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Original Article

Relationship between Uric Acid Level and Blood Lipid in Sex Difference among Chinese Community Elderly Population

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Abstract:

Objective: This study aimed evaluate the association between serum uric acid (SUA) levels and blood lipid among community elderly and explore the sex difference.

Methods: A cross sectional study was conducted in a representative urban area of Hangzhou in 2023. A two-stage stratified clustering sampling method was used and 1998 elderly participants were included. Overnight fasting blood samples were taken to determine serum uric acid, cholesterol, triglyceride, low density lipoprotein, high density lipoprotein, γ-glutamyl transpeptidase and other biochemical indexes. Demographic and clinical variables, including body mass index (BMI/height^2), waist-to-hip ratio and blood pressure, were measured and recorded through face-to-face interviews with structured questionnaires.

Results: The prevalence of SUA was 34.26% in men and 28.95% in women, respectively. There was a strong association between hyperuricemia and three components of blood lipid in men and two components in women. Multivariate Logistic regression analysis showed : (1) triglyceride was a risk factor for men and women. (2) Total cholesterol was statistically significant only in men, while high density lipoprotein was only a protective factor in women.

Conclusion: This study shows that there is a significant correlation between serum uric acid and blood lipids among the elderly in the community of Hangzhou. Among women, uric acid is more closely related to the risk of blood lipids than men. Doctors should recognize that hyperlipidemia is a common common disease of SUA and take measures as soon as possible to prevent follow-up chronic diseases.

Keywords: Serum Uric Acid, Blood Lipid, Community Elderly, Sex Difference, Cross-sectional Study.

Introduction

From 1980s, rapid economic development and improved living standards have brought profound changes in diet structure and lifestyle among the Chinese people, with a notable consequence being an increase in high uric acid diet. Uric acid is the final product of purine metabolism, most of which is reabsorbed by proximal renal tubules and excreted through renal tubules with urine excretion. Dysfunction of purine metabolism, abnormal energy metabolism, and renal excretion of uric acid can cause either an increase (hyperuricemia) or decrease (hypouricemia) in plasma uric acid concentration.High-purine diet such as seafood and meat can increase the incidence of hyperuricemia[1].Excessive uric acid production and its decreased excretion by the kidneys are one of the major causes of hyperuricemia. In addition to causing gout, HUA is also closely related to cardiovascular conditions and diseases, such as hypertension, diabetes,

metabolic syndrome, stroke and coronary heart diseases.[2], A number of studies have been reported since the 1960s, the prevalence of hypertriglyceridemia is higher in hyperuricemia patients[3] and there were relationship between serum urine acid(SUA) and triglyceride(TG)[4]. According to statistics, there were 253.88 million people aged over 60 by the end of 2019[5], the health status of the elderly has become the focus of current society. Our study will explain the relationship between SUA and blood lipids in community elderly to provide reference for the formulation of community health management program.

2. Materials and Methods

2.1 Subjects

This was a population-based cross-sectional survey conducted in TangxizhenSUAcheng, Guangji, Shuibei, Leyuan, Nanyuan, Xixiaohe, Dongxiaohe communities of Yuhang district that a metropolitan area representative of the geographic and economic characteristics in Hangzhou, China. The subjects were individuals aged older than 60years who had lived in the local. Between January 2023 and December 2023 , a total of 2257 residents selected and completed the survey, about 91% of total participants were accounted for this study. Delete the incomplete data, a total of 1998 participants were older than 60 years were selected in finally. All participants gave informed consent.

2.2 Methods

In hospital, the data were collected by trained and qualified investigators. Each participant was interviewed and completed a questionnaire including demographic factors, physical health assessment (chronic disease), life behavior and social function evaluation (smoking, drinking, physical exercise, dietary habits). Physical examination include height, weight, waistline, hipline, blood pressure, they were measured according to standardized protocol. Laboratory tests include blood glucose, blood lipids, uric acid.

2.3 Mesurements

Height and weight were measured on participants wearing light clothing without shoes, and body mass index(BMI) was calculated as weight(kg)divided by squared heith(m). Blood pressure was measured on right or left upper arm in sitting position after 5 minutes rest. Blood sample were collected from participants after an overnight fast of at least 8 hours.

Peripheral blood was obtained for measuring the following parameters: total cholesterol(TC), low-density lipoprotein(LDL), high-density lipoprotein(HDL), triglycerides(TG), urin acid(UA), gamma-glutamyltranspeptidas(GGT).

2.4 Definition of Hyperuricemia

Participants were diagnosed with hyperuricemia if their SUA level was ≥417mmol/L (7.0mg/dL) in men or ≥357mmol/L (6.0mg/dL) in women [6].

2.4 Statistical Analysis

Using excel to establish database. All the data were processed by SPSS 21 statistical software. Kolmogorov Smirnov test was used to examine normal distribution. Nonparametric test (Mann-Whitney U tests) is used to compare the measurement data of two independent samples of non-normal distribution, were expressed as Median (25%,75%). Chi-square test was used to compare the rate between groups. The relationship between SUA levels and other variables was assessed using the correlation coefficients. We used odds ratio (OR) and 95% confidence intervals (CIs) of SUA and blood lipids. Reported probabilities were two-sided, all tests were set at the 0.05 level of statistical significance.

3. Results

A total of 1968 participants competed our study, with 972(48.6%) men and 1026(51.4%) women. The mean age was 69.56±6.64(60-97yrs).

3.1 General Characteristics

The baseline characteristics of participants according to sex and hyperuricemia are presented in Table 1. It showed the demographic characteristics and anthropometric measurements of the 1998 participants. The mean uric acid was 355.235±101.28μmol/L. In men and women, participants with hyperuricemia had older age, greater WC, higher BMI, higher blood pressure, higher TC, higher TG, lower HDL-C level. But there were no significant differences in hyperglycemia and LDL.

Table 1 Characteristics of the participants with hyperuricemia and those without

Characteristics	Men Hyperuricemia No (n=616)	Yes(n=343)	Z/χ^2	*P*-value	Women Hyperuricemia No (n=692)	Yes(n=317)	Z/χ^2	*P*-value
Age(yrs) [a]	69.16(64.0	70.24(64.	-1.944	0.052	69.04(64.0,7	70.76(65.	-4.114	<0.00
Waist(cm) [a]	,72.0)	0,75.0)	-4.407	<0.00	2.0)	0,74.5)	-7.192	1
BMI(kg/m^2) [a]	82.97(78.0	85.74(80.	-5.464	1	80.77(76.0,8	84.33(78.	-9.404	<0.00
SBP(mmHg) [a]	,88.0)	0,90.0)	-3.996	<0.00	5.0)	5,89.0)	-1158	1
DBP(mmHg) [a]	22.92(20.9	24.0(22.0	-2.741	1	22.94(20.89,	24.65(22.	-1.365	<0.00
TC(mmol/L) [a]	0,24.78)	4,25.75)	-2.432	<0.00	24.78)	48,26.71)	-1.201	1
TG(mmol/L) [a]	138.14(12	143.62(13	-7.402	1	142.25(126.7	143.82(13	-7.329	0.247
LDL(mmol/L) [a]	3.0,150.0)	0.,158.0)	-0.048	0.006	5,156.0)	1.0,155.5)	0.167	0.172
HDL(mmol/L) [a]	77.61(70.0	79.82(72.	-3.264	0.015	76.40(68.0,8	77.45(70.	-4.264	0.23
Hyperglycemia [a]	,85.0),	0,86.0)	-1.451	<0.00	3.25)	0,85.0)	-3.076	<0.00
Current smoke [b]	4.82(4.19,	5.04(4.26,	3.389	1	5.29(4.59,5.9	5.34(4.76,	0.428	1
Current drink [b]	5.45)	5.69)	0.062	0.962	7)	5.94)	0.467	0.867
Physical activity [b]	1.42(0.89,	1.93(1.10,	0.299	0.001	1.72(1.07,2.0	2.17(1.40,	0.296	<0.00
	1.65)	2.26)		0.147	4)	2.63)		1
	2.54(2.10,	2.57(2.0,3		0.074	2.72(2.18,3.2	2.74(2.20,		0.002
	3.0)	.10)		0.83	8)	3.30)		0.684
	1.38(1.13,	1.29(1.06,		0.618	1.52(1.27,1.7	1.41(1.18,		0.561
	1.56)	1.45)			4)	1.59)		0.623
	5.26(4.89,	5.38(4.98,			5.31(4.98,5.7	5.46(5.06,		
	5.94)	6.103)			7)	6.42)		
	189(30.7)	86(25.1)			4(0.6)	3(0.9)		
	206(33.4)	112(32.7)			23(3.3)	8(2.5)		
	413(67.0)	224(65.3)			433(62.6)	204(64.4)		

Data expressed [a] median(25%, 75%) for Continuous values or [b]n (%) for category values.

3.2 Correlation of SUA and Blood Lipid

Table 2 showed the correlation coefficients between uric acid and other characteristics of the participants. Uric acid level was positively correlated with age, WC, BMI, blood pressure, TG, blood pressure and negatively correlated with HDL-C in both sexes. Hyperglycemia was positively correlation with uric acid in women and negatively correlated in men. There was not correlation with TC and LDL.

Table 2 Correlation of Urine Acid and characteristics of the study participants

	Men		Women		Total	
	r	*P*- value	*r*	*P*- value	*r*	*P* -value

Age(yrs)	0.105	0.001	0.112	<0.001	0.100	<0.001
Waist(cm)	0.153	<0.001	0.204	<0.001	0.207	<0.001
BMI(kg/m2)	0.155	<0.001	0.220	<0.001	0.164	<0.001
TC(mmol/L)	0.082	0.011	0.056	0.075	-0.005	0.837
TG(mmol/L)	0.184	<0.001	0.221	<0.001	0.148	<0.001
LDL-C(mmol/L)	0.006	0.883	0.035	0.372	-0.016	0.553
HDL-C(mmol/L)	-0.087	0.029	-0.120	0.002	-0.158	<0.001
SBP(mmHg)	0.120	<0.001	0.06	0.059	0.061	0.008
DBP(mmHg)	0.079	0.016	0.053	0.101	0.189	<0.001
Hyperglycemia	-0.108	0.007	0.052	0.179	-0.034	0.225

3.3 ORs of SUA and Blood Lipid

The results of the logistic regression analysis were shown in Table 3 and 4. It was performed to investigate the relationship between SUA and blood lipid. The OR tested the contribution of each single variable for SUA. The aOR tested the contribution of each single variable to sleep disturbance after controlling for age, BMI, current smoking, current drinking, physical activity, history of dyslipidemia, hypertension. After adjusting for some variables, TG was risk factor of SUA in men(OR=1.422, 95% CI=1.226-1.650) and in women(OR=1.358, 95% CI=1.193-1.547) and HDL-C was preventive factor of SUA(OR=0.437, 95% CI=0.237-0.805) in women.

Table 3 Logistic regression analysis of SUA and blood lipid in elderly men

	OR（95% CI）	aOR* （95% CI）
TC(mmol/L) TG(mmol/L) LDL-C(mmol/L) HDL-C(mmol/L)	1.252(1.095-1.431) 1.536(1.332-1.771) 1.046(0.835-1.309) 0.457(0.270-0.774)	1.652(1.080-2.527) 1.422(1.226-1.650) 1.043(0.812-1.339) 0.700(0.381-1.286)
*: adjusted odds ratio. Adjusted for age, BMI, current smoking, current drinking, physical activity , history of dyslipidemia, hypertension.		

Table 4 Logistic regression analysis of SUA and blood lipid in elderly women

	OR（95% CI）	aOR* （95% CI）
TC (mmol/L)	1.078(0.946-1.227)	1.126(0.974-1.301)
TG (mmol/L)	1.448(1.280-1.638)	1.358(1.193-1.547)
LDL-C (mmol/L)	1.066(0.856-1.326)	1.162(0.907-1.488)
HDL-C (mmol/L	0.355(0.209-0.604)	0.437(0.237-0.805)
*: adjusted odds ratio. Adjusted for age, BMI, current smoking, current drinking, physical activity, history of dyslipidemia, hypertension.		

4. Discussion

This study evaluated the association of urine acid level and blood lipid level in community elderly population. In our study, the prevalence of SUA was 34.26% in men and 28.95% in women(P<0.05). The level difference among genders was consistent with other literatures [7,8] ,which showed the mean level of SUA was significantly higher in male than in the female subjects .This results were higher than other community studies[9]. But there were also study

that the prevalence of SUA in women (14.1%) was higher than men (12.0%)[10]. It showed that there were widely difference of prevalence of SUA in different area of China.

The results showed that TG was a common risk factor in men and women. The literature pointed out the mechanism of urine acid complicated with lipid metabolism disorder, it may be due to the high uric acid level in the body that can be reduced the activity of lipoprotein lipase and decompose of TG by high uric acid level in body then increase TG level[11]. In recent years, study found Proprotein Convertase Subtilisin Kexin type 9 (PCSK9) was a newly gene that closely related to the regulation of lipid metabolism[12]. Zhong[13] used rats to explicate the correlation between urine acid and lipid metabolism disorders, the results showed that hyperuricemia could increase the level of PCSK9 which may affect lipid metabolism by increasing the expression of PCSK9 gene.

The team conducted further studies on the relationship between triglycerides and hyperuricemia in different gender and age groups. They retrospectively analyzed the physical examination data of 24438 subjects (12557 men and 11881 women). The results showed that there was a positive correlation between hypertriglyceridemia and hyperuricemia in both men and women. Further age stratification analysis showed that the positive correlation was significant in the male 20~, 30~, 30~, 40~, 50~, 60~ and 80~. Among women, there was no statistical significance in the 60 ~ and 70 ~ age groups.[14]

One of the main findings was that SUA is an independent risk factor for high-density lipoprotein (HDL) cholesterol. Some studies showed that hyperuricemia is primarily associated with HDL cholesterol in cross-sectional studies[15-18] that is consistent with our results. The protective properties of HDL-C were well known. As well as participating in the inverse transport of cholesterol for its hepatic elimination, HDL-C particles possess antioxidant, anti-inflammatory and antithrombotic properties that protect against the development of atherosclerosis and CVD[19]. The possible mechanism of the relationship between HDL and SUA is as follows: (1)HDL is a kind of plasma lipoprotein that can resist atherosclerosis. When HDL level decreases, the probability of atherosclerosis will increase. The damage of renal function caused by microangiopathy in arteriosclerosis and excessive lactic acid caused by hypoxia will lead to the Competitive inhibition of SUA excretion, resulting in the blockage of SUA excretion, which leads to the elevation of SUA level in patients[20]. (2) The decrease of HDL level and the accumulation of visceral fat can accelerate the production of SUA, then lead to more liver neutral fat synthesis and activate the SUA synthesis pathway[21]. (3) The deposition of sodium urate in the kidney leads to the decrease of renal function, resulting in the discharge of HDL and the accumulation of LDL[22]. (4) Visceral adipose tissue produces some adipocytokines to promote the development of insulin resistance, while hyperinsulinemia in turn reduces the renal excitation of SUA, leading to hyperuricemia[23,24].

Total cholesterol refers to the total cholesterol contained in all the lipoproteins in the blood. High total cholesterol indicates that the liver and lungs begin to develop substantial lesions. A study of northwest China showed that a significant correlation between total cholesterol and SUA[25], and many studies have shown that the risk of hyperuricemia increases with the increase in total cholesterol and triglyceride[26,27]. Uric acid not only can cause gout, but also with cardiovascular disease, kidney-related diseases, metabolic syndrome and diabetes[28,29], should cause clinical enough attention. The reason for the difference in correlation intensity between the sexes is still unclear and may be related to genetic

factors[30,31].In another study, men and women with high levels of TG and total TC significantly increased the prevalence of HUA. Age stratification analysis showed that there was a strong correlation between TG and HUA in men ≥ 55 years old and women under 55 years old, and there was a strong correlation between TC and HUA in both sexes < 55 years old, which was consistent with the results of our study.[32]

There are several limitations in this study that we need to be considered. First, this is a cross-sectional study, it did not make sure to ensure the relationship. Second, the participants in this study were aged≥60 years therefore the results may not be inferenced to all people. Third, the sex difference result needs more investigations to explore the underlying mechanisms.

5. Conclusions

In summary, this study showed a significant association between SUA and blood lipid in Chinese community elderly population who lives in Hangzhou. Results also provides additional evidence that SUA is more closely associated with the risk of lipid in women than men. The doctors should recognize high blood lipid level as a frequent comorbidity of SUA and take early action to prevent subsequent chronic disease.

Author Contributions

Huizhi Ding,Qingcheng Wang: Writing the original draft.**, Yan Ye:** Investigation.**, Yong Zheng:** Conceptualization, Supervision, review, and editing.

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