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Research Article

AEROBIC TRAINING IS NOT ASSOCIATED WITH INFLAMMATORY PROPERTY IN DIABETIC PATIENTS

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ABSTRACT
This study aimed to determine whether 12 wk of aerobic training altered serum resistin as inflammatory adipocytokine in obese males with type 2 diabetes. Twenty eight sedentary males [mean (SD): age 40.4 (5.1) yr, body mass index 32.2 (1.9) kg/m(2)] were randomized into exercise (n=14) and control (n=14) groups. Subjects of exercise group undertook 36 aerobic exercise sessions over 12 wk at 60-80% of maximal heart rate. Pre and post-training serum resistin and glucose concentration were measured after overnight fat of two groups. Data were compared between conditions using a paired-samples t-test. Aerobic training result in significant increase in serum resistin (p=0.032) and significant decrease in fasting glucose (p=0.000) and anthropometrical markers in exercise group. All variables remained without changed in control group. These finding does not support of aerobic training as anti-inflammatory intervention in diabetic patients.

Keywords: *Type-2 Diabetes, Aerobic Training, Inflammation*

INTRODUCTION
The increased incidence of some chronic diseases such as Type 2 diabetes, asthma, insulin resistance, metabolic syndrome, hypertension, heart disease and some cancers is attributed to increased incidence of obesity. Hence, obesity and obesity-related problems have received much attention by many basic and clinical sciences researchers.
It has been recently identified that in addition to the fat stores of body, the adipose tissue secretes some hormones such as leptin, adiponectin and resistin as a highly active endocrine organ. Along with other interfering hormones, these hormones affect the factors involved in obesity and the regulation of homeostasis and energy metabolism (Ursula *et al.,* 2004). Resistin is a hormone that is secreted by adipose tissue and plays an important role in the relationship between obesity and insulin resistance (Steppan *et al.,* 2001). Early studies have shown that resistin levels are increased in obese and diabetic patients (Steppan *et al.,* 2001). Some other studies supported the potential role of resistin in the relationship between obesity, insulin resistance and Type 2 diabetes. These studies indicate the role of resistin gene polymorphism in the pathogenesis of obesity, impaired glucose tolerance and Type 2 diabetes (El-Shal *et al.,* 2013). The results of a recent study showed a significant positive correlation between resistin and insulin, insulin resistance and CRP as an inflammatory cytokine (Ghareeb *et al.,* 2013).
According to literature, weight loss due to diet or exercise or a combination of both factors plays a significant role in reducing insulin resistance, BMI, hypertension, and obesity-related disorders such as Type 2 diabetes in patients and healthy individuals (Roemmich *et al.,* 2004). However, there are fewer human studies on the role of immediate or long-term physical activity or exercise-induced weight loss in obese or diabetics in serum resistin levels (Eizadi *et al.,* 2013). The findings of the few studies in this area are contradictory and controversial.
The findings of a recent study revealed a significant reduction in serum resistin level following 12 months of aerobic exercise in obese subjects (Park *et al.,* 2008). But in another study, no significant change of these peptide mediators was observed following 14 months of exercise (Giannopoulou *et al.,* 2005). On the other hand, the results of another study showed a significant reduction in serum resistin in the absence of a significant reduction in body weight (Kadoglou *et al.,* 2007). According to some other studies, serum

resistin levels were significantly reduced following prolonged periods of aerobic exercise despite the lack of change in other cytokines such as adiponectin and leptin (Wenning *et al.*, 2013) and CRP (Many *et al.*, 2013). Given the discrepancies, there is not still a general consensus about the impact of the exercise program, in particular, long-term aerobic exercise on the serum levels of this inflammatory mediator. Thus, a general conclusion in this regard seems to be somewhat difficult. Hence, the present study aims at investigating the effect of a 10-week aerobic exercise program on the serum levels of this hormone in men with Type 2 diabetes.

MATERIALS AND METHODS

Study Population

This study was aimed to investigate the effect of 12 weeks aerobic exercise training on serum resistin in diabetic patients. Participants included twenty eight non-trained obese men (aged 40.4 ± 5.1 years, body weight 32.2 ± 1.9 kg, height 172.9 ± 3.63 cm) with type II diabetes that participated in study by accessible sampling and randomized into exercise or control group. An informed consent was obtained from all participants before the study were carried out.

Inclusion or Exclusion Criteria

A main inclusion criterion was a history of type 2 diabetes at least for 3 years. All subject were obese, non-trained and non-smokers. Participants were included if they had not been involved in regular physical activity in the previous 6 months. We also excluded people who had any self reported physician diagnosed chronic disease such as arthritis, stroke, hypertension, cancer, heart attack, chronic cough, or bronchitis.

Anthropometry

Pre and post-training of anthropometrical markers and body composition were measured of two groups. Weight and height were measured in the morning, in fasting condition, standing, wearing light clothing and no shoes. BMI was calculated as weight in kilograms divided by the square of height in meters (kg/m2). Percentage of body fat was estimated by bioelectrical impedance method (Omron Body Fat Analyzer, Finland).

Exercise Protocol and Biochemical Measurements

Subjects attended the hematology lab on one morning at 08.00 h after overnight for blood sampling.
Venous blood samples were collected in order to measuring serum resistin and glucose concentration. Then all patients of exercise group were completed a three weeks aerobic training involved 3 sessions per week. Each exercise session was supervised by an exercise physiologist or one of the study physicians. Exercise intensity was between 60 – 80(%) of maximal heart rate during intervention program. In each session, subjects completed a 5-10 min warm-up, followed by 60 min of aerobic exercise at 60-80%VO2max (with continuous heart rate monitoring) and a 5-min cool down. Target heart rate was monitored by polar telemetry. Aerobic exercises in each session included walking on a treadmill and stationary cycling. All anthropometrical and biochemical measurements were repeated at 48 h after lasted session.

Statistical Methods

Normal distribution of variables performed with a Kolmogorov–Smirnov test, and the parametric variables with skewed distribution were expressed as mean ± SD. After calculation of the mean and the standard deviation, the statistical analysis was conducted using unpaired T-test to compare all variables in exercise with the control group. Student's t-tests for paired samples were performed to determine significance of changes in variables by exercise intervention in studied subjects. A p-value < 0.05 was considered to be statistically significant.

RESULTS

In present study, we evaluate the effect of aerobic exercise program on serum resistin in males with type II diabetes. Table 1 presents the anthropometrical and the circulating fasting concentrations for serum resistin and glucose in pre and post-training of exercise group or control subjects. All variables are given

as mean and standard deviation. Anthropometrical markers such as weight, BMI, body fat (%) and abdominal circumference decreased significantly in exercise group by aerobic training program. Data by independent T test showed no significant difference in all variables between two groups at baseline ($p \geq 0.05$). Results indicated that serum resistin increased significantly by aerobic program in exercise group ($p=0.032$, Figure 1) but not in the control groups. We also observed that aerobic program result in significant decrease in fasting glucose in exercise groups ($p=0.000$, Figure 2). Fasting glucose and anthropometrical markers were not changed in control groups between pre and post program.

Table 1: Mean and standard deviation of anthropometrical and spirometric markers and VO2max before and after intervention in studied groups

Variables	Control diabetic		Exercise diabetic	
	Pretest	**Post-Test**	**Pretest**	**Post-Test**
Weight (kg)	96.1 ± 1.64	91.9 ± 1.53	97.2 ± 2.11	96.8 ± 1.36
Waist circumference (cm)	106 ± 2.15	103 ± 1.96	105 ± 1.32	105 ± 1.64
Hip circumference (cm)	105 ± 1.14	102 ± 1.13	106 ± 1.21	106 ± 1.56
Abdominal to hip ratio	1.02 ± 0.012	1.01 ± 0.011	0.99 ± 0.014	0.99 ± 0.011
BMI (kg/m2)	32.2 ± 0.52	30.8 ± 0.51	32.5 ± 0.62	32.4 ± 1.36
Body fat (%)	31.4 ± 0.53	28.2 ± 0.71	31.4 ± 0.41	31.8 ± 1.71
Resistin (ng/ml)	1.79 ± 0.32	3.74 ± 0.83	1.68 ± 0.65	1.76 ± 0.31
Glucose (mg/dl)	242 ± 20	206 ± 18	251 ± 19	246 ± 21

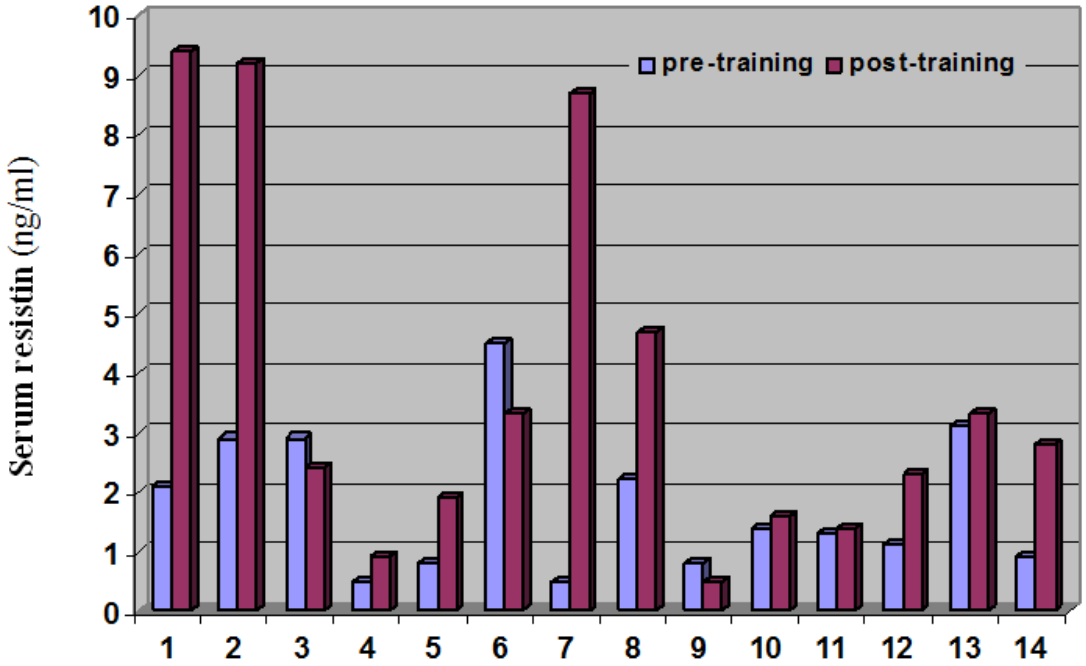

Figure 1: Pre and post training of serum resistin of exercise group. Exercise program result in significant increase in serum resistin

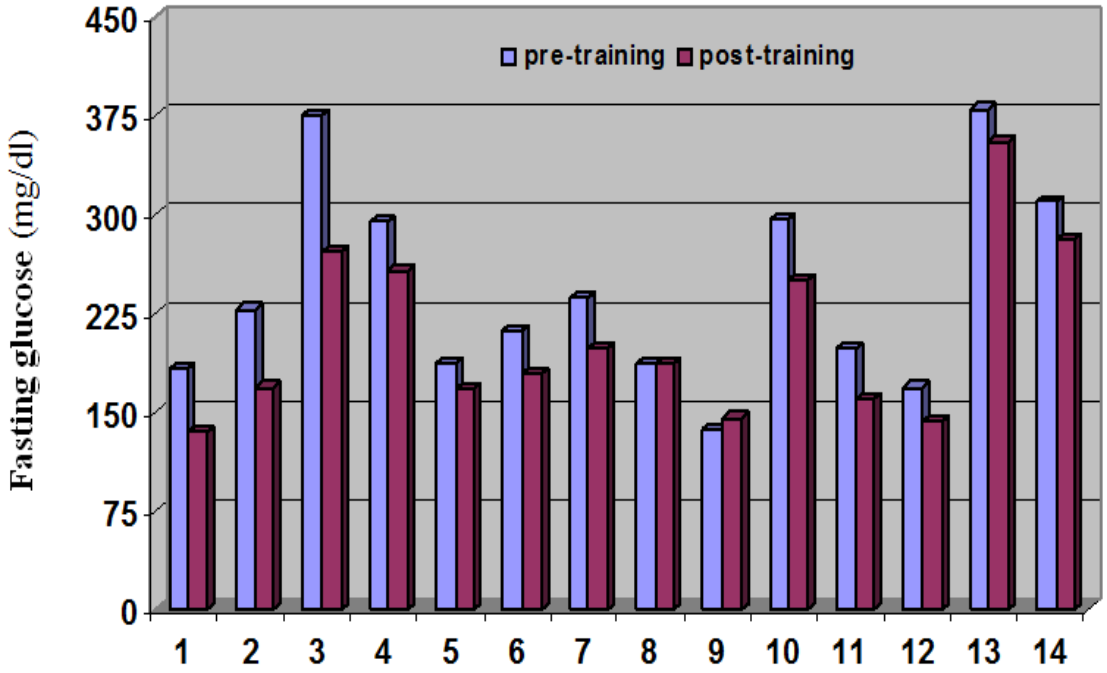

Figure 2: Pre and post training of fasting glucose of exercise group. Exercise program result in significant decrease in fasting glucose

DISCUSSION

So far, several studies have been conducted to determine the effect of short-or long-term exercise programs on serum levels of inflammatory and anti-inflammatory adipocytokines or cytokines in different populations. The findings of these studies were similar or conflicting depending on the population in terms of athletes or non-athletes and the type of illness. This contradiction is also dependent on the initial fitness level and baseline levels of cytokines (Weikert *et al.*, 2008; Ordonez *et al.*, 2013; Talebi-Garakani *et al.*, 2013). The findings of the present study showed that the aerobic exercise program not only led to reduced serum resistin levels as an inflammatory mediator, but increased it in diabetic patients. In other words, the 10-week aerobic exercise program with three sessions per week led to a significant increase in serum resistin levels in men with Type 2 diabetes. The increased resistin levels following the exercise program is somewhat controversial so that the interpretation of possible involved mechanisms seems to be difficult.

There is no general consensus on the impact of exercise programs on the levels of other cytokines. In this regard, the findings of a recent study showed that two weeks of intense interval workout did not lead to a change in serum levels of these variables and insulin sensitivity in obese female adults (Leggate *et al.*, 1985). Given the exercise period in these studies, it seems that short exercise period is the main reason for insignificant changes in inflammatory and anti-inflammatory cytokines. Hence, it seems that longer exercise program should be designed for this purpose. According to a recent study, 4 weeks of resistance exercise led to a significant reduction of inflammatory cytokines such as CRP and TNF-α in diabetic rats (Talebi-Garakani *et al.*, 2013). Nonetheless, 8 weeks of progressive aerobic exercise did not lead to a significant change in the levels of serum resistin and other adipocytokines such as adiponectin, leptin, IL-6, CRP and TNF-α in overweighed child (Kelly *et al.*, 2007).

According to some recent studies, a minimum of 5% weight loss is required to improve the anti-inflammatory cytokines, particularly in obese healthy individuals or patients (Sheu *et al.*, 2008). Nevertheless, the results of other studies indicate no change in the cytokine level following long-term exercise despite a significant reduction in weight and body fat in obese individuals. Several studies

attributed the contradicted findings to different types of exercise programs, type of population, measurement tools, time of blood sampling, the initial fitness level of the subjects and disease type (Bouassida *et al.*, 2010).

Despite a significant reduction in weight, body fat percentage and waist in the present study, the exercise program not lead to decreased the serum resistin as a inflammatory mediator in diabetics, but significantly increased serum resistin in diabetics. This result is somewhat controversial so that the interpretation of possible mechanisms of this response to the exercise program seems somewhat difficult. The increased serum resistin levels following exercise program may be attributed to gradual increase of workout intensity at final sessions. If this hypothesis is accepted, it can be argued that the final exercise sessions were associated with inflammatory properties instead of anti-inflammatory properties in diabetics. On the other hand, the increase in resistin level following exercise program can be attributed to the role of resistin in anti-oxidative defense of the body. According to previous studies, resistin acts as an antioxidant in response to inflammatory stimuli (Bo *et al.*, 2005).

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