



RESEARCH PAPER

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Acute response of C - reactive protein to moderate exercise test in smoker men

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Abstract

Accumulating evidence indicates that cigarette smoking is associated with systemic inflammation and is a risk factor for cardiovascular disease. In this study, we sought to evaluate the consequences of an acute bout of exercise on serum C reactive protein (CRP) in smoker men. Subjects were aged 33–38 years, sedentary that participated in this study by accessible sampling. Venous blood samples were collected from all smokers before and immediately after a single bout exercise (Running, 35-minute) with in order to measuring serum CRP. Data were analyzed by Student's paired T test. No significant differences were found in serum CRP by running exercise with compared to baseline. Based on these data, we conclude that one session exercise test with moderate intensity can not change serum CRP in smoker men.

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Introduction

Much evidence suggests that cardiovascular disease contains a component of inflammation and has even been referred to as an inflammatory disease (Libby *et al.*, 2009; Ross, 1999). It was reported that Tobacco continues to be the second major cause of death in the world. By 2030, if current trends continue, smoking will kill >9 million people annually. On the other hand, review of research evidence shows that Smoking play important role on numerous organs of the body and the list of diseases where smoking has been recognized as a contributory factor is extensive (Tonstad *et al.*, 2009).

It has been previously reported that cigarette smoking is a classical and major risk factor in the development of cardiovascular disease and atherosclerosis (Ockene *et al.*, 1997; Smith *et al.*, 2004). Although some changes caused by smoking are reversible after quitting, some inflammatory mediators like CRP are still significantly raised in ex-smokers up to 10 to 20 years after quitting, suggesting ongoing low-grade inflammatory response persisting in former smokers (Dilyara *et al.*, 2007). According to the population studies, it has been indicated that CRP might be not only a biomarker of different cardiovascular diseases but may have direct effects on the pathogenesis of atherosclerosis and endothelial dysfunction (Szmitko *et al.*, 2003).

It is generally accepted that High-sensitivity C-reactive protein (hs-CRP) is a sensitive marker for inflammation, infection and tissue damage, and also contributes to the host defense against infection by activating the complement pathway (Sahoo *et al.*, 2009). Numerous studies have reported that increased CRP is correlated with current asthma, respiratory impairment and bronchial hyper-reactivity (Kony *et al.*, 2004; Jousilahti *et al.*, 2002). It is also important to note that cigarette smoking is associated with elevated levels of C-reactive protein (CRP), fibrinogen, and interleukin-6, as well as increased counts of WBC have been reported (Dilyara *et al.*, 2007).

Recent epidemiological studies and clinical interventions have reported contradictory findings related to exercise interventions and the resulting alterations in cytokines such as CRP. So some previous studies have been supported the benefic effects of various exercise training (de Salles *et al.*, 2010) and other studies reported no significant effect of exercise training on serum levels of this inflammatory cytokine (Collins *et al.*, 2006; Czarkowska-Paczek *et al.*, 2005). In addition, increased serum CRP immediately after cycling exercise test was reported by another researcher (Eizadi *et al.*, 2011). On the other hand, there is limited information about acute response of CRP to exercise test on smokers. Therefore, in this study, we investigated the effect of a single bout running exercise on serum CRP in adult smoker men.

Material and methods

Subjects were sixteen sedentary, non-trained smoker men aged 33–38 years (BMI 27–32 kg/m²) that participated in this study by accessible sampling. The objective of this study was to determine acute response of serum CRP to a one session running test for 35 min in smoker men. The study was conducted with the approval of the Ethics Committee of the Islamic Azad University. Inclusion criteria for participate in study was smoking 10 cigarettes a day for at least 5 years. Participants were non-athletes and non-alcoholics. Participants were included if they had not been involved in regular physical activity or diet in the previous 6 months. Exclusion criteria for the study group were: diagnosed type 2 diabetes, coronary artery disease, cerebrovascular disease, and peripheral artery disease, using medicine or hormone preparations that affect the carbohydrate and lipid metabolism.

After introduction and awareness of the subjects of the objectives of the study and once they had completed consent forms, the process of test implementation began. All anthropometric measurements were made by the same trained general physician and under the supervision of the same pediatrician following standard protocols.

Measurements of height (m) and weight (kg) were performed by means of an anthropometric scale. Height was measured without shoes on standing while the shoulders were tangent with the wall. Body weight was measured in duplicate in the morning following a 12-h fast. Body Mass index (BMI) was calculated using the formula body weight/height in terms of kg/m². Percentage body fat was measured using body composition monitor (OMRON, Finland). After anthropometrical measurements, venous blood samples were collected of subjects. Venous blood samples were collected from all smokers before and immediately after a single bout exercise (Running, 35-minute) with in order to measuring serum CRP. Exercise test was single bout modified tests consist of 35 min running at an intensity of 75(%) maximal heart rate. Subjects were asked to avoid doing any

heavy physical activity for 48 hours before blood sampling. Blood samples were dispensed into EDTA-coated tubes and centrifuged for 10 minutes in order to separate serum. Serum CRP was determined by ELISA method (Diagnostics Biochem Canada Inc. High sensitivity C - reactive protein (Hs-CRP)).

Statistical analysis

All values are given as mean and standard deviation. Statistic analysis was done with SPSS 15.0 for Windows. Normal distribution of data was analyzed by the Kolmogorov-Smirnov normality test. Student's t-tests for paired samples used to determine whether there were significant changes in serum CRP in response to exercise test. A p-value of less than 0.05 was considered to be statistically significant.

Table 1. Anthropometric and physiological characteristics of subjects (n = 16).

Variable	Age (years)	Height (cm)	Weight (kg)	Body fat (%)	BMI (kg/m ²)
Mean	34	175	93	29.8	30.37
SD	4.3	5.3	6.8	4.1	3.2

Abbreviations: BMI, body mass index; SD, standard deviation.

Results

In present study, we investigated the effect of single bout exercise test consisted of 35 minutes of running on serum CRP in smoker adult men. Anthropometric characteristics of the study participants are shown in Table 1. Data were expressed as individual values or the mean \pm SD. There were no significant intra-group differences in age, anthropometrical indexes and serum CRP of smokers at baseline.

No significant differences were found in serum CRP by running exercise with compared to baseline (from 2112 ± 243 to 2321 ± 323 ng/ml, $p > 0.05$). On the other hand, exercise test was accompanied with no acute response of CRP in smoker men (Fig 1).

Discussion

The major finding of this investigation was no significant response of serum CRP to exercise in

studied smokers. We also observed that one session running test didn't significant change in LDL lipoprotein, although serum HDL increased significantly. The specific mechanisms responsible for these observations are not obvious.

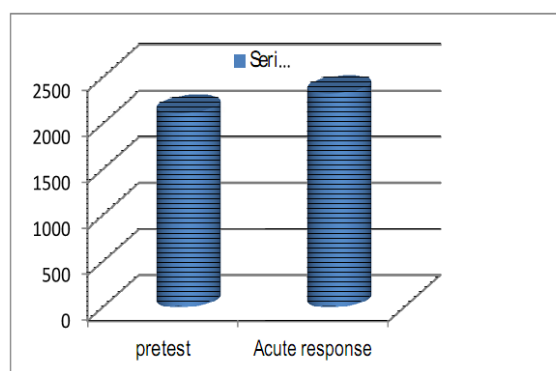


Fig.1. The changes pattern of serum CRP in pretest and acute response to exercise test. The results showed that serum CRP did not change in response to exercise test in smoker men.

The factors which cause inflammatory cytokines' contradictory responses to different types of exercise in healthy or diseased populations are not completely identified. Over the past two decades, there has been a large volume of studies, some of which are conflicting, in which serum CRP concentrations have been measured in parallel to smoking status because of the possible link between smoking and the induction of inflammatory pathways (Yanbaeva *et al.*, 2007). It has been previously reported that increased IL-1 β and IL-6 in response to lung inflammation and are implicated in the induction of CRP gene expression, may mediate the stimulation of bone marrow cells (Van Eeden *et al.*, 2005). It is now clearly established that Adipose tissue secretes a variety of bioactive mediators including adipocytokines such as adiponectin, leptin, resistin or classical cytokines such as the pro-inflammatory mediators TNF- α and interleukin 6 (IL-6) (Hotamisligil, 2006; Tilg *et al.*, 2006). High sensitivity C-reactive protein (hs-CRP) is an inflammatory mediator known to be related to inflammation, and cardiovascular diseases (Eizadi *et al.*, 2011).

CRP is mainly secreted by hepatocytes, but can also be expressed by adipocytes (Ouchi *et al.*, 2003) and cultured coronary artery smooth muscle cells (Calabro *et al.*, 2005), suggesting that localised inflammation can induce CRP expression. IL-6 and TNF- α are two primary regulators of CRP and the acute phase proteins, which are secreted by neutrophil granulocytes and macrophages at sites of injury (Tonstad *et al.*, 2009). Most of the previous studies have reported that cigarette smoking increases serum CRP. It was reported that passive smokers who are exposed regularly to environmental tobacco smoke have significantly higher CRP levels in plasma (Panagiotakos *et al.*, 2004; Das, 1985; Danesh *et al.*, 2000) indicating an ongoing inflammatory process.

Although many studies reported increased CRP among smokers compared to non-smokers, but some studies showed insignificant difference in this

cytokine between smoker and non-smokers (Merghani *et al.*, 2012).

It is also likely that the serum levels of this inflammatory cytokine are lack significant change in response to exercise test is related to its baseline levels. In fact, the lack of non-smoker group is one of the limitations of the present study. Because it is possible that there is no significant difference in CRP baseline levels between the studied smokers and non-smokers and it is probably that studied smokers have normal CRP levels. In this event, CRP's not changing significantly may be attributed to its normal baseline levels. In this regard, some previous researches have also reported insignificant difference in serum CRP between smokers and non-smokers.

Consistent with these findings, in a recent study, although smoking status did correlate with a significant elevation in levels of IL-6 and serum amyloid protein A, another acute phase protein, the increase in CRP levels observed in smokers was not found to be statistically significant (Helmersson *et al.*, 2005). The results of another study showed that CRP levels were significantly lower in never-smokers ($p < 0.0001$) than in current smokers (Wannamethee *et al.*, 2005).

On the other hand, even though there are few studies on CRP's instantaneous response to short term exercise in smokers, there are other studies on other healthy and diseased populations which have reported this inflammatory cytokine's lack of response or insignificant change following a single bout exercise tests. For instance, the findings of the study by Collins *et al.* indicated that conducting an exercise test does not lead to a significant change in serum levels of CRP and IL-6 (Collins *et al.*, 2006). In addition, the study by Paczeck *et al.* on non-smokers demonstrated that intense exercise test did not result in a significant change in CRP immediately and 2 hours after the exercise (Czarkowska-Paczek *et al.*, 2005). On the other hand, considering CRP's not changing significantly in response to 35 minutes of moderate running test in the present study, it may be

concluded that one session of exercise with the aforementioned characteristics is not accompanied by inflammatory effects on serum CRP levels in male smokers.

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