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Original Article

Association between serum uric acid (SUA) levels and metabolic syndrome (MetS) components in personnel of Shahroud University of Medical Sciences

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ABSTRACT

Aims: Serum uric acid level has been suggested to be associated with metabolic syndrome risk factors. However, the association between metabolic syndrome and serum uric acid is still controversial and challenging. This study was aimed to investigate the association between serum uric acid levels and metabolic syndrome components in personnel of the Shahroud University of Medical Sciences.
Material and methods: This case–control study was conducted on 499 personnel aged 30–60 years old who were working in Shahroud University of Medical Sciences, in 2015. MetS was defined according to the National Cholesterol Education Program (NCEP) criteria. The relationship between serum UA level and the number of metabolic components was determined by linear regression analysis.
Result: In this study, the mean concentration of serum uric acid in men with the syndrome was higher than that in women. Mean serum UA level increased as the number of metabolic factors increased. The mean serum uric acid levels was 4.98 ± 1.64 in patients with metabolic syndrome and 4.5 ± 1.28 in non-patients ($p = 0.005$). Subject with abnormal uric acid were almost 2.62 times more likely than other subject to develop the syndrome.
Conclusions: The results of this study showed that only hypertriglyceridemia is a component which increases the risk of hyperuricemia. In addition, hyperuricemia increases the risk of metabolic syndrome by more than two fold. It seems that high uric acid can be considered as a predisposing factor for metabolic syndrome; thus, it is recommended to measure serum uric acid in routine tests.

1. Aims

Metabolic syndrome is a problem that threatens public health, because this syndrome increases the risks of cardiovascular diseases, type II diabetes, and mortality due to such diseases [1,2]. The prevalence of this syndrome varies among different population groups based on population properties, such as nationality, ethnic differences, geographic location, and syndrome criteria [3,4]. In most countries, about 20–30% of the adult population is affected by metabolic syndrome [5]. In Iran, the prevalence of metabolic syndrome has been reported from 21% to 32% [6–13].

Although several definitions are used for the diagnosis of metabolic syndrome, the most clinically applicable method of diagnosis is to use Adult Treatment Panel (ATP III) definition. According to this definition, the affected person must have at least three of the cardiovascular risk factors simultaneously (Table 1) [14].

In addition to the risk factors outlined in the ATP III, some studies have reported an association between metabolic syndrome and some other risk factors such as increased blood uric acid, increased oxidative stress, and low status systemic inflammation

Abbreviations: MetS, metabolic syndrome; SUA, serum uric acid; BMI, body mass index; WC, Waist circumference; SBP, systolic blood pressure; DBP, diastolic blood pressure; HDL-cholesterol, high-density lipoprotein cholesterol; TG, Triglycerides.

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Table 1
Clinical identification of the metabolic syndrome according to National Cholesterol Education Program Adult Treatment Panel III criteria.

Risk factor	Defining level
Waist circumference (cm)	≥102 cm in men, ≥88 cm in women
Blood pressure (mmHg)	≥130/85 mmHg or drug treatment for elevated blood pressure
Fasting glucose (mg/dl)	≥100 mg/dl or drug treatment for elevated blood glucose
Triglycerides (mg/dl)	≥150 mg/dl
HDL-cholesterol (mg/dl)	≤40 mg/dl in men, ≤50 mg/dl in women

[15–17]. Uric acid is generated as a result of purine metabolism; because of its endothelial pro-inflammatory effect, it is associated with metabolic syndrome risk factors such as hypertension, insulin resistance, and elevated triglyceride levels [18]. Several studies have examined the relationship between increased levels of uric acid and metabolic syndrome [19–21]. Although various studies have reported elevated levels of uric acid in patients with metabolic syndrome, its clinical interpretation is still controversial and challenging [22,23].

And its role as a risk factor for metabolic syndrome and as criteria for predicting the syndrome is under debate [24–26]. In view of that, this study was aimed to investigate the association between serum uric acid levels and the risk factors metabolic syndrome.

2. Methods

This case–control study was conducted on 499 personnel aged 30–60 years old who were working in Shahroud University of Medical Sciences in 2015. To identify patients with the metabolic syndrome, first we informed all the personnel about the objectives of the study; and then, we obtained written informed consent from the volunteers and asked them to complete a registration form. The participants completed a questionnaire containing eight questions about demographic data, and five other questions about anthropometric characteristics. After measuring and recording blood pressure and abdominal circumference, fasting blood samples were collected to test HDL-C, TG, and FBS; the samples were sent to a laboratory. Metabolic syndrome was diagnosed when at least three criteria of ATP III were present [14].

Inclusion criteria were the followings: being aged older than 30 years, and being employed at Shahroud University of Medical Sciences. Pregnancy and breast feeding were set as the exclusion criteria.

2.1. Assessment of blood pressure and anthropometric variables

Participants' heights, without shoes, were measured using a non-stretchable tape measure. Participants' weights were measured using a digital weight scale and then BMI was calculated. Participants' weights were classified into four groups of underweight (BMI ≤ 18), normal weight (BMI = 18–24), overweight (25 ≤ BMI < 30), and obese (BMI ≥ 30) [27,28]. A non-elastic tape measure was used to measure waist circumference at the uppermost border of the iliac crest, WC was measured with+=0.1 cm. To measure the blood pressure we used a cuff that fitted arm circumference. We used a mercury sphygmomanometer and measured the blood pressure of the participants two times with at least 10 min time interval. Blood pressure measurement was performed on the right hand, in a sitting position.

2.2. Laboratory exams

Blood samples were collected from all participants after 12 h of fasting. Serums were kept at −70 °C. To test and measure fasting blood glucose, triglycerides, and HDL via enzymatic method, we used Pas Azmoon kit. To test uric acid we used Zist Shimi kit. Hyperuricemia was diagnosed when uric acid ≥6.1 for women and uric acid ≥7.3 for men.

2.3. Statistical methods

To analyze the data we used descriptive statistics such as mean, and standard deviation. We also used statistical tests of *t*-test, analysis of variance (ANOVA), Chi-Square test, and Logistic Regression test. All analyses were performed at a significant level of 0.05, using the SPSS Statistics 21 and Stata 12 software.

3. Results

The mean age of the staffs who participated in the study was 40.97 ± 10.9 years for females and 41.81 ± 9.78 years for males; there was no statistically significant difference between the two genders in terms of mean age ($p = 0.39$).

The prevalence of metabolic syndrome among the staffs working in Shahroud University of Medical Sciences was 20.6% (confidence interval: 17.1–24.2).

Of all, 59 women (18.3%) and 44 men (24.9%) were affected by metabolic syndrome. The prevalence of metabolic syndrome was not significantly different between the two genders ($p = 0.1$). In addition, the mean age of patients with metabolic syndrome was 44.76 ± 9.13 years while in those without the syndrome it was 40.36 ± 10.67 years, and this difference was statistically significant ($p < 0.0001$). Of all, 19.7% of administrative personnel, 23% of clinical personnel, and 17.7% of health workers had metabolic syndrome. There was no statistically significant relationship between the work place and the metabolic syndrome ($p = 0.53$).

The mean BMI was 29 ± 4.41 in patients with metabolic syndrome and 25.58 ± 4.12 in those who were not affected by the syndrome. The difference in mean BMI was statistically significant in terms of developing the metabolic syndrome; accordingly, the patients with metabolic syndrome had a higher BMI ($p < 0.001$).

According to the results of the study, abdominal obesity ($p < 0.001$) and low HDL ($p = 0.01$) in women and high triglycerides ($p < 0.001$) in men were more prevalent and this difference was statistically significant. However, there was no statistically significant difference between the two genders in terms of the prevalence of hypertension and impaired glucose tolerance (Table 2).

The mean serum uric acid levels in the study population was 4.64 ± 1.37 (confidence interval: 4.52–4.76); in addition, it was 4.98 ± 1.64 in patients with metabolic syndrome and 4.5 ± 1.28 in non-patients; the difference between the two groups was statistically significant ($p = 0.005$). Furthermore, the mean serum uric acid level in patients with metabolic syndrome was 5.57 ± 1.19 in males and 5.54 ± 1.26 in females. The difference between the two groups was statistically significant ($p = 0.0039$).

Of all the subjects, 5.3% of females and 10.7% of males were affected by hyperuricemia. The two genders were significantly different in terms of the prevalence of hyperuricemia ($p = 0.03$). In addition, the prevalence of hyperuricemia among the patients with the metabolic syndrome was 13.6% (20.5% in males and 8.5% in females). In patients with metabolic syndrome, the prevalence of hyperuricemia was not significantly different in terms of gender ($p = 0.09$).

Taking into consideration the number of metabolic syndrome components, the study population was divided into five groups of patients with 0 (healthy controls) ($n = 64$), 1 ($n = 180$), 2 ($n = 152$),