



RESEARCH PAPER

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Single bout exercise increases interleukine-6 in cigarette smokers

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Abstract

Epidemiologic studies clearly show strong relationship between inflammatory markers and metabolic disturbances. In this study, we evaluated the effect of one session exercise on serum IL-6 in smoker men. For this purpose, serum IL-6 was measured before and immediately after a relatively long time running test in fifteen smoker men aged 40-48 year year. All smokers were non-trained. Student's paired 't' test was applied to compare the pre and post training values. Significance was accepted at $P < 0.05$. Data showed that exercise test resulted in significant increase in serum IL-6 in smoker subjects ($p = 0.028$). Based on this data, increased IL-6 has been attributed to the anti-inflammatory effects of exercise on these subjects, although further studies are needed to clarify possible mechanisms by which exercise affect inflammatory profile in smokers or other population..

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Introduction

Modern studies show that smoking is increasing not only in developed countries but also in developing countries. So it has attracted the attention of many researchers in health sciences. Many studies have often reported that smoking not only brings about mental trauma and frustration but it also contributes to incidence of chronic diseases or their aggravation in people suffering from such diseases by disrupting some hormones and peptide mediators (Patrícia, 2011).

Interleukin-6 is an inflammatory cytokine and its increased concentration in the bloodstream leads to a decrease in muscle mass and decreased mobility (Ferrucciet *al.*, 1999; Ferrucciet *al.*, 2002; Visseret *al.*, 2002). Literature suggests that higher levels of this inflammatory cytokine are considered a predictor indicator of mortality in elderly individuals (Reuben *et al.*, 2002). Certain scientific resources have noted a direct link between increased IL-6 and increased catabolism of skeletal muscles (Charles *et al.*, 2008).

Despite the disruption or changes of IL-6 levels due to obesity or chronic inflammatory disease, systemic levels of this inflammatory cytokine are also affected by smoking in both healthy subjects and smoker patients. Direct correlation between their higher levels and the number of white blood cells, with smoking rate and their increased levels has also been reported in other studies (Frohlichet *al.*, 2003; Bermudez *et al.*, 2002; Woodward *et al.*, 1999; Helmerssonet *al.*, 2005). Studies on older smokers have shown that serum levels of IL-6 are much higher in these people than in their smoker counterparts (Helmerssonet *al.*, 2005). In a recent study, levels of IL-6 were reported 47% higher in smokers than non-smokers (Woodward *et al.*, 1999).

The question is whether the side effects of smoking, such as impaired inflammatory cytokines, can be moderated or reduced to normal levels by some non-pharmacological interventions. Some sources have pointed out in this connection that there are several sources of secretion of IL-6, however, skeletal

muscles have the most important role in the production and secretion of IL-6 into the bloodstream in response to exercise (Fischer, 2006). The researchers also state that the amount of IL-6 ensuing from exercise is dependent on the intensity and especially the duration of exercise while the type and manner of performing the exercise have a limited effect (Fischer, 2006). Of course there are few studies on the response of IL-6 to a single session of exercise on smokers. Hence, this study aims to determine the response of IL-6 to a single session of exercise with relatively long duration and moderate-intensity in smokers.

Method and subjects

Subjects

Participants were fifteen sedentary no trained smoker men that selected for study by accessible sampling. This study aimed to evaluate effects of one session exercise test on serum IL-6 in smoker men. The study was conducted with the approval of the Ethics Committee of Islamic Azad University, Iran. All subjects gave their informed consent to participate in the study.

Anthropometrical measurements

All anthropometric measurements were made by the same trained general physician and under the supervision of the same pediatrician following standard protocols. Body weight and height were measured with the subject wearing light clothes. Height and body mass were measured using a wall-mounted stadiometer and a digital scale, respectively. BMI was calculated as weight (in kilograms) divided by the square of height (in meters).

Inclusion and exclusion criteria

All of subjects had not participated in regular exercise for the preceding 6 months. Inclusion criteria to study for smoker group were smoking history of At least 10cigarettesa day for 5 years. The exclusion criteria were hepatic disorders, use of alcohol, having history of known coronary artery disease, diabetes, and using medicine or hormone preparations that affect the carbohydrate and lipid metabolism.

Blood samples and exercise test

Pre and post exercise blood samples were taken in order to measuring serum IL-6 in all subjects. Exercise test lasted 35 min running on a flat surface with no slope at 70 % HRmax. In each subject, target heart rate controlled and monitored by polar telemetry. Participants were also told that avoid using the medicine or hormone preparations that affect the carbohydrate and lipid metabolism. Subjects were asked to avoid doing any heavy physical activity for 48 hours before blood sampling. Blood samples were collected in vacuum tubes containing either EDTA or lithium heparin. Blood samples were centrifuged for 10 minutes by 3000 rpm speed for serum separation. Serum IL-6 was determined by ELISA method ((Enzyme-linked Immunosorbent Assay for quantitative detection of human IL-6)), using a Biovendor- Laboratorial kit made by Biovendor Company, Czech. The sensitivity of the IL-6 assay was 0.92 Pg/mL. Intra and inter-assay coefficients of variation were 3.4 and 5.2%, respectively.

Statistical analyses

Data were analyzed by computer using SPSS software version 15.0. Data were expressed as individual values or the mean \pm SD. The Kolmogorov-Smirnov test was applied to determine the variables with normal distribution. Student's paired 't' test was applied to compare the pre and post training values. An alpha-error below 5% was considered as statistically significant.

Results

Table 1 shows the characteristics of the 24 536 healthy persons aged 25–55 years by sex in the cross sectional study. Descriptive characteristics of anthropometrical markers are presented in Table 1. Normally distributed data were presented as means \pm standard deviation of mean (SD).

Table 1. The descriptive anthropometric and biochemical features of smoker subjects.

Variable	Mean	Standard deviation	Range
Age (years)	45.93	1.62	43 – 49
Weight (kg)	90.7	8.54	77 – 104
Height (cm)	177.1	2.56	173 – 182
Body mass index (kg/m ²)	28.92	2.73	25 – 34
Abdominal obesity (cm)	97.2	5.31	89 – 108
Hip circumference (cm)	96.5	4.79	86 – 105
AHO ratio	1.01	0.019	0.98 – 1.05

Exercise test resulted significant increase in serum IL-6 in smoker subjects (from 4.20 ± 2.41 in pre versus 5.56 ± 1.55 in post, $p = 0.028$, Fig 1).

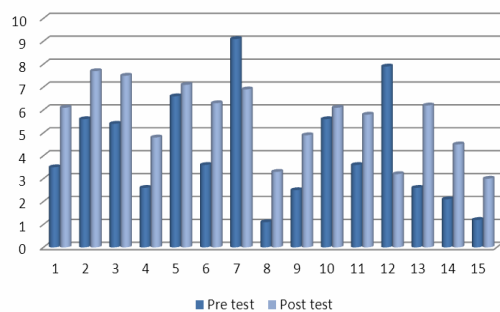


Fig. 1. Interleukin-6 in response to single bout running test in smokers. This figure shows that exercise test resulted significant increase in this cytokine in smokers.

Discussion

The findings of this study showed that a relatively long-term running exercise with moderate intensity led to a significant increase in serum IL-6 in male smokers. Although these findings appear refers to the inflammatory effects of exercise with emphasis on IL-6 it probably somehow signifies the importance of exercise in reducing systemic inflammation by increasing IL-6. However, the decreased serum levels of IL-6 following exercise in other healthy populations and non-smoker patients have been reported by some other studies (Gielen *et al.*, 2003; Brown *et al.*, 2000).

The study on male smokers, however, indicates the increase of this inflammatory cytokine in response to a moderate intensity exercise session.

In this context, when contracted the skeletal muscles are known to be able to synthesize and release IL-6 into the intercellular space and into the systemic circulation in response to a single exercise session (Fischer, 2006). Also IL-6 is known to regulate metabolic and immunological responses to exercise through its effects on the liver, adipose tissue and leukocytes. It seems that the contracted skeletal muscles are the main source of IL-6 in circulation in response to exercise as the simultaneous measurement of arterial-venous IL-6 shows that a large amount of IL-6 is released into the bloodstream during exercise by the active leg muscle contraction (Steensberget *et al.*, 2000).

Primary IL-6 is known to be the cytokine the levels of which in the blood flow change during exercise and varies in response to exercise considerably faster than any other cytokine (Petersen *et al.*, 2006). Scientific sources have also noted that the level of IL-6 significantly increase following exercise in the absence of muscle damage (Pedersen *et al.*, 2003; Febbraio *et al.*, 2002; Pedersen *et al.*, 2001; Pedersen *et al.*, 2000). It is also known that at first exercise rapidly increases levels of IL-6 and the consequent is increased IL-10 in the systemic circulation which is somehow indicative of the anti-inflammatory effect of increasing IL-6 in response to exercise (Steensberget *et al.*, 2003).

It is also known that increased IL-6 in response to exercise is associated with an inhibitory effect on the secretion of TNF- α (Steensberget *et al.*, 2000). Some studies also suggest that exercise has anti-inflammatory effects in skeletal muscle; not at blood circulation levels (Gielen *et al.*, 2003). These researchers found that aerobic exercise would reduce expression of IL-6 and other inflammatory cytokines in skeletal muscles but not their systemic levels (Gielen *et al.*, 2003). Scientific studies suggest that a program combining exercise and calorie intake

reduction causing weight loss decreases mRNA IL-6 in skeletal muscles, though these studies do not clarify whether IL-6 decreased expression has been a result of exercise or diet (Brown *et al.*, 2000).

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