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Research Article

INFLAMMATORY EFFECT OF SINGLE BOUT EXERCISE ON RESISTIN NON-TRAINED INDIVIDUALS WITH TYPE II DIABETES

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ABSTRACT
Resistin as inflammatory adipokine is associated with obesity, insulin resistance. In this study, acute response of serum resistin to one bout exercise test was investigated in type II diabetes patients. For this purpose, venous blood samples were collected of twelve adult males with type II diabetes. Serum resistin was also measured immediately after one moderate cycling test. Student's paired 't' test was applied to compare the pre and post exercise resistin. Data of statistical analysis showed significant increase in serum resistin by exercise test in studied subjects (from 1.63 ± 1.19 to 2.65 ± 1.32 ng/ml, p = 0.027). We conclude that one session exercise with short time and moderate intensity is associated increased serum resistin in non-trained males with diabetes.

Keywords: *Glucose, Acute Exercise, Adipokine, Body Weight*

INTRODUCTION
The prevalence of obesity which is directly associated with certain diseases such as hypertension and type II diabetes is growing rapidly in many countries including Iran (Kaplan, 2002), underlying much of the current research in terms of prevention and treatment.
Certain adipocytokines and peptide hormones are secreted from adipose tissue and gastrointestinal tract and some research resources pointed out frequently their role in prevalence of obesity, appetite control, energy balance, insulin resistance, and prevalence of some diseases such as type II diabetes (Eizadi *et al.*, 2014; Ursula *et al.*, 2004). Among adipocytokines secreted from adipose tissue and other tissues of the body, resistin is related to insulin resistance and glucose tolerance that are characteristic of type II diabetes (Steppan *et al.*, 2001). In rodents, resistin is mainly produced in adipose tissue and reduces insulin sensitivity in adipose tissue and skeletal muscle through reduction of glucose transport (Palanivel *et al.*, 2006). Resistin regulates levels of blood glucose during fasting by increasing the release of hepatic glucose (Banerjee *et al.*, 2004). Serum resistin levels are significantly higher in obese people than lean subjects (Azuma *et al.*, 2003). This 12.5 kDa peptide hormone is identified as an effective mediator relating obesity to type II diabetes (Kim *et al.*, 2001; Steppan *et al.*, 2001) and its injection into normal mice leads to insulin resistance (James *et al.*, 2003). In this context, the study of Silha (2003) and Rubin (2008) revealed a significant correlation between resistin levels and insulin resistance (Silha *et al.*, 2003; Rubin *et al.*, 2008). Increased resistin levels lead to insulin resistance and are associated with incidence of type II diabetes in obese people (Ursula *et al.*, 2004).
Manipulation of obesity-related peptide mediators secreted from adipose tissue or other tissues by factors such as control or change of diet, medication, short- or long-term physical activity, or other internal and external factors is somehow effective in incidence of obesity and related disorders such as type II diabetes. Meanwhile, the role of exercise and physical activity was frequently studied but the findings were more or less contradictory. For example, a 12-week weight loss program through diet and exercise by Zhang (Jung *et al.*, 2008) and another study showed that more than 5% weight loss is associated with a decrease in resistin and improvement of insulin resistance (Jung *et al.*, 2008; Valsamakis *et al.*, 2004). But the findings of D. Lewis (2007) showed that no change occurs in resistin levels in obese patients following 3 months weight loss (de Luis *et al.*, 2007). Also, Jamurtas (2006) showed that a single session aerobic exercise does not affect resistin and adiponectin levels in overweight men until 48 hours after test (Jamurtas *et al.*, 2006). Despite the inconsistency between serum resistin levels in response to long-term

training programs, studies on immediate or short-term effect of exercise on serum levels of this inflammatory mediator, particularly in patients with type II diabetes was not conducted. Hence, this study aimed to investigate immediate response of serum resistin to a single session biking in men with type II diabetes.

MATERIALS AND METHODS

Study Subjects and Recruitment

Twelve ages 44 (7.5), sex (men) and body mass index 30.58 (2.68) matched with type II diabetes were recruited for participate in present study by accessible sampling. Having history of at least 3 years diabetes was the main criterion for inclusion. All of subjects had not participated in regular exercise for the preceding 6 months, nor did all subjects have stable body weight. All subjects were non-smokers and non-trained. Subjects with any history of smoking, chronic cough, recurrent respiratory tract infection, history of chest or spinal deformity, personal history of asthma, chronic obstructive lung diseases were excluded from the study. Informed consent was obtained from all the patients prior to enrolment.

Anthropometry

Each subject's body weight and height were measured. Each of these measurements was conducted two times and the average was reported. All of these measurements were conducted by the same researcher. BMI was calculated as kilograms per square meter. The waist girth was measured at the level of the umbilicus horizontally without clothing after a normal expiration, while the hip girth was measured at the level of the greatest protrusion of the gluteal muscles with underwear. Waist-hip ratio (WHR) was calculated.

Blood Collection and Protocol

Blood samples were collected for measure insulin and glucose and serum resistin before exercise test. Resistin was also measured immediately after exercise. All participants asked to avoid doing any heavy physical activity for 48 hours before blood sampling. Exercise test involved 15 min on an electromagnetically braked cycle ergometer at 75(%) of maximal heart rate. Target heart rate was controlled by polar telemetry. Serum resistin and glucose was determined by ELISA method (Resistin, Biovendor-Laboratoria medicina a.s. Czech; Insulin, Demeditec, Germany).

Data Analysis

All analyses in the statistical evaluation were carried out with SPSS-15.0 software. Normality of distribution was assessed by Kolmogorov–Smirnov test. Student's paired 't' test was applied to compare the pre and post exercise values. All data are expressed as means ± S.D., and values of $P<0.05$ were considered statistically significant.

RESULTS

The effect of one single bout cycling on serum resistin in males with type II diabetes were investigated in present study. The anthropometrical and biomedical characteristics of the study participants are described in Table 1 and 2. All values are reported as mean and standard deviation. Serum resistin was not associated with glucose concentration in studied subjects. Exercise test resulted in significantly increase in serum resistin (from 1.63 ± 1.19 to 2.65 ± 1.32 ng/ml, $p = 0.027$, Fig 1). In the other hand, a single bout cycling for short time with moderate intensity was associated with increased in serum resistin in type II diabetes patients. But insulin resistance did not change by exercise test in studied patients (from 4.46 ± 1.16 to 4 ± 1.64, $p = 0.23$).

Table 1: Anthropometric characteristics of studied subjects (Mean *(SD)*)

Variable	Age *(years)*	Height *(cm)*	Weight *(kg)*	Body fat *(%)*	WC *(cm)*	HC *(cm)*	AHO	BMI *(kg/m2)*
	44(7.5)	**173**(5.59)	**92** (7.5)	**28.4** (4.25)	**102** (6.2)	**104** (2.8)	**0.98** (0.05)	**30.58** (2.68)

Abbreviations: BMI, body mass index; AC, Abdominal circumference; HC, Hip circumference

Table 2: The descriptive biochemical features of the study subjects (Mean *(SD)*)

Variable	Resistin *(ng/ml)*	Glucose *(mg/dl)*	Insulin resistance *(HOMA-IR)*	Insulin *(*µIU/ml*)*
	1.63 (1.19)	**218** (54)	**4.46** (1.16)	**8.38** (1.82)

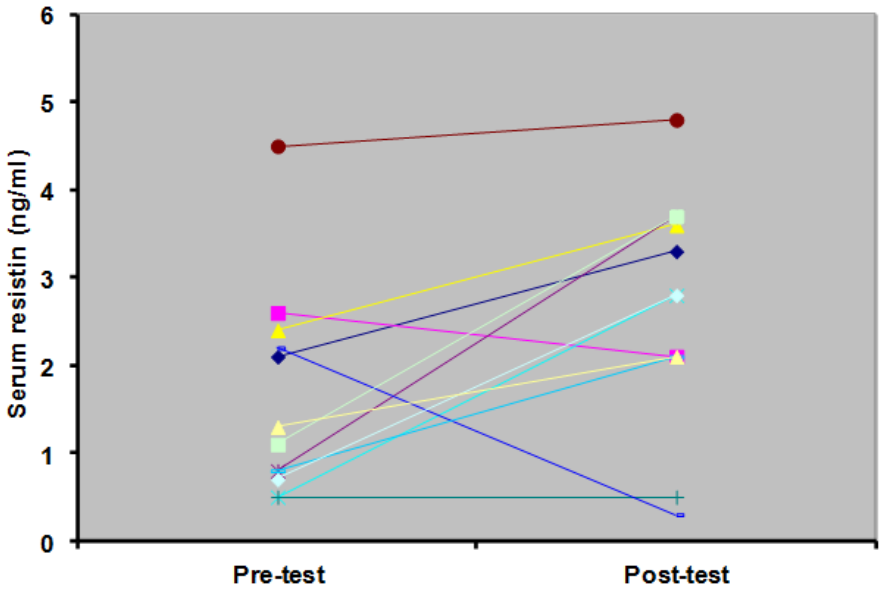

Figure 1: Serum resistin in pre and post test. This fig is showed that serum resistin increased significantly by exercise test in diabetic patients

DISCUSSION

Based on what was mentioned, the impact of a single-session short-term biking with a relatively modest intensity on serum resistin was assessed in this study. Regarding immediate response of inflammatory or anti-inflammatory cytokines to short-term exercise, although some studies has been carried out on other adipocytokines such as adiponectin, leptin, and CRP, the number of studies performed so far with the methodology and objectives of the present study, especially the response of serum resistin in type II diabetics is low. However, the findings of other studies are more or less counter and contradictory. In the present study, a single-session short-term biking led to a significant increase in serum resistin levels in adult men with type II diabetes, referring to the inflammatory feature of the desired activity in sedentary diabetics.

Given the inflammatory characteristics of resistin and the role of lipid levels in plasma or serum concentrations of resistin, it seems that the response of this peptide mediator to single-session or short-term exercises is completely independent of long-term training programs. For example, in a recent study, three months of endurance exercise led to a decrease in serum resistin levels in type II diabetes (Wenning *et al.*, 2013). In another study, 8 weeks of aerobic exercise led to a significant reduction in serum resistin in obese people and changes in resistin levels were associated with changes in BMI (Bai *et al.*, 2013). But based on what was mentioned earlier, although the findings on immediate response of resistin to single-session exercise is less seen, changes in the levels of other inflammatory or anti-inflammatory cytokines following single-session exercise has been reported previously by some studies. For example, in one study, a session of brisk walking for 45 minutes with an intensity of 60%-80% of maximum heart rate did not lead to a change in plasma leptin concentrations in obese women, although insulin resistance decreased (Sari *et al.*, 2007). In another study, 45 minutes of aerobic exercise with relatively moderate intensity did not result in changes in adiponectin concentrations in obese men immediately and 2 h after the test, although insulin sensitivity increased (Jamurtas *et al.*, 2006).

In this context, researchers have noted that those exercises that take less than 60 minutes or do not lead to negative energy balance are not associated with a change in systemic levels of inflammatory or anti-inflammatory cytokines (Kraemer *et al.,* 2002; Bouassida *et al.,* 2006). These researchers pointed out that at least 60 minutes of exercise or at least 800 kcal consumption of energy through a single-session exercise is required for improvement of the inflammatory profile (Bouassida *et al.,* 2006). For example, a session of long-term endurance training with more than 1400 kcal of energy expenditure was associated with a significant reduction in serum leptin levels in a study (Olive *et al.,* 2001). Based on these findings, it seems that two causes of changes in weight and body fat levels due to long-term training programs, as well as a significant change in energy balance through a session of exercise are the most important factors that influence other cytokines levels in healthy or sick obese populations. However, in another study, 20 minutes of intense running of middle-aged men and women led to a significant reduction in serum leptin (Legakis *et al.,* 2004).

Unlike most previous studies, our findings show that a short-term biking with relatively moderate intensity significantly increased serum resistin levels in men with type II diabetes which is somewhat controversial. This means that a session of exercise, even with a relatively modest intensity and duration, leads to an increase in serum resistin levels in inactive diabetic men. On the other hand, increased resistin in response to exercise may be attributed to the role of this hormone in defending the body against oxidation, because it has been previously hypothesized that resistin acts as an antioxidant in response to inflammatory stimuli (Bo *et al.,* 2005). Also, it is likely that the increase in levels of resistin or other cytokines after one session exercise occurs due to changes in plasma volume. For example, in one study, researchers have pointed out that 30 minutes of continuous heavy running did not affect serum adiponectin concentration and the exercise-induced increase in adiponectin levels was attributed to changes in plasma volume.

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