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# Acute and recovery responses of serum IL-6 to one bout moderate exercise test in obese men

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**Abstract**

Interleukin 6 (IL-6) as a pro-inflammatory cytokines produced by human adipose tissue is known to be associated with obesity and related diseases. The aim of this study was to evaluate the effects of one exercise session on serum IL-6 levels in adult inactive men. For this purpose, fifteen inactive healthy men aged 39.4 ± 1.9 years and body mass index (BMI) 31.3 ± 1.4 kg/m2 were selected to participate in this study by accidentally. Anthropometrical markers were measured. All participants underwent an exercise test involved 40 min running with no slope. Venous blood samples (5ml) were collected from all individuals at pre, 0 and 60 min after exercise test. Blood samples were analyzed for IL-6 after serum separate. Comparisons of data between 3 blood samples were analyzed by the repeated measures ANOVA model. Significance was accepted at $P < 0.05$. No significant change was found in acute ($p = 0.37$) of recovery ($p = 0.89$) response of serum IL-6 to exercise test when compared with pre-test. Based on these data, we concluded that one moderate exercise does not inflammatory property in inactive adult obese men.

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## Introduction

In addition to its role in fuel storage, adipose tissue secret some biologically active and diverse cytokines, termed adipokines (Pajvani *et al.*, 2003; Aldhahi *et al.*, 2003). Increased visceral fat can affect insulin resistance and energy homeostasis by secreting adipokines into the circulation which then bind with their cognate receptors in various tissues and alter glucose and lipid metabolism (Vivian *et al.*, 2007). Nevertheless, the role of adipose tissue derived cytokine proteins, such as leptin and adiponectin and interleukins, are implicated in numerous biological functions. Inflammatory cytokines may cause vascular dysfunction through progression of atherosclerosis, oxidative stress, vasoconstriction, endothelial cell apoptosis and adverse vascular remodeling (Anker *et al.*, 2004). A first, relationship between obesity and a pro-inflammatory cytokine came from a study by Hotamisligil *et al*, who established the concept of a role for TNFa/inflammation in obesity (Hotamisligil *et al.*, 1993).

Among inflammatory cytokines, the pathogenic role of IL-6 in metabolic syndrome prevalence has been reported, in part because the presence of a chronic low-level increase of plasma IL-6 (usually <10 pg/ml) is associated with obesity, low physical activity, insulin-resistance, type 2 diabetes, cardiovascular disease and may serve as a predictor of mortality (Bruun *et al.*, 2003; Bruunsgaard, 2002; Fisman *et al.*, 2006; Panagiotakos *et al.*, 2005). Accumulating evidence indicates that obesity and overweight are associated with increased IL-6 and weight loss results in decreased IL-6 serum levels (Fontana *et al.*, 2007; Kopp *et al.*, 2003). Accumulating evidence indicates that this pro-inflammatory cytokines such and tumour necrosis factor-a (TNFa) are produced by human adipose tissue dependent on the degree of obesity (Moschen *et al.*, 2010).

The role of physical activity or exercise training on adipocytokine and other peptide mediators has been previous reported. In this area, some previous studies showed that those exercise training program resulted a significant decrease in body weight of adipose tissue can be changed inflammatory cytokines in obese or related diseases (Abd El-Kader *et al.*, 2013; Beavers *et al.*, 2013). However, some other studies demonstrated that the change in inflammatory profile id independent of weight loss (Bouchonville *et al.*, 2013; Wenning *et al.*, 2013; Riesco *et al.*, 2013). Nevertheless, there are limited studies about acute or recovery of these mediators such as IL-6 to short-time or one bout exercise in obese or related disorder.

## Method and Subjects

Fifteen apparently healthy obese men were recruited for this study through local advertising. Participants were 39.4 ± 2 years old with a body mass index (BMI) of 31.3 ± 1.4 kg/m2. The objective of this study was to determine acute and recovery responses of serum IL-6 to a moderate running test in mentioned subjects. The study was approved by the University Research Ethics Board of Islamic Azad University, Shahr-e-Qods Branch, Iran. All study participants completed the consent process and provided written informed consent prior to randomization.

A detailed history and physical examination of each subject was carried out. Participants were non-athletes, non-smokers and non-alcoholics. Participants were included if they had not been involved in regular physical activity/diet in the previous 6 months. Subjects with a history or clinical evidence of impaired fasting glucose or diabetes, orthopedic abnormalities, liver or kidney disease or who were on medications known to alter fat-carbohydrate metabolism were excluded.

*Anthropometric measurements*

Anthropometric measurements were made by the same trained general physician. The weight and height of the participants were measured in the morning, in fasting condition, standing when the participant had thin clothes on and was wearing no shoes. Abdominal circumference and hip circumference were measured in the most condensed part using a non-elastic cloth meter. Hip circumference was measured at the level of the

greater trochanter. Body mass index (kg/m²) was calculated as weight (kg) divided by squared height (m²). Visceral fat and body fat percentage was determined using body composition monitor (OMRON, Finland).

*Blood Collection and exercise*

Venous blood sample was collected from all the subjects before, 0 (acute response) and 60 min (recovery response) after exercise test. The subjects did not perform any serious physical activity for 48 hours before the blood collection. All blood samples were separated serum for calculation serum IL-6. Exercise test lasted 40 min with 65 (%) of maximal heart rate involved running on flat surface with no slope. Target heart rate was controlled with polar telemetry. ELISA method (Enzyme-linked Immunosorbent Assay for quantitative detection of human IL-6, Biovendor- Laboratorial kit made by Biovendor Company, Czech) used for determine Serum IL-6. Intra and inter-assay coefficients of variation were 3.4 and 5.2%, respectively.

*Statistical analysis*

Statistical analysis was performed with the SPSS software version 15.0. The Kolmogorov-Smirnov test was applied to determine the variables with normal distribution. Comparisons of data between 3 blood samples were analyzed by the repeated measures ANOVA model. All statistical tests were performed and considered significant at a $P \leq 0.05$.

**Results**

As above mentioned, in this study, acute and 60 min recovery response of serum IL-6 to 40 min running test on Smooth surface with no slope with moderate intensity were investigated. Table 1 shows the anthropometrical characteristics of the 15 subjects that participated in the study.

**Table 1.** The anthropometrical characteristics of studied subjects.

| | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|
| Age (Year) | 35 | 42 | 39.40 | 1.993 |
| Height (cm) | 165 | 178 | 173.80 | 3.783 |
| Weight (kg) | 82 | 104 | 94.60 | 6.631 |
| Abdominal (cm) | 97 | 110 | 104.53 | 4.324 |
| Hip (cm) | 96 | 113 | 104.33 | 4.909 |
| WHO | 97 | 1.03 | 1.0023 | .01684 |
| BMI (kg/m2) | 29 | 34 | 31.29 | 1.386 |
| Body fat (%) | 30 | 34 | 31.70 | 1.051 |
| Visceral Fat | 11 | 17 | 13.40 | 1.682 |

Table 2 show the mean and standard error of serum IL-6 in 3 separate stages of blood samples. Data of repeated measure analysis showed no significant change in serum IL-6 between pre-test and acute response to exercise teat ($p = 0.34$, Fig 1). In fact, exercise test did not resulted in significant change in this cytokine when compared with baseline values. No significant differences were also found in serum IL-6 in 60 min recovery running exercise with compared to baseline ($p = 0.89$, Fig 1). In addition, we did not change between acute and recovery response in serum IL-6 with each other ($p = 0.35$, Fig 1).

**Table 1.** Serum IL-6 at 3 stages of blood samples in studied subject.

| | Mean | Std. Deviation | N |
|---|---|---|---|
| IL-6 (pre-test) | 2.633 | .7208 | 15 |
| IL-6( Acute response) | 3.053 | 1.4496 | 15 |
| IL-6 (60 min recovery response) | 2.595 | 1.2885 | 15 |

**Discussion**

Accumulating experimental and epidemiologic data Obesity is associated with a chronic inflammatory in response to abnormal cytokine production and activation of inflammatory signaling pathways. Adipose tissue secretes a variety of bioactive mediators including adipocytokines such as adiponectin, leptin, resistin and classical cytokines such as the pro-inflammatory mediators tumour necrosis factor a (TNFa) and interleukin 6 (Hotamisligil, 2006; Tilg *et al.*, 2006). Epidemiological evidence is accumulating that expression of IL-6 as a pro-inflammatory cytokines, is markedly regulated at the transcriptional level and increased in human fat cells from obese subjects and patients with insulin resistance (Rotter *et al.*, 2003). Although, IL-6 is secreted by several sources such as fat tissue or microphages, contracting muscles are main secretor of that into the circulation in response to exercise.

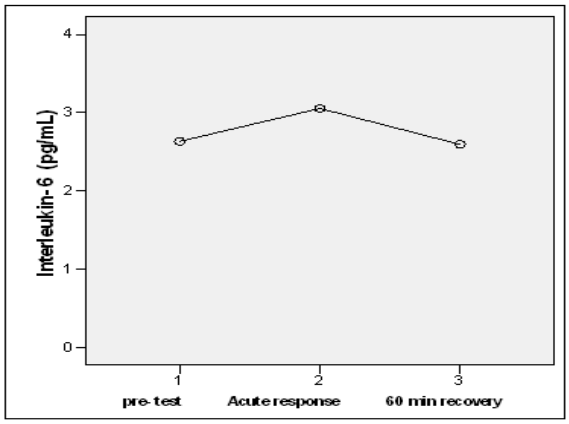


**Fig. 1.** The pattern change of serum IL-6 of acute and recovery response to exercise test in studied subject. No significant changes were observed by exercise teat..

Despite conflicting findings about the role of training programs on inflammatory cytokines in obese or non-obese, trained or non-trained and disease or healthy population, Our study showed no significant change in serum IL-6 to exercise test in studied subjects. On the other hand, exercise test included 40 min running with no slope with moderate intensity is not associated with acute or recovery response in adult obese men. It is noted that our study subject was inactive. It seems that the role of long-term exercise program is different with acute or recovery response of them to one session exercise test. In this area, some previous studies have demonstrated that the plasma concentration of IL-6 increases more dramatically than other cytokines after exercise (Ostrowski *et al.*, 1999; Pedersen *et al.*, 2000).

IL-6 response to exercise is dependent on intensity and especially duration of the exercise, while the mode of exercise has little effect (Fischer *et al.*, 2006). However, prolonged exercise involving a significant muscle mass in the contractile activity is necessary in order to produce a marked systemic IL-6 response, it was reported that a decreased plasma IL-6 concentration at rest as well as in response to exercise appears to characterize normal training adaptation (Fischer, 2006).

IL-6 has been shown to may increase up to 100 fold Following exercise, but less dramatic increases are more frequent. It has also been speculated that, the 8000-fold increase of plasma IL-6 following a 246 km "Spartathlon" race (Margeli *et al.*, 2005) suggesting an atypical and extreme response. It is also important to note that the exercise-induced increase of plasma IL-6 is not linear over time; repeated measurements during exercise show an accelerating increase of the IL-6 in plasma in an almost exponential manner (Fischer *et al.*, 2004; Ostrowski *et al.*, 1998; Steensberg *et al.*, 2000). On the other hand, the peak IL-6 level is reached at the end of the exercise or shortly thereafter (Fischer *et al.*, 2004; Ostrowski *et al.*, 1998), followed by a rapid decrease towards pre-exercise levels.

Overall, base on our study data; we conclude that one session exercise for 40 min and moderate intensity can not affect serum IL-6 immediately and 60 min recovery. In this area, although there are limited studies about IL-6, but some previous studies about leptin as another adipocytokine stated that decreases of leptin values may be registered after prolonged physical exercise, over 60 minutes duration, which determines the stimulation of free fatty acids release or after exercise that generates an energy

expenditure higher than 800 kcal (Højbjerre *et al.*, 2007; Athyros *et al.*, 2010).

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