was discovered in 1997, and there is growing evidence of the potential role of this protein in various pathologies including diabetes, metabolic syndrome, obesity, and cardiovascular disease (7). There is strong evidence that chemerin plays a major role in adipocyte differentiation, maturation and metabolism, and is associated with glucose homeostasis, insulin resistance and the metabolic syndrome (8). Chemerin has been shown to be positively correlated with body mass index (BMI), insulin resistance, blood pressure, circulating triglycerides (9) as well as with other obesity-related markers such as leptin, resistin, C-reactive protein (CRP) and glycosylated hemoglobin (HbA1C) (10). Chemerin is an adipokine that has been shown to be elevated in individuals with central obesity (11) and has been proposed as a potential link between obesity and development of type 2 diabetes (12). The precise role of chemerin remains unclear, although its positive association with BMI and obesity (13,14) and its regulatory function in adipocyte differentiation in vitro (15) have been demonstrated. Several reports suggest a potential role of chemerin in obesity and obesity-related parameters including type II diabetes and metabolic syndrome. Chemerin modulates the expression of adipocyte genes involved in glucose and lipid homeostasis, including glucose transporter-4, leptin, and adiponectin (16).

On the other hand, it seems that the main treatment for obesity is physical activity and dietary intervention. Regular exercise has emerged as a strategy with great potential to improve outcomes in obesity treatment (16,17). The benefit of exercise for general health are clear and unquestioned (18). Regular exercise lowers all-cause mortality and can prevent the onset of obesity, type II diabetes, hypertension, and cardiovascular disease. However, the clinical effectiveness of physical activity as a weight loss maintenance strategy, in the form of regimented exercise or increased activity of daily living, has been the subject of much debate (19). Several studies demonstrated an association between chronic exercise and diminished chemerin levels and enhanced health indices (20). Some researcher recently reported that exercise and lifestyle modification can significantly reduce circulating chemerin levels, and the degree of reduction in chemerin level to be associated with the degree of reduction in obesity (21). However, the effects of rhythmically exercise training on circulating chemerin levels in overweight women have not been studied to date. Thus, the aim of this study was to determine whether serum chemerin levels and body composition would improve following 8 weeks' exercise training in overweight women.

2. Material & Methods

Twenty- four pre-menopausal women between the ages of 30-45 years were recruited using advertisement announcement at the city of shahrekord. All participants had a BMI ranging from 25 to 30 kg/m^2 and were weight stable ($\pm$2.0 kg) for 6 months. All participants met the Following criteria to participate in the study: a) had been normal regular menstrual cycle (i.e., 28-35 days), b) were not engaged in any exercise program (any physical Activity accumulated more than 20min) for the previous 6 months, c) were not taking any medication known to alter lipid and lipoprotein metabolism, and d) self-reported no diagnoses of cardiovascular diseases, type1 or 2 diabetes, or any known metabolic disorder.

Participants were informed that the study involved identifying the impact of eight weeks' exercise training on chemerin levels and body composition. Participants that satisfied the inclusion criteria were asked to present themselves to the laboratory for the first initial visit, in which the pre-test evaluation took place. As is outlined in the breakdown of the pre-test session, the participants were asked to present themselves to the laboratory at 08:30am. In first session participants were explained the proceeding events surrounding the study. After the participants were explained all necessary information and provided the opportunity to ask any questions, the informed consent documentation was signed by the participants. After which, the participants were asked to fill out a medical history questionnaire. This was to ensure that all-extraneous pathological variable or diseases were known prior to the commencement of the study.

Three day later, at second session, participants arrived to the laboratory at approximately at 8:00. Participants were told to follow a 3-day standardized diet and to be fasted from 19:00 the night before. In addition, they were asked to refrain from physical activity for at least 48 hours prior to the testing sessions. Venous blood samples measurements for plasma chemerin were drawn into EDTA containing tubes, by two specialized nurses, and immediately placed on ice. All tubes were centrifuged at 4° C for collection of plasma and stored at -80° C until required for analysis. Participants were in a seated position and rested for five minutes. Blood samples were measured for chemerin concentrations using enzymelinked immunosorbent assay.

After receiving information about exercise protocol and procedures, the subjects gave written informed consent, and were randomly to two groups including: rhythmic exercise training and control. Training groups participated in sport activities for eight weeks, three times a week with 50-70 heart rpm for 60-90 minutes. Each training session began with a light warm-up followed by light stretching routine. The main program portion of exercise group was aerobic rhythmic training that performed rhythmically with music. The control group was instructed not to change their daily patterns of physical activity during the study period.

Height was measured by using a standard stand-up scale (±0.1 cm). Weight was measured using a standard scale (±0.1 kg), and waist circumference with a standard tape measure (±0.1 cm) and was measured from the mid-distance between the iliac crest and the widest portion of the waist. Bioelectrical impedance was used to determine percent body fat using In body (270, Korea). This method works on the principle that a weak electrical current circulates through the body, which determines values of resistance for fat mass (FM) and fat-free mass (FFM).

All these measurements repeated similarly after a minimum of 48 hours since the last physical exercise intervention.

Statistical analyses were performed using SPSS, Windows version 19.0. All data were reported as mean ± standard deviation. Descriptive analyses and independent t-tests were used to assess baseline characteristics. The changes in blood chemerin and body composition variables were analyzed using an independent sample t-test. Paired t-tests were used to assess baseline characteristics with data collected after eight weeks for two study groups. Statistical significance was set at $P<0.05$.

3. Results

Thirty healthy participants initially agreed to participate in this study, and 24 participants successfully completed the entire study. Four subjects were unable to complete the study due to personal matters, and two left the study for personal medical reasons.

At baseline evaluation, no significant differences were observed between the study groups for any of the studied variables. The general and anthropometric characteristics of the 24 women who agreed to participate in the study are shown in table 1.

Table 1. Characteristics of subjects before and after 8 weeks of training in two study groups

Variable	**Exercise**		**Control**		**P value**
	Pre	**Post**	**Pre**	**Post**	
Age (years)	40.2±5.9		42.8±6.3		
Height (cm)	168.2±5.2		170.7±4.4		
Weight (kg)	75.8±7.2	70.6±5.8	74.6±6.4	74.1±7.1	0.04*
BMI (kg/m^2)	27.6±2.7	25.3±2.5	28.2±3.1	27.9±2.8	0.01*
Waist Circumference (cm)	97.1±7.8	95.4±7.1	98.2±9.4	97.6±9.2	0.59
Waist–Hip ratio	.92±.05	.89 ±.06	.91±.04	.92±.03	0.65
Body fat (%)	33.3±4.2	32.4±4.7	32.8±3.1	32.6±4.3	0.32

As shown in table 1, weight and BMI in exercise group was significantly decreased in compare with control. Regardless of decline in body fat percent, waist-hip ratio and waist circumference in exercise group Compared to the baseline values, but these data were no significant differences with the control group.

Table 2. Chemerin levels in groups before and after 8 week of training

Variable	**Exercise**		**Control**		**P value**
	Pre	**Post**	**Pre**	**Post**	
Chemerin(ng/ml)	218.7±7.6	190.3±9.2	205.9±8.9	198.1±12.1	0.01*

Values are means ± SD
*Significantly different between groups P≤0.05

As shown in table 2 the serum chemerin levels were significantly decreased from 218.7 ± 7.6 to190.3 ± 9.2 ng/mL (P<0.01) after training program.

4. Discussion

This study aimed to determine the effect of exercise using rhythmic aerobic training on body composition variables and chemerin, among the overweight women. Obesity is recognized as one of the most important underlying risk factors for a wide variety of diseases, including hypertension, dyslipidemia, diabetes mellitus, stroke, breast cancer and osteoarthritis. Several factors can contribute to the increased prevalence of obesity in female, such as age, increased lipoprotein lipase in abdominal and gluteal adipocytes, decreased lipolysis, reduced physical activity and energy expenditure, increase in caloric intake, variation in hormonal patterns, higher rates of depression and anxiety, use of antidepressant medication, and attitude and perception of weight and weight management.

Body composition, also, is influenced by genetic factors, physical activity, nutrition, diseases and others (22). Subjects in the present study had a significant decrease in some indices of body composition. A significant improvement in weight and BMI was observed in exercise group compared with the control group. This suggests that aerobic training can improves body composition. Studies demonstrate the effectiveness of aerobic exercise in reducing body weight and adiposity (23). Some studies report decrease in fat percent, waist circumference and waist-hip ratio from different type of aerobic exercise training which were not demonstrated in the current study. For example, Kemmler et al. (2009) had subjects complete eight weeks of aerobic training that emphasized high training volumes and body composition improved as anticipated (24). Garber et al. (2011), also, has been well documented the effectiveness of aerobic exercise on body fat reduction (18). Conversely, the present study consisted of an aerobic training protocol with a focus in rhythmic performance that had no change in lean and fat mass. These differences may be attributed to the differences in training programs, include intensity and duration of training. The exercise-induced body composition improvement may prevent cardiovascular disease and cancers in women (25). Aerobic training increases the activity of mitochondrial oxidative enzymes in muscle, enhances protein synthesis, improves lipid and carbohydrate metabolism and reduces total and abdominal adiposity, especially at vigorous intensities (26).

In addition, in this study, circulating chemerin levels were reduced in the exercise group. Chemerin is a novel adipokine, that may play a role at modulation of adipose tissue function directly because chemerin has been shown to regulate adipocyte differentiation and expression of adipocyte genes. Chemerin in humans have been found to be significantly associated with higher BMI and traits of the metabolic syndrome including low high density lipoprotein cholesterol, high plasma glucose and triglycerides, and hypertension (13). Also, chemerin as a chemoattractant protein may contribute to recruitment of macrophages into adipose tissue and has a role at an early stage of adipose tissue inflammation (27). Chronically elevated circulating chemerin level is known to cause insulin resistance in the skeletal muscle (10) and this may also support the hypothesis that a reduction in chemerin levels after lifestyle modification may contribute to an improvement in HOMA-IR.

Our findings of exercise-induced decreases in chemerin are consistent with previous and recent studies in many different population including overweight and obese and type 2 diabetic patients (22,29). These studies consistently reported that weight reduction whether through exercise or lifestyle modification reduced circulating chemerin levels, alongside with circulating insulin (20,21,29).

Recently, Sell et al. (2010) showed that chemerin plasma concentrations are significantly elevated in obese patients and can be reduced by weight loss (10). Chakaroun et al. (2012), also, demonstrated with both weight loss intervention and cross-sectional studies that mRNA and circulating chemerin levels are correlated with adiposity, HOMA-IR and weight reduction through exercise training, and hypocaloric diet significantly decreased circulating chemerin levels (20).

5. Conclusions

This study reveals that exercise exerted significant benefits on body weight, BMI and chemerin levels in overweight women compared with non-exercise group. Exercises, especially those performed at least 8 weeks, significantly reduce body fat, BMI and waist circumference as well as assist in maintaining lean body mass. Exercise protocol, particularly rhythmically aerobic training applied in current study was effective in promoting improvement in body composition and is a safe therapy and is not associated with major side effects. We did not focus on a traditional continuous aerobic-based exercises, such as running or cycling, because we felt that these may not be the exercises of choice for overweight women to continue over long periods of time. Women should be encouraged to maintain physical activity and regular exercise all time during lifestyle. However, a Well-designed and well-executed exercise with optimum type and duration is necessary for all women in any given age and levels of fitness.

Conflict of interests: There was no conflict of interest among authors.

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