COMPARISON OF SERUM LEVELS OF CRP AND URIC ACID IN ACTIVE, PASSIVE, AND NON-SMOKERS

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Abstract

INTRODUCTION: Some studies have shown that C-reactive protein (CRP) and uric acid may have a role in development of coronary artery disease (CAD); the role cigarette smoking plays in CAD through various mechanisms has also been demonstrated. Hence, the question is raised: does cigarette smoking exert its atherogenic effect through increasing CRP and uric acid levels in the serum? The first step in responding to this question would be to study the relationship between cigarette smoking, CAD, CRP and uric acid levels. As cigarette smoking is highly prevalent in Iran, the present study was conducted to compare mean serum levels of CRP and uric acid in 3 groups of active smokers, passive smokers, and non-smokers, to determine any possible association between cigarette smoking and serum CRP and uric acid levels.

METHODS: The study involved 177 men aged 20-40 years in 3 groups of active smokers, passive smokers, and non-smokers (59 individuals in each group). In addition, fasting blood samples were taken from all subjects to measure serum levels of CRP serologically and uric acid photometrically (using ELAN 2000). Questionnaires on anthropometrics, personal information, disease history, drug use and other related subjects were completed for all the subjects.

RESULTS: Mean serum CRP levels were 5.4±1.9, 3.7±0.8 and 4.0±0.8 mg/L for the active smokers, passive smokers, and non-smokers, respectively. The difference between active smokers and the other two groups was statistically significant (P=0.000), while no significant difference was found between passive smokers and non-smokers (P=0.13). Serum levels of uric acid in active smokers, passive smokers, and non-smokers was 7.0±1.4, 5.3±1.3 and 5.6±1.3 mg/dl, respectively. The difference between active smokers and the other two groups was significant (P=0.000). The difference between passive smokers and non-smokers was insignificant (P=0.34).

CONCLUSIONS: Higher mean serum levels of CRP and uric acid in active smokers seem to confirm the harmful effects of nicotine on the two variables. We recommended studies on the possible role of increased serum CRP and uric acid levels due to cigarette smoking in CVD development.

Key Words: Uric acid, acute phase C-reactive protein, active smokers, passive smokers, non-smokers, Iran.

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Introduction

Cardiovascular diseases (CVD) are a heavy financial burden on the health system because of their high prevalence.[1] CVD are the leading cause of death in Iran.[2] Smoking is a major CVD risk factor.[3,4]

Cigarette smoking not only increases the incidence of CVD in smokers,[5] but also increases the probability of disease in non-smokers.[5] The association between cigarette smoking (both active and passive) and coronary heart disease (CHD) has been shown in many studies.[6] Cigarette smoking accelerates the development of arteriosclerosis in coronary arteries in both sexes at all ages and increases the risk of myocardial infarction (MI) and death.[7] Furthermore, it aggravates chest pain through increasing the need of myocardium for oxygen and decreasing oxygen supply.[7]

Many changes occur in smokers. For example, their fibrinogen and oxidant levels are higher.[8,9] The rise in levels of uric acid seen in coronary artery disease (CAD)[10] has been suggested as a risk factor for CHD.[11]

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The association between serum uric acid level and many CVD risk factors has been shown.[11] As an example, the prevalence of hypertension increases with uric acid level.[12]

Serum CRP has also been identified as a new risk factor for CVD.[11] In one study, increased CRP levels were found to be associated with the risk of MI, thromboembolic attacks, and peripheral vascular diseases.[13]

Evidence points to the increasing prevalence of cigarette smoking in Iran[14] accompanied by increased CAD prevalence.[15] The prevalence of cigarette smoking has increased markedly among Iranian youth.[16] Given the presumed role of CRP and uric acid in the development and increased prevalence of CAD, the synergistic effect of cigarette smoking on some other CAD risk factors, and the increase in blood oxidant levels with smoking, this study was conducted to determine serum levels of CRP and uric acid in active, passive and non-smokers, and compare them between the three groups. The findings will help improve our understanding of the mechanisms whereby cigarette smoke affects the body, and will undoubtedly have practical implications in public health.

Materials and methods

This cross-sectional analytical study included 177 men aged 20-40 years in three groups of 59, namely smokers, passive smokers, and non-smokers unexposed to cigarette smoke. Smokers were selected from among individuals receiving consultation services at Isfahan Cardiovascular Research Center. Passive smokers were selected from among family members of other smokers.

An active smoker was defined as a person who had smoked at least 10 cigarettes per day during the previous year, and a passive smoker as one who had been exposed to cigarette smoke for at least 1 hour per day in the previous 10 years.[13]

A questionnaire on age, sex, occupation, cigarette smoking, family history of disease, and drug consumption was completed for every subject. Based on clinical examinations, history, and laboratory tests when necessary, individuals detected as suffering from the following diseases and conditions were excluded from the study and replaced with healthy subjects: infectious diseases, inflammatory and connective tissue diseases, diabetes, cancer, gout, nephrotic syndrome, cirrhosis, acute hepatitis, cholestatic diseases, renovascular hypertension, preeclampsia, CHF, pheochromocytoma, and primary hypertension. Individuals taking vitamin supplements, diuretics, pyrazinamide, ethambutol, aspirin, ethanol, probenecid or sulfinpyrazone were also excluded. Fasting blood samples were taken from eligible subjects on a specified date to measure CRP serologically and uric acid biochemically (ELAN 2000 autoanalyzer). SPSS was used for data analysis. Differences of serum CRP and uric acid between the three groups and between every two groups were determined with ANOVA and independent t-test, respectively. Chi-square test was used to compare prevalence rates.

Results

The mean ages of active smokers, passive smokers and non-smokers were 30.9±5.9, 28.7±6.1 and 29.6±5.5 years, respectively, with no significant difference between the three groups (P=0.38). Mean body mass index (BMI) of active smokers, passive smokers and non-smokers was 24.1±4.7, 25.2±4.4, and 26.7±4.9, respectively (P>0.05). Table 1 shows the serum levels of CRP and uric acid in the three groups. There is a significant difference with regard to both dependent variables between at least two of the three groups (P=0.00). More specifically, the differences between active smokers on the one hand, and passive smokers [CRP (95% CI*: 1.02, 2.19), uric acid (95% CI: 1.08, 2.19)] and non-smokers [CRP (95% CI: 0.76, 1.95), uric acid (95% CI: 0.85, 1.93)] on the other were significant (P=0.00).

Confidence Interval

TABLE 1. Comparison of serum levels of CRP and uric acid in active smokers, passive smokers and non-smokers

Group	CRP X±SD (mg/L)	Uric acid X±SD (mg/dl)
Active smokers	5.4±1.9	7.0±1.4
Passive smokers	3.7±0.8	5.3±1.3
Non-smokers	4.0±0.8	5.6±1.3
P*	0.00	0.00

*One-way ANOVA

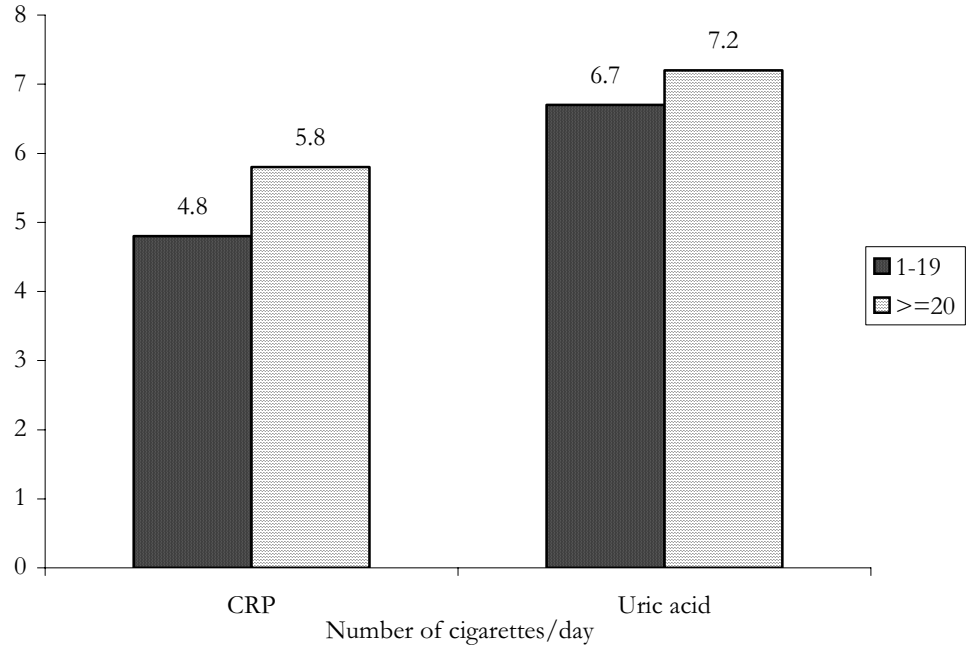

FIGURE 1. Comparison of serum levels of CRP and uric acid in smokers smoking 1-19 and ≥ 20 cigarettes per day, P value of independent t-test for both factors was 0.00

The difference between passive smokers and non-smokers was not significant with respect to either uric acid (95% CI: -0.76, 0.26 P=0.34) or CRP (95% CI: -0.57, 0.07 P=0.13).

As shown in Figure 1, mean serum levels of both CRP and uric acid were significantly different between smokers smoking at least 20 cigarettes per day and those smoking fewer than 20 cigarettes per day. The distribution of subjects according to occupation was similar in the three groups.

Similarly, no significant difference was seen between the three groups based on questions about family history of CVD risk factors, i.e. diabetes mellitus, hypertension, hyperlipidemia, sudden death, and having a CVD (data not shown).

Discussion

The mean serum level of CRP in active smokers was found to be significantly higher than in non-smokers. In a study in 1997, serum levels of CRP in patients with IHD at the time admission were considered as an indicator of acute coronary syndrome and were found useful for identification of patients at high risk of MI.[17] Increased serum levels of CRP are associated with a higher risk of MI, thromboembolic attacks, and peripheral vascular diseases.[13] There is also a positive relationship between the infarct size and serum CRP levels in acute MI.[18]

Cigarette smoking is responsible for 20% of CVD deaths in the USA.[5] The risk of CAD, sudden death, cerebrovascular diseases, peripheral vascular diseases, and aortic aneurism increases with cigarette smoking;[5] similarly, the atherosclerotic process of the coronary arteries, which may also lead to acute ischemic events, is accelerated with cigarette smoking at all ages and in both sexes.[7]

Given that smoking accelerates the process of coronary artery atherosclerosis and acute ischemic events,[5,19,20] one can hypothesize that the effect of smoking on CAD may correspond with serum levels of CRP. The findings of the present study seem to back this hypothesis. In addition, the significant difference between active and passive smokers with regard to serum CRP levels (P=0.000) can be due to differences in blood nicotine levels. Similarly, the significant difference of serum CRP levels between individuals smoking at least 20 cigarettes per day and those smoking less than 20 cigarette per day (P=0.04) can also be related to differences in the blood nicotine levels associated with the number of cigarettes smoked.

The insignificant difference between non-smokers and passive smokers as regards serum CRP level indicates that in order for the CRP level to increase, the nicotine level should probably reach a certain threshold.

In a study of the role of uric acid as an independent factor in CAD,[15] serum uric acid levels in CAD patients were found to be higher than normal.[11,20]
The association between increased uric acid levels and CAD is higher in diabetic women than diabetic men, and is independent of hypertension and nephropathy.[21] The prevalence of hypertension has been shown to increase with the rise uric acid levels.[12]
In our study, the difference between smokers and non-smokers with respect to plasma uric acid was found to be significant, confirming findings of some investigators. However, some researchers have not found any significant difference.
While the Normotive Aging Study showed the increasing effect of cigarette smoking (whether active or passive) on serum uric acid levels,[22] Liu et al[23] observed no such effect; they could not find any difference between smokers and non-smokers. In another study, serum levels of uric acid in active and passive smokers were found to be higher than in non-smokers[24] and increased uric acid levels were considered as a factor associated with CAD development.[25]
Considering the findings of the present study which show the effects of nicotine on serum uric acid and CRP levels, and also in view of the role of CRP and uric acid in CVD, other mechanisms can be presumed to be at play in the cardiovascular effects of smoking. It is recommended that studies with controlled serum levels of uric acid and CRP be conducted to confirm the role of cigarette smoking in the development of CVD though the mentioned variables.

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