Gender Difference in the Association Between Serum Uric Acid Level and Metabolic Syndrome and Components: A Cross-Sectional Analysis Among Chinese Young Adults

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Abstract

Background

This study aimed to investigate the associations between serum uric acid (SUA) levels and metabolic syndrome (MetS) and MetS components in Chinese young adults.

Methods

A cross-sectional survey was conducted among 3044 young adults (1266 men and 1778 women). The anthropometric index, lipid profile, fasting blood glucose and SUA levels were measured. Male and female participants were grouped according to the quartiles of SUA level separately. Multiple logistic regression analyses were performed to evaluate the association of SUA quartiles with MetS and its components.

Results

The overall prevalence of hyperuricemia and MetS was 29.7% and 2%, respectively. Multiple logistic regression analysis revealed that compared with the lowest 2 quartiles of SUA together, the highest quartile showed an association with the prevalence of MetS and high triglyceride in males, and OR (95% CI) were 3.438(1.090-10.841) and 4.364(2.133–8.930) respectively after adjustments confounding factors. In terms of abdominal obesity, compared with the lowest 2 quartiles of SUA together, the OR (95% CI) was 1.976(1.128–3.459) for those in the third quartile and 1.766(1.020–3.057) for those in the highest quartile after adjustments confounding factors in females.

Conclusions

This study suggested a significant positive relationship between SUA and MetS and its components among young adults. Hence, routine measurement of SUA is recommended to prevent hyperuricemia and its related complications.

Background

Metabolic syndrome (MetS) is an increasing public health problem, including general or central adiposity, high blood pressure, hyperglycemia, and dyslipidemia ¹. The prevalence rates of MetS in China were 9.8% in men and 17.8% in women based on a survey conducted in 2000–2001² and the rates increased to 31.0% and 36.8%, respectively³. Epidemiological studies have reported that MetS with individual component is involved in various chronic diseases, such as cardiovascular diseases ⁴, diabetes ⁵ and cancers ⁶. Therefore, early intervention for MetS components is necessary to prevent the development of related diseases and reduce the public health burden worldwide.

Uric acid (UA) is the ultimate metabolite of purine compounds. Previous studies have shown that uric acid, as one of the strong antioxidants, can provide some type of protection against cell oxidative damage. However,

overproduction or underexcretion of uric acid can lead to adverse consequences, such as hyperuricemia and gout, which contribute to essential disease burden and health loss⁷. Previous epidemiological studies have found an association of increased serum uric acid (SUA) levels and MetS in different populations^{8–10}. Furthermore, studies have demonstrated that increased SUA level is an important marker for predicting the risk of developing MetS components, such as hypertension¹¹, diabetes¹², obesity¹³, and dyslipidemia¹⁴. Our previous study found that a significantly increasing trend existed in the body mass indices (BMI) across the SUA level quartiles (23.8 kg/m², 24.8 kg/m², 26.2 kg/m², and 30.1 kg/m²)¹⁵. However, most studies have focused on this relationship in adults.

It has been documented that lifestyle in early life may be a strong predictor of uric acid metabolism and the resulting disease risk¹⁶. Given the increased prevalence of MetS in the Chinese young adults, this study aimed to further evaluate the relationships between SUA and MetS components, including dyslipidemia, hypertension, and obesity among Chinese young adults.

Methods

Sample and procedure

This study was conducted from September to November 2018, all 3450 young adults from a medical school participated in the physical examination, with 3430 students participating in the survey (response rate: 99.42%). Excluded subjects were those who less than 18 years old (n=300), or missed height or weight (n=86), finally, 3044 eligible subjects were included in the final analyses. The self-administrated questionnaire was completed by trained interviewers with demographic characteristics of gender, age, smoking and drinking status, physical activity, etc.

Anthropometric measurement

All participants received physical examinations; weight, height, waist circumference (WC), hip circumference (HC) and blood pressure were measured. The measurements were obtained from each participant by trained staff according to a standard protocol. Height, WC and HC were measured to the nearest 0.1 cm and weight to the nearest 0.1 kg by ultrasound height and weight measuring instrument (Shengyuan, China). Subjects were measured in socks or bare feet and light clothes. WC was measured 1cm above the umbilicus in a horizontal plane. HC was measured at the level of the maximal gluteal protrusion by using general tape. Waist-hip ratio (WHR) was calculated as WC divided by HC. Blood pressure was measured 2 times by Omron U30 electronic sphygmomanometer in the seated position after at least 5 minutes of rest and their average value was obtained for analysis. Obesity was defined according to body mass index (BMI; weight (kg)/height (m)²) based on Chinese-specific criteria¹⁷. Accordingly, normal weight or underweight was defined as BMI<23.9kg/m², overweight as BMI of 24-27.9kg/m² and obesity as BMI≥28 kg/m². At least 30 minutes duration of exercises per day, that caused heavy sweating or large increases in breathing or heart rate, was defined as physical activity¹⁸. High physical activity was defined as exercising 3 times or more per week.

Laboratory measurements

Blood samples were obtained from participants after 10 hours of overnight fasting. High-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), total cholesterol (TC), triglycerides (TG), SUA and fasting plasma glucose (FPG) were measured by enzymology in Hitachi 7170A automatic analyzer (Hitachi, Japan). Hyperuricemia was defined as $\text{SUA} \geq 416$ ($\mu\text{mol/L}$) in males or ≥ 357 ($\mu\text{mol/L}$) in females¹⁹.

Definition of MetS

The definition of MetS was in accordance with the International Diabetes Federation and the American Heart Association criteria that the presence of any 3 of the following condition constitutes a diagnosis of MetS: WC for Asians ≥ 80 cm in women and ≥ 90 cm in men; systolic blood pressure (SBP) ≥ 130 mmHg or diastolic blood pressure (DBP) ≥ 85 mmHg; FPG ≥ 100 mg/dl; HDL-C < 50 mg/dl in women and < 40 mg/dl in men; TG level ≥ 150 mg/dl²⁰.

Statistical analysis

Continuous data were expressed by means $\pm$ standard difference (SD) and categorical variables by percentage. T-test and one-way ANOVA were used in continuous data analysis. Categorical variables distributions were compared by the Chi-square test and trend Chi-square test. Correlation analysis between SUA and continuous variables of MetS components were assessed by Pearson's correlation coefficient test. Multivariable logistic regressions were performed to evaluate the association of SUA and MetS and components to calculate odds ratios (ORs) and its 95% interval confidence (CI). SPSS 18.0 was used for statistical analysis (SPSS, Inc, Chicago, IL), and a P value < 0.05 was defined to be statistically significant.

Results

Baseline characteristics of this study

A total of 3044 young adults were included in the final data analysis. The mean age of the participants was 18.69 ± 0.95 years (range 18–26 years). Of the 3044 subjects, 1778 (58.41%) were females and the mean ($\pm$ SD) age was 18.68 ± 0.95 years. The prevalence of MetS, hyperuricemia and high physical activity in males was significantly higher than that in females ($P < 0.05$). The males had significantly higher BMI, WC, HP, WHR, SBP, DBP, LDL-C and FPG levels but significantly lower HDL-C and TC levels than the females ($P < 0.05$). The demographic characteristics of all participants are summarized in Table 1.

Table 1
Demographic and clinical characteristics of this study

Characteristic	Both genders (n = 3044)	Males (n = 1266)	Females (n = 1778)	t/ χ^2	P
Age (year)	18.69 ± 0.95	18.71 ± 0.95	18.68 ± 0.95	0.901	0.368
Height (cm)	165.37 ± 8.59	172.94 ± 6.04	159.98 ± 5.53	60.37	<0.001
Weight (kg)	61.32 ± 12.34	69.16 ± 12.55	55.74 ± 8.58	32.969	<0.001
BMI (kg/m ²)	22.32 ± 3.50	23.11 ± 3.93	21.76 ± 3.04	10.251	<0.001
WC (cm)	72.70 ± 9.00	78.25 ± 9.49	69.47 ± 7.02	24.747	<0.001
Abdominal obesity, n (%)	301 (9.9)	138 (10.9)	163 (9.2)	2.492	0.114
HC (cm)	94.09 ± 6.74	96.30 ± 7.27	92.51 ± 5.85	15.372	<0.001
WHR	0.77 ± 0.06	0.80 ± 0.05	0.75 ± 0.05	26.323	<0.001
SBP (mmHg)	114.07 ± 13.74	121.7 ± 13.49	108.64 ± 11.08	28.289	<0.001
DBP (mmHg)	71.03 ± 10.56	73.38 ± 11.01	69.35 ± 9.89	10.381	<0.001
TC (mmol/L)	4.06 ± 0.68	4.02 ± 0.74	4.09 ± 0.63	2.851	0.004
TG (mmol/L)	0.83 ± 0.40	0.87 ± 0.47	0.80 ± 0.34	4.309	<0.001
HDL-C (mmol/L)	1.42 ± 0.29	1.32 ± 0.29	1.49 ± 0.26	16.974	<0.001
LDL-C (mmol/L)	2.1 ± 0.56	2.16 ± 0.63	2.05 ± 0.50	5.16	<0.001
FPG (mmol/L)	4.56 ± 0.40	4.52 ± 0.39	4.59 ± 0.41	5.134	<0.001
Serum uric acid (μmol/L)	348.73 ± 100.09	422.77 ± 90.84	296.01 ± 67.79	42.016	<0.001
Hyperuricemia, n (%)	903 (29.7)	600 (47.4)	303 (17.0)	326.492	<0.001
Metabolic syndrome, n (%)	61(2.0)	33(2.6)	28(1.6)	4.009	0.045
High physical activity, n (%)	886 (29.1)	539 (42.6)	347 (19.5)	190.544	<0.001

Prevalence of MetS and its components among SUA quartiles by gender

Results showed that the BMI, WC, HP, WHR, SBP, DBP, TG, TC, LDL-C levels were progressively increased and HDL-C were progressively decreased across the SUA quartiles in both genders.

The participants were divided into 4 groups based on SUA levels (Q1: ≤359.15; Q2: 359.16-410.25; Q3: 410.26-472.55 and Q4: >472.55) in males. The prevalence of MetS, abdominal obesity, high blood pressure, high TG and low HDL-C showed a liner increased trend across the SUA quartiles ($P_{\chi^2 \text{ trend}}=0.001$). The detailed results were presented in Table 2.

Table 2
Characteristics of the subjects according to SUA quartiles in males

	Q1	Q2	Q3	Q4	F/χ^2	P
SUA ($\mu\text{mol/L}$)	≤ 359.15	359.16-410.25	410.26-472.55	> 472.55	-	-
Numbers (n)	316	317	317	316	-	-
Age(years)	18.80 ± 1.16	18.74 ± 0.94	18.62 ± 0.81	18.64 ± 0.85	2.526	0.056
Height (cm)	172.93 ± 5.84	172.8 ± 6.15	172.86 ± 5.71	173.17 ± 6.47	0.221	0.882
Weight (kg)	63.35 ± 8.78	67.84 ± 10.80	69.45 ± 11.26	76.02 ± 15.11	63.49	<0.001
BMI (kg/m^2)	21.17 ± 2.67	22.72 ± 3.47	23.24 ± 3.53	25.32 ± 4.65	69.596	<0.001
WC (cm)	72.98 ± 6.51	76.37 ± 8.44	77.25 ± 8.51	82.40 ± 11.39	60.734	<0.001
HC (cm)	93.14 ± 5.73	95.68 ± 6.80	96.6 ± 6.51	99.79 ± 8.22	50.343	<0.001
WHR	0.78 ± 0.04	0.80 ± 0.05	0.80 ± 0.05	0.82 ± 0.06	32.802	<0.001
SBP (mmHg)	119.15 ± 12.37	121.28 ± 12.96	122.03 ± 13.64	124.34 ± 14.47	8.092	<0.001
DBP (mmHg)	72.22 ± 10.23	73.20 ± 10.77	72.87 ± 10.90	75.23 ± 11.91	4.428	0.004
TC (mmol/L)	3.84 ± 0.63	3.93 ± 0.63	4.07 ± 0.87	4.24 ± 0.73	18.932	<0.001
TG (mmol/L)	0.74 ± 0.29	0.83 ± 0.37	0.87 ± 0.44	1.03 ± 0.66	22.202	<0.001
HDL-C (mmol/L)	1.36 ± 0.23	1.34 ± 0.27	1.31 ± 0.23	1.24 ± 0.23	14.418	<0.001
LDL-C (mmol/L)	1.98 ± 0.52	2.07 ± 0.53	2.21 ± 0.72	2.39 ± 0.64	27.004	<0.001
FPG (mmol/L)	4.50 ± 0.37	4.53 ± 0.37	4.52 ± 0.39	4.53 ± 0.41	0.408	0.747
Abdominal obesity, n (%)	7 (2.2)	26 (8.2)	32 (10.1)	73 (23.1)	75.565*	<0.001
High blood pressure, n (%)	96 (30.4)	103 (32.5)	113 (35.6)	137 (43.4)	13.393*	<0.001
High TG, n (%)	4 (1.3)	8 (2.5)	14 (4.4)	41(13)	52.764*	<0.001
Low HDL-C, n (%)	11 (3.5)	17 (5.4)	18(5.7)	38(12.0)	21.192*	<0.001
hyperglycemia, n (%)	1 (0.3)	2(0.6)	3(0.9)	5(1.6)	3.217	0.359
MetS, n (%)	0(0.0)	4(1.3)	7(2.2)	22(7.0)	34.526*	<0.001

	Q1	Q2	Q3	Q4	F/χ^2	P
High physical activity, n (%)	128(40.5)	127(40.1)	135(42.6)	149(47.2)	4.079	0.253
* The values of the chi-square trend test.						

In females, the participants were divided into 4 groups based on SUA levels (Q1: ≤ 249.48 ; Q2: 249.49-289.15; Q3: 289.16-334.93 and Q4: >334.93). The prevalence of MetS, abdominal obesity, high TG and low HDL-C showed a liner increased trend across the SUA quartiles ($P_{\chi^2 \text{ trend}}=0.001$). The detailed results were presented in Table 3.

Table 3
Characteristics of the subjects according to SUA quartiles in females

	Q1	Q2	Q3	Q4	F/χ^2	P
SUA ($\mu\text{mol/L}$)	≤ 249.48	249.49- 289.15	289.16- 334.93	> 334.93	-	-
Numbers (n)	444	445	445	444	-	-
Age(years)	18.67 ± 0.93	18.72 ± 1.01	18.67 ± 0.94	18.66 ± 0.93	0.346	0.792
Height (cm)	159.47 ± 5.69	159.87 ± 5.39	160.61 ± 5.52	159.97 ± 5.49	3.249	0.021
Weight (kg)	53.09 ± 6.99	53.84 ± 7.26	56.65 ± 7.94	59.39 ± 10.28	54.291	<0.001
BMI (kg/m^2)	20.86 ± 2.37	21.05 ± 2.51	21.94 ± 2.73	23.19 ± 3.77	59.985	<0.001
WC (cm)	67.55 ± 5.78	67.85 ± 5.79	70.14 ± 6.57	72.34 ± 8.52	48.668	<0.001
HC (cm)	90.93 ± 4.89	91.29 ± 5.18	93.11 ± 5.48	94.70 ± 6.86	42.418	<0.001
WHR	0.74 ± 0.05	0.74 ± 0.04	0.75 ± 0.05	0.76 ± 0.05	16.808	<0.001
SBP (mmHg)	107.67 ± 10.66	107.83 ± 10.59	108.90 ± 11.27	110.19 ± 11.62	4.953	0.002
DBP (mmHg)	68.69 ± 9.91	68.72 ± 10.31	69.55 ± 9.72	70.43 ± 9.55	3.098	0.026
TC (mmol/L)	4.04 ± 0.60	4.05 ± 0.61	4.11 ± 0.63	4.17 ± 0.66	4.315	0.005
TG (mmol/L)	0.75 ± 0.27	0.77 ± 0.31	0.82 ± 0.36	0.87 ± 0.42	9.745	<0.001
HDL-C (mmol/L)	1.53 ± 0.24	1.51 ± 0.27	1.48 ± 0.26	1.45 ± 0.28	8.751	<0.001
LDL-C (mmol/L)	1.98 ± 0.46	1.99 ± 0.48	2.07 ± 0.50	2.17 ± 0.53	13.786	<0.001
FPG (mmol/L)	4.59 ± 0.40	4.60 ± 0.42	4.60 ± 0.40	4.58 ± 0.45	0.201	0.896
Abdominal obesity, n (%)	16 (3.6)	19 (4.3)	43 (9.7)	85 (19.1)	72.106*	<0.001
High blood pressure, n (%)	46 (10.4)	43 (9.7)	48 (10.8)	52 (11.7)	1.03	0.794
High TG, n (%)	3 (0.7)	5(1.1)	7 (1.6)	16 (3.6)	11.041*	0.001
Low HDL-C, n (%)	69 (15.5)	99(22.2)	103 (23.1)	140 (31.5)	29.814*	<0.001
hyperglycemia, n (%)	4 (0.9)	5(1.1)	4 (0.9)	7 (1.6)	1.219	0.748
MetS, n (%)	0(0.0)	4(0.9)	4 (0.9)	20(4.5)	26.135*	<0.001
High physical activity, n (%)	75(16.9)	86(19.3)	91(20.4)	95(21.4)	3.203	0.361

Q1	Q2	Q3	Q4	F/χ^2	P
* The values of the chi-square trend test.					

Correlation Between Sua And Continuous Variables Of Mets Components

In males, SUA levels was positively associated with WC ($r = 0.301$), SBP($r = 0.109$), DBP ($r = 0.111$), TG ($r = 0.140$), and was negatively associated with HDL ($r = -0.206$). All P values were less than 0.001. In females, SUA levels was positively associated with WC ($r = 0.379$), SBP($r = 0.144$), DBP ($r = 0.092$), TG($r = 0.254$), and negatively associated with HDL ($r = -0.134$). All P values were <0.001 .

Association Between Sua And Mets And Mets Components

The prevalence of the MetS was too low among participants in the lowest quartile (cases = 0) of the serum concentration of the uric acid. Therefore, we collapsed the 2 lowest quartiles of uric acid into a single reference group. After adjusted for age and obesity (based on BMI), the SUA showed a significant association with the prevalence of MetS in males (OR: 3.438, 95% CI: 1.090-10.841). Of the 5 components, after adjustment for age, obesity and the other components of the MetS as dichotomized variables, a positive association was observed between SUA and high TG in males (the highest quartile vs. the lowest 2 quartiles OR: 4.364, 95% CI: 2.133–8.930).

In females, compared with the lowest 2 quartiles, the SUA was categorized in the 3rd quartile and the highest quartile showed a positive association with abdominal obesity prevalence after adjustment for age, obesity and the other components of the MetS as dichotomized variables, with the OR (95% CI) were 1.976(1.128–3.459) and 1.766(1.020–3.057), respectively. The data were presented in Table 4.

Table 4
Adjusted odds ratios for MetS and components according to serum uric acid by gender

			Q1 + Q2	Q3	Q4		
			Reference	OR (95% CI)	P	OR (95% CI)	P
Males	MetS	Crude	1	3.551(1.032–12.221)	0.044	11.767(4.019–34.454)	<0.001
		Adjust*	1	1.932(0.528–7.067)	0.32	3.438(1.090–10.841)	0.035
	High TG	Crude	1	2.391(1.093–5.233)	0.029	7.715(3.993–14.909)	<0.001
		Adjust†	1	1.912(0.848–4.307)	0.118	4.364(2.133–8.930)	<0.001
	Low HDL-C	Crude	1	1.301(0.708–2.389)	0.397	2.953(1.776–4.91)	<0.001
		Adjust†	1	0.935(0.496–1.763)	0.835	1.346(0.750–2.415)	0.319
	Abdominal obesity	Crude	1	2.041(1.23–3.387)	0.006	5.462(3.527–8.458)	<0.001
		Adjust†	1	0.712(0.328–1.547)	0.391	0.966(0.479–1.949)	0.924
	High blood pressure	Crude	1	1.208(0.909–1.606)	0.193	1.669(1.263–2.206)	<0.001
		Adjust†	1	1.022(0.760–1.375)	0.884	1.072(0.786–1.462)	0.659
Females	MetS	Crude	1	2.007(0.5–8.062)	0.326	10.436(3.545–30.724)	<0.001
		Adjust*	1	1.231(0.288–5.270)	0.779	2.302(0.700–7.572)	0.17
	High TG	Crude	1	1.76(0.634–4.885)	0.278	4.117(1.748–9.695)	0.001
		Adjust†	1	1.421(0.500–4.039)	0.51	1.875(0.716–4.908)	0.201
	Low HDL-C	Crude	1	1.293(0.98–1.705)	0.069	1.976(1.522–2.567)	<0.001
		Adjust†	1	1.119(0.839–1.491)	0.445	1.280(0.959–1.708)	0.093

		Q1 + Q2	Q3	Q4		
Abdominal obesity	Crude	1	2.61(1.645–4.141)	<0.001	5.777(3.824–8.727)	<0.001
	Adjust†	1	1.976(1.128–3.459)	0.017	1.766(1.020–3.057)	0.042
High blood pressure	Crude	1	1.087(0.75–1.575)	0.66	1.192(0.83–1.714)	0.342
	Adjust†	1	1.005(0.690–1.463)	0.98	0.938(0.637–1.381)	0.746
Hyperuricemia	Crude	1	0.887(0.272–2.896)	0.842	1.566(0.579–4.234)	0.376
	Adjust†	1	0.759(0.228–2.528)	0.654	1.193(0.407–3.493)	0.748
* adjusted for age and obesity(based on BMI),†Adjusted for age, obesity and the other components of the MetS as dichotomized variables						

Discussion

In this cross-sectional study, the overall prevalence rate of hyperuricemia was 29.7%, which was significantly more common in males than in females (47.6% vs. 17%). This rate was higher than those in most Asian epidemiological studies: Bangladesh, 9.3%²¹; Japan, 25.8%²²; and Thailand, 10.6%²³. These disparities may be attributable to racial or ethnic differences. A more recent Thai study reported that the prevalence of hyperuricemia in men has reached 59%²⁴. Age differences may also partly explain this phenomenon. In the present study, the participants were young adults. In a Spanish study, the prevalence rate of hyperuricemia in children was 53%²⁵. In China, students had high-intensity learning and accompanying high nutrition, including plenty of purine-rich foods in senior high school, which may lead to increased uric acid level and weight gain.

The results of the present study showed that the prevalence of MetS increased linearly in the quaternion of SUA, which confirmed the strong association between SUA level and MetS in Chinese young adults. These results were consistent with several epidemiological studies which reported in Asian population^{9,10}, European population^{14,26}, North American population²⁷. After adjustment for confounding factors, SUA remained a risk factor for MetS in males. Low prevalence of MetS in the young participants may explain the possible reason. In a longitudinal study on Taiwanese adults, SUA seems an important predictor for the risk of incident MetS in 30–40 years but not in 20–30 years age groups²⁸. The mechanism for the positive association between SUA levels and MetS has not been fully elucidated, but some studies have suggested several possible explanations. Xanthine oxidoreductase (XOR) is a key enzyme in the formation of UA. It may participate in the pathogenesis of metabolic syndrome through oxidative stress and inflammation induced by XOR derived reactive oxygen species and UA²⁹. Animal experiments showed that XOR knockout mice could not produce UA, which led to the defect of fat accretion, suggesting that UA is involved in the adipogenesis³⁰. Hyperuricemia has been demonstrated to impair nitric oxide generation and subsequent endothelial dysfunction³¹. Another

important mechanism may be that hyperuricemia involved in insulin resistance through the production of reactive oxygen species and Deficiency of endothelial-formed nitric oxide³².

In addition, a positive association of SUA levels with low HDL-C and high TG was observed independent sex. However, the association with low HDL-C was no longer significant, whereas associated with high TG in males in multivariable regressions. This finding was partly similar to that of previous study which conducted among US children and adolescents³³. In a survey of 234 male seafarers, SUA levels was associated with MetS and high TG³⁴. Studies on the association between SUA levels and dyslipidemia were primarily conducted in elderly or middle-aged adults even though the results were controversial³⁵⁻³⁷. However, these results were likely to be disturbed by other confounding factors, such as chronic cardiovascular diseases and long-term medication. This observation indicated that SUA level might be a biomarker in the development of high TG in males.

Our results further found an association between SUA levels and abdominal obesity in females. The finding, which was more relevant to women, was similar to a Japanese study³⁸. As we know, abdominal obesity is characterized by accumulation of visceral fat. Hikita et al.³⁹ reported that SUA level was positively correlated with visceral fat area and subcutaneous fat area. According to a recent study, saliva UA has been proved to be an important marker of fat accumulation in adolescents⁴⁰. Hyperuricemia reduces serum leptin levels, thereby inhibiting the decomposition of visceral fat and increasing the accumulation of TG in non-adipocytes, promoting the development of obesity⁴¹. Rats model experiments indicated that inhibition of UA production could block the conversion of fructose to TG in hepatocytes and reduce the accumulation of TG⁴². It is suggested that the increase of SUA level is involved in the occurrence and development of abdominal obesity.

Of the MetS components, high blood pressure showed an increased prevalence across the SUA levels in males, but the difference failed to reach statistical significance adjustment for other MetS components. This result is different from that shown by a 5-year cohort study, which indicated that hyperuricemia was associated with increased incidence rates of hypertension⁴³. The difference might be attributed to the different subjects that subjects in our study were younger (18 to 26 years) than the reported study (30 to 85 years). Additionally, we adjusted abdominal obesity, hyperglycemia, high TG and low HDL-C that maybe interferes or modify this relationship. A Japanese cross-sectional study revealed that serum TG level may interfere with the relationship between SUA and prehypertension⁴⁴. These results suggest that, if there are other metabolic factors or interactions interfere with or alter this relationship.

Our results should be interpreted in the context of potential limitations. Firstly, as it is a cross-sectional study, this study cannot prove the causal relationship between SUA and MetS and its components. Therefore, more prospective studies need to be conducted. Secondly, as the subjects of this study were young adults, the prevalence of hyperglycemia in females was 1.12% and 0.87% in males, and the prevalence of MetS in the total subjects was 2%. This low prevalence may affect the confidence of the results. Finally, this study was conducted in a medical university and may not be applicable to other ethnic populations.

Conclusions

In present study, we confirmed that SUA level was positively associated with the prevalence of MetS and high TG in young male adults. In females, SUA was significantly associated with the prevalence of abdominal obesity. Additionally, more attention is necessary to examine the role of SUA in the pathogenesis of MetS.

List Of Abbreviations

SUA serum uric acid

MetS metabolic syndrome

BMI body mass indices

WC waist circumference

HC hip circumference

WHR Waist-hip ratio

HDL-C High-density lipoprotein cholesterol

LDL-C low-density lipoprotein cholesterol

TC total cholesterol

TG triglycerides

FPG fasting plasma glucose

SBP systolic blood pressure

DBP diastolic blood pressure

Declarations

Ethics approval and consent to participate

The study procedure was approved by the Scientific Research Institutional Review Board of Wannan Medical College Yijishan Hospital, and was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all the participants.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Study concept and design: YYS and FZM. Subjects' collection: FZM, CY, ZLJ, HLP, JYL, and YYS. Acquisition and analysis of data: ZLJ and JYL. The drafting and writing of the manuscript: FZM and HLP. The revision of the manuscript: YYS and CY. All authors approved the final manuscript.

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