Relationship between serum uric acid and selected cardiovascular risk factors in Hangzhou populations

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Abstract

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Uric acid is the final metabolite of purine. Increased serum uric acid level is associated with incidence of gout and cardiovascular diseases. The aim of this study was to investigate the relationship between serum uric acid and parameters of biochemistry and haematology in Hangzhou populations, China. In this cross-sectional study, 186 male (56±14 y) and 85 female (55±11 y) free-living subjects were recruited from Hangzhou, China. The physiological parameters were measured. Each subject gave fasting blood, urine and faeces samples, from which serum uric acid and other parameters of biochemistry and haematology were measured with standard methods. Serum uric concentration was significantly higher in males than in females, 329±69 μmol/L for male and 237±53 μmol/L for female (P<0.0001). Compared with female subjects, male had significantly higher BMI (P = 0.0215), serum TAG (P = 0.0012) and creatinine (P<0.0001), significantly lower TC (P = 0.0013) and HDL-C (P<0.0001). Bivariate analysis results showed that serum uric acid was significantly positively correlated with age (r = 0.171, P = 0.0076), BMI (r = 0.343, P<0.0001), systolic blood pressure (r =

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0.234, P = 0.0002), diastolic blood pressure (r = 0.204, P = 0.0014), blood urea nitrogen (r = 0.251, P<0.0001), serum concentrations of total cholesterol (r = 0.192, P = 0.0026) and triacylglycerol (r = 0.306, P<0.0001), and significantly negatively correlated with HDL-cholesterol (r = -0.381, P<0.0001). In the bivariate analysis for separate gender, serum uric acid concentration was significantly positively correlated with TC (r = 0.255, P = 0.001), LDL-C (r = 0.329, P<0.0001) and HDL-C (r = -0.185, P = 0.0181) for males, but not for females. Serum uric acid concentration was significantly positively correlated with age for females (r = 0.289, P = 0.0081), but not for males. The results from the present study indicated that increased serum uric acid concentration was associated with a cluster of the cardiovascular risk factors in Hangzhou populations.

Uric acid is the final metabolite of purine in humans, and it is excreted mainly by the kidneys when renal function is normal. Increased serum uric acid is a biomarker of purine intake. Results from epidemiological studies showed that an increased serum uric acid level is associated with incidence of gout (Lin *et al*., 2000; Monu and Pope, 2004) and cardiovascular diseases (CVD) (Niskanen *et al*., 2004; Feng and Alderman, 2000; Liese *et al*., 1999). A recent study from China reported that serum uric acid was positively correlated with both diastolic and systolic blood pressure, body mass index (BMI) and serum levels of triacylglycerol and glucose in Beijing populations (Li *et al*., 1997). However, there is no data on the relationship between serum uric acid and cardiovascular risk factors in Hangzhou populations.

We had collected blood, urine and faeces samples from 186 male (56±14 yrs) and 85 female (55±11 yrs) free-living subjects who were recruited from Hangzhou, China. The physiological parameters, serum uric acid and other parameters of biochemistry and haematology were measured. We hypothesised that Hangzhou population has a similar profile with Beijing population on the relationship between serum uric acid and cardiovascular risk factors. The aim of this study was to investigate the correlation between serum uric acid and parameters of biochemistry and haematology in Hangzhou population.

Materials and Methods

Design

In this cross-sectional study, each subject gave fasting blood, urine and faeces samples, from which serum uric acid and other parameters of biochemistry and haematology were measured with standard methods, the physiological parameters were also measured.

Subjects

The project was approved by the Research Ethics Committee, School of Biosystem Engineering and Food Science, Zhejiang University, and all subjects gave written informed consent prior to participation in the study. Two hundred and seventy one healthy free-living subjects, 186 male (56±14 yrs) and 85 female (55±11 yrs), were recruited through local newspaper advertisements from Hangzhou, China. Each subject completed a questionnaire and gave samples of blood, urine and faeces. The exclusion criteria for this study were: evidence from doctor's diagnosis or laboratory examination result of hypertension, CVD, renal disease, hyperlipidemia, hematological disorders and diabetes, and family history of CVD, excess alcohol intake and drug therapy.

Blood specimen collections

Subjects attended the Zhejiang Hospital in the morning following an overnight fast. They were allowed to sit and relax for 10 min, before their weight, height and blood pressure were measured, and their venous blood was taken in plain and EDTA tubes with 21-gauge needles. Full blood examination was performed during the three hours following the blood sampling. Plasma and serum samples were prepared during the two hours after the blood was drawn, aliquoted into separate tubes and stored at -20ºC until analysis.

Serum uric acid and other parameters

Uric acid, creatine, triacylglycerol (TAG) and total cholesterol (TC) concentrations of fasting serum were determined with standard enzymatic dipyridamole methods using commercially available kits (Fenghui Medical Science Tech. Co., Ltd., China). HDL-C and LDL-C were measured with differential antibody methods using commercially available kit (Woko, Japan). Blood glucose was measured with hexokinase methods using commercially available kit (Fenghui Medical Sci & Tech Cooperation, China) on an auto-biochemical analyser (Olympus AU 2700, Japan).

Statistical analyses

The data analyses were performed using a StatView software program. Descriptive statistics were initially performed. Mann-Whitney U test was used to determine the differences between genders for each parameter. Linear regressions were employed to determine the relationship between serum uric acid concentrations and selected cardiovascular risk factors. The values are reported as mean ± SD. P values were two tailed and $p < 0.05$ was considered as significance.

Results

Serum uric concentration was significantly higher in males than in females, 329±69 µmol/L for male and 237±53 µmol/L for female (P<

0.0001). Figure 1 shows the percentage of male and female subjects correlated with serum uric acid. Hyperuricemia was defined with accepted cut-off values of >420 µmol/L for men and >360 µmol/L for women (Fang and Alderman, 2000). There was 35% hyperuricemia for male and no hyperuricemia for female in this study population ($P < 0.0001$).

Table 1 shows the mean ± standard deviation for selected cardiovascular risk factors of the two gender groups. Compared with female subjects, male had significantly higher body mass index (BMI) (P = 0.0215), serum TAG (P = 0.0012) and creatinine (P < 0.0001), and significantly lower TC (P = 0.0013) and HDL-C (P<0.0001).

Table 2 reports the results of bivariate analysis between serum uric acid and selected CVD risk factors. Serum uric acid concentration was significantly positively correlated with age (r = 0.171, P = 0.0076), BMI (r = 0.343, P<0.0001), systolic blood pressure (r = 0.234, P = 0.0002), diastolic blood pressure (r = 0.204, P = 0.0014), serum concentrations of creatinine (r = 0.582, P< 0.0001), total cholesterol (r = 0.192, P = 0.0026) and triacylglycerol (r = 0.306, P<0.0001), and significantly negatively correlated with HDL-cholesterol (r = -0.381, P<0.0001). In the bivariate analysis for separate gender, serum uric acid concentration was significantly positively correlated with TC (r = 0.255, P = 0.001), LDL-C (r = 0.329, P<0.0001) and HDL-C (r = -0.185, P = 0.0181) for
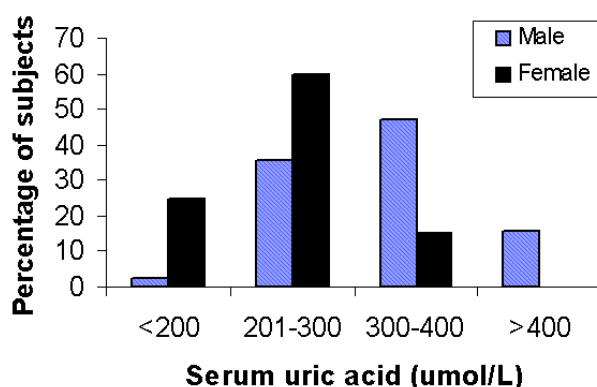

Figure 1. Distribution of serum uric acid (µmol/L) in Hangzhou both gender populations.

Table 1. Selected cardiovascular risk factors of two gender groups.

CVD Risk Factors	Male (n=186)	Female (n=85)	P Values
Uric acid (µmol/L)	329±69	237±53	<0.0001
Age (year)	55.7±14.1	54.6±11.3	0.5302
BMI (kg/m^2)	23.6±2.9	22.7±3.0	0.0215
Sys BP (mm Hg)	131±21	127±21	0.2380
Dias BP (mm Hg)	79±12	77±11	0.3315
Creatinine (µmol/L)	113.4±9.6	98.3±7.5	<0.0001
Glucose (mmol/L)	4.9±1.2	5.0±1.4	0.6063
TC (mmol/L)	4.7±0.8	5.1±0.9	0.0013
LDL-C (mmol/L)	2.2±0.5	2.3±0.6	0.3637
HDL-C (mmol/L)	1.2±0.2	1.5±0.3	<0.0001
TAG (mmol/L)	1.6±0.9	1.3±0.6	0.0012

Table 2. Bivariate analysis between serum uric acid and CVD selected risk factors.

Correlates	Male + Female		Male		Female	
	r	P value	r	P value	r	P value
Age (year)	0.171	0.0076	0.099	0.2109	0.289	0.0081
BMI (kg/m^2)	0.343	<0.0001	0.286	0.0002	0.312	0.0041
Sys BP (mm Hg)	0.234	0.0002	0.2	0.0104	0.307	0.0048
Dias BP (mm Hg)	0.204	0.0014	0.164	0.0367	0.301	0.0058
Creatinine (µmol/L)	0.582	<0.0001	0.359	<0.0001	0.315	0.0038
Glucose (mmol/L)	-0.063	0.3281	-0.066	0.4054	-0.057	0.6145
TC (mmol/L)	0.068	0.2891	0.255	0.001	0.204	0.0663
LDL-C (mmol/L)	0.192	0.0026	0.329	<0.0001	0.202	0.0683
HDL-C (mmol/L)	-0.381	<0.0001	-0.185	0.0181	-0.12	0.2255
TAG (mmol/L)	0.306	<0.0001	0.233	0.0027	0.234	0.0342

males, but not for females. Serum uric acid concentration was significantly positively correlated with age for females (r = 0.289, P = 0.0081), but not for males.

Discussion

The aim of this cross-sectional study was to investigate the serum uric acid status and its correlation with selected CVD risk factors in Hangzhou populations. Higher serum uric acid concentration in men than women in the Hangzhou population is consistent with previous studies from other different populations (Russo *et al.*,

1996; Li *et al.*, 1997; Moriarity *et al.*, 2000; Conen *et al.*, 2004).

Difference between male and female on BMI and TAG in the present study are not consistent with the results from Beijing urban population that was reported by Li *et al.* (1997). In that study BMI was 24.3 and 25.0 kg/m^2, and TAG was 106.8 and 119.4 mg/dL for men and women, respectively. This difference was probably due to the lifestyle and dietary habits between men and women in Hangzhou and Beijing (Li and Premier, 2004).

It has long been known that increased serum uric concentration is strongly positively associated with incidence of gout (Lin *et al.*, 2000;

Monu and Pope, 2004). Many recent studies from epidemiological, cross-sectional and case-control have found that increased serum uric acid levels is a risk factor for CVD (Takagi, 1982; Lin *et al*., 2004, Niskanen *et al*., 2004). In the present study, the positive correlation between serum uric acid concentration and BMI, systolic and diastolic BP, serum concentration of TC, TAG, LDL-C and creatinine, and the negative correlation with HDL-C are consistent with previous studies (Li *et al*., 1997; Nagahama *et al*., 2004; Conen *et al*., 2004).

The results from the present study indicated that increased serum uric acid concentration is associated with a cluster of the cardiovascular risk factors in Hangzhou populations.

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