Original Article

Uric acid status and its correlates in Hangzhou urban population

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The aim of this study was to investigate the uric acid status and its correlates in relation to selected cardiovascular risk factors in a cross-sectional study in Hangzhou, China. In this cross-sectional study, 186 male (56 ± 14 yrs) and 85 female (55 ± 11 yrs) free-living subjects were recruited from the Hangzhou metropolitan area, China. Their 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 by standard methods. Serum uric concentration was 329 ± 69 μmol/L for male and 237 ± 53 μmol/L for female (P <0.0001). Compared with female subjects, males had significantly higher BMI (P = 0.0215), serum triacylglycerol (TAG) (P = 0.0012) and creatinine (P <0.0001), and significantly lower total cholesterol (TC) (P = 0.0013) and HDL-C (P <0.0001). In the partial correlation analysis, after controlling for sex, age and BMI, serum uric acid was significantly positively correlated with serum concentrations of TC (r = 0.205, P = 0.001), LDL-C (r = 0.229, P <0.001), TAG (r=0.172, P = 0.008) and creatinine (r=0.330, P < 0.001). The results from the present study indicated that prevalence rates of hyperuricaemia are lower in Hangzhou than in Beijing; increased serum uric acid concentration was associated with a cluster of cardiovascular risk factors for the Hangzhou urban population.

Key words: uric acid, correlation, cardiovascular risk factors, Hangzhou, China.

Introduction

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. Higher consumption of purine-rich meat and seafood are associated with higher serum levels of uric acid.[1]

Results from epidemiological studies show that an increased serum uric acid level is associated with incidences of gout[2,3] and cardiovascular diseases (CVD).[4-6] Patients with lymphoma or acute leukemia with increased leukocyte counts are at high risk for complications of hyperuricemia as reviewed by Tsimberidou and Keating.[7] A recent study from China reported that serum uric acid was positively correlated with both diastolic and systolic blood pressure, BMI and serum levels of triacylglycerol and glucose in Beijing populations.[8]

Unlike typical Chinese pork-soy tradition, Hangzhou urban population consume a vast array of aquatic foods, many types of fungi, different types of edible bamboos and a great variety of green vegetables, and relatively low meat intake. This combination leads to a unique dietary pattern – Hangzhou dietary culture.[9] It has been reported that non-communicable diseases are restively lower and life span is relatively longer in Hangzhou urban population compared with Beijing.[10] However, there is no data on purine intake, serum uric status, and the relationship between serum uric acid and cardiovascular risk factors in Hangzhou urban population. It is difficult to accurately estimate the dietary purine intake because the Hangzhou urban population normally dine out (restaurant or canteen) once or twice per day consuming a large variety of foods. The database on the purine content is not available for all foods or is not up-to-date in China. As a result of this difficulty, analysis of serum uric acid has been used as a biomarker of dietary purine intake in the present study.

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The aim of this study was to investigate the serum uric acid status, and the relationship between serum uric acid and selected cardiovascular risk factors in Hangzhou urban population. We hypothesised that the Hangzhou urban population has a similar profile with the Beijing population on serum uric acid, and the relationship between serum uric acid and cardiovascular risk factors.

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 by 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) subjects were recruited through local newspaper advertisements from Hangzhou, China. Each subject completed a questionnaire and gave samples of blood, urine and faeces.

Blood specimen collections

Subjects attended the Zhejiang Hospital on one morning following an overnight fast. Subjects were allowed to sit relaxed for 10 minutes, weight, height and blood pressure were measured, and then venous blood was taken in plain and EDTA tubes with 21-gauge needles. Full blood examination was performed during the three hours following blood sampling. Plasma and serum samples were prepared during the two hours after blood was drawn, aliquoted into separate tubes and stored at -20^{0}C until analysis.

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

CVD risk factors	Males (N = 186)	Females (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

Serum uric acid and other parameters

Uric acid, creatine, triacylglycerol (TAG) and total cholesterol (TC) concentration of fasting serum were determined by standard enzymatic dipyridamole methods using commercially available kits (Fenghui Medical Science Tech. Co., Ltd., China), HDL-C and LDL-C were measured by differential antibody methods using comercially available kit (Wako, Japan) and blood glucose was measured by 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. Bivariate correlation was initially employed to determine the relationship between serum uric acid concentrations and selected cardiovascular risk factors. In order to control confounding factors, partial correlation analysis was performed, controlled for sex, age and BMI. Comparison of the number of subject in male and female with serum uric acid below and above reference values were made using multiple X^2 tests. The values are reported as mean ± SD. P values were two tailed and P <0.05 was considered as significant.

Results and Discussion

Figure 1 shows the serum uric acid distribution for percentage of subjects. Hyperuricemia is defined with accepted cut-off values of >420μmol/L for men and >360 μmol/L for women.[5] Prevalence rates of hyperuricaemia was 11% for males and none for females in this study population (P<0.0001). Prevalence rates of hyperuricaemia in the present study population were lower than in the Beijing urban population (men 15.4%, women 11.0%).[8] Table 1 shows the mean ± standard deviation for serum uric acid concentration and selected cardio-vascular risk factors of two gender groups. Serum uric acid concentration was significantly higher in males than in females, with levels of 329 ± 69 μmol/L and 237 ± 53 μmol/L

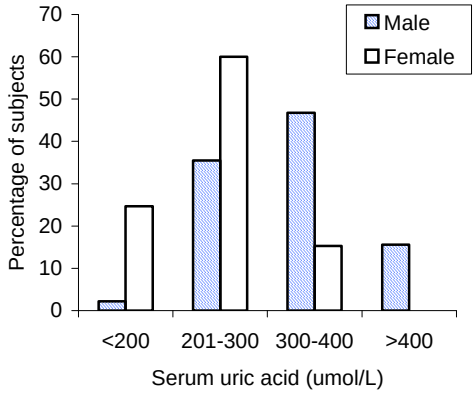

Figure 1. Serum uric acid distributions in men and women

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

	Males + Females		Males		Females	
Correlates	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

(*P*<0.0001), respectively. Higher serum uric acid concentration in men than women in the Hangzhou urban population is consistent with previous studies from other different populations.[8,11-13] Compared with female subjects, males had significantly higher 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). Differences between males and females 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.*[8] BMI and TAG were significantly lower in Beijing urban males than in females (*P*<0.05). This difference is probably due to the different lifestyles and dietary habits between men and women in Hangzhou and Beijing.[8]

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), LDL-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 genders, 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, however 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.

Table 3. Partial correlation analysis between serum uric acid and CVD selected risk factors, controlled for sex, age and BMI

Correlates	Standardised coefficients	*P* value
Sys BP (mm Hg)	0.118	0.067
Dias BP (mm Hg)	0.082	0.202
Creatinine (μmol/L)	0.330	<0.001
Glucose (mmol/L)	-0.120	0.063
TC (mmol/L)	0.205	0.001
LDL-C (mmol/L)	0.229	<0.001
HDL-C (mmol/L)	-0.111	0.085
TAG (mmol/L)	0.172	0.008

In the partial correlation analysis, after controlling for sex, age and BMI, serum uric acid was significantly positively correlated with serum concentrations of TC (r = 0.205, *P*=0.001), LDL-C (r = 0.229, *P* <0.001), TAG (r = 0.172, *P* = 0.008) and creatinine (r = 0.330, *P* <0.001) (Table 3). It has long been known that increased serum uric acid concentration is strongly positively associated with incidence of gout.[2,3] Many recent studies from epidemiological, cross-sectional and case-control have found that increased serum uric acid levels is a risk factor for CVD.[4,14,15]

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.[8,13,16] The results from the present study indicate that prevalence rates of hyperuricaemia is lower in Hangzhou than in Beijing populations. Increased serum uric acid concentration is associated with a cluster of cardiovascular risk factors in the Hangzhou urban population.

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杭州市人群的尿酸水平及其与心血管危害因子间的相关性

本文通过在中国杭州开展的一次代表性研究来调查人体内的尿酸水平及其与所选择的心血管危害因子之间的关系。本研究征募在杭州主要城区自由生活的 186 名男性（56±14 岁）和 85 名女性（55±11 岁）为受试者，并测量了他们的生理指标。每个受试者提供了各自的空腹血液、尿液和粪便样品。然后采用标准方法对这些样品进行检测，得到血清尿酸浓度及其它的生化和血液学参数。男性受试者血清尿酸的浓度为 329±69 μmol/L，显著高于女性的 237±53 μmol/L（$P<0.0001$）。与女性受试者相比，男性受试者具有显著高的体重指数（$P=0.0215$）、血清三磷酸甘油酯（$P=0.0012$）和肌酸酐（$P<0.0001$），同时具有显著低的总胆固醇（$P=0.0013$）和高密度脂蛋白－胆固醇（$P<0.0001$）。在偏相关性分析中，对性别、年龄和体重指数校正后发现，血清尿酸浓度与血清中总胆固醇（r=0.205，$P=0.001$）、低密度脂蛋白－胆固醇（r=0.229，$P<0.001$）、三磷酸甘油酯（r=0.172，$P=0.008$）和肌酸酐（r=0.330，$P<0.001$）间有着显著的正相关性。本研究的结果显示：杭州市人群的高尿酸血症患病率要低于北京市人群；对于杭州市人群来说，血清尿酸浓度的升高与许多心血管危害因子有关。

关键词：尿酸、相关性、心血管危害因子、杭州、中国。