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The impact of serum uric acid on the diagnostic of metabolic syndrome in apparently healthy Brazilian middle-aged men

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Abstract

Background: **Hyperuricemia is related to Metabolic Syndrome (MetS) and cardiovascular diseases, but the use of serum uric acid (UA) to diagnose MetS is currently ignored in clinical practices.**

Objectives: **To examine the impact of serum UA on the diagnostic of MetS and the relationship of serum UA with cardiometabolic risk factors in apparently healthy Brazilian middle-aged men residents in a city of Minas Gerais.**

Methods: **In a cross-sectional analysis, 289 apparently healthy middle-aged men underwent anthropometric, clinical, sociodemographic and blood serum biochemical evaluation. By using receive operating curve the internal cutoff of serum UA was determined (5.25 mg/dL).**

Results: **Subjects with two or more components of MetS exhibited higher serum UA as compared to those with one or none component. The inclusion of serum UA ≥ 5.25mg/dL as an additional component of MetS increased the occurrence of this syndrome by 13%. Subjects with UA ≥ 5.25mg/dL showed high prevalence for MetS and association with its components (central obesity, hypertriglyceridemia, dyslipidemia and hypertension) as well as atherogenic risk.**

Conclusions: **Serum UA has an important impact on the diagnostic of MetS and is related to cardiometabolic risk factors in apparently healthy Brazilian middle-aged men. Its use in clinical practices could aggregate accuracy to diagnose MetS.**

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EL IMPACTO DEL ÁCIDO ÚRICO SÉRICO EN EL DIAGNÓSTICO DEL SÍNDROME METABÓLICO EN BRASILEÑOS DE MEDIANA EDAD APARENTEMENTE SALUDABLES

Resumen

Introducción: **La hiperuricemia viene sido asociada con el síndrome metabólico (SM) y las enfermedades cardiovasculares, pero el uso del ácido úrico (AU) en el diagnóstico del SM es comúnmente ignorado en la práctica clínica.**

Objetivos: **Investigar el impacto de las concentraciones de AU en el diagnóstico del SM y la asociación del AU sérico con los factores de riesgo cardiometabólico en brasileños de mediana edad aparentemente saludables residentes en una ciudad de Minas Gerais.**

Métodos: **Por medio de un análisis transversal, 289 hombres de mediana edad aparentemente saludables fueron sometidos a evaluaciones para determinaciones de variables antropométricas, clínicas, sociodemograficos y bioquímicas. Para determinar el mejor punto de corte para la concentración del AU sérico con respecto al diagnóstico del SM (5.25 mg/dL) fue utilizada la curva ROC.**

Resultados: **Sujetos con dos o más componentes del SM han demostrado mayores concentraciones séricas de AU cuando comparados con individuos con uno o ninguno componente. Además, la inclusión del AU > 5.25 mg/dL como un componente adicional en el diagnóstico del SM aumentó la ocurrencia de este síndrome en un 13%. Finalmente, los hombres con AU ≥ 5.25mg/dL presentaron una asociación positiva con componentes del SM (obesidad central, hipertrigliceridemia, dislipemia e hipertensión arterial), así como un mayor riesgo aterogénico.**

Conclusión: **AU serico tiene un relevante impacto en la ocurrencia del SM, asi como es asociado a reconocidos factores de riesgo cardiometabólico en brasileños de mediana edad aparentemente saludables y, su uso en la práctica clínica podría añadir en la exactitud del diagnóstico del SM.**

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Palabras clave: *Enfermedades cardiovasculares. Hiperuricemia. Envejecimiento*.

Abbreviations

MetS: Metabolic Syndrome.
pre-MetS: pre Metabolic Syndrome.
UA: uric acid.
CVD: cardiovascular diseases.
CI: confidence interval.
UFV: Universidade Federal de Viçosa.
ECHR: Ethnic Committee Human Research.
SBP: Systolic blood pressure.
DBP: Diastolic blood pressure.
HDL-c: high-density lipoprotein cholesterol.
hs-CRP: high sensitivity C-reactive protein.
HOMA-IR: homeostasis model assessment.
IR: insulin resistance.
TC: HDL-c: total cholesterol to HDL-c ratio.
TG: HDL-c: triacylglycerol/high-density lipoprotein cholesterol ratio.

Introduction

The metabolic syndrome (MetS) has been investigated in the view of its relationship with cardiovascular diseases (CVD) and mortality[1]. Acording to Alberti et al.[2], individuals exhibiting three or more of the following components: central obesity, hyperglycemia, hypertension and dyslipidemia (i.e. high triglycerides and/or low high-density lipoprotein cholesterol) are diagnosed with MetS. As of the accuracy of MetS diagnostic in clinical practices[3], recent studies indicated the inclusion of other factors/components to diagnose MetS, such as the levels of cortisol and uric acid (UA)[4-5].

In this sense, previous studies showed that serum UA is associated with cardiometabolic risk factors and MetS in different populations[5-8] In Brazil, such association was observed in adult men of different ages (i.e. from 20 to 82 years) residents in the states of São Paulo[9,10], Espírito Santo[11] and Rio de Janeiro[12]. Taking into consideration that in Brazil the increase of MetS, CVD and type 2 diabetes in middle-aged individuals is notorious[11], it is noteworthy that only the study of Desai et al.[10] reported the association of UA and MetS in this specific stage of life. In addition, although previous studies were carried out in the Brazilian southeast region, the most populated and urbanized in this country, no studies were performed in the state of Minas Gerais, where the second largest Brazilian middle-age and elderly population live[14]. Moreover, the impact of serum UA on the diagnostic of MetS in Brazilian middle-aged men is not known. Such finding could help the early diagnostic of MetS in this population and then improve detection and prevention of related diseases.

Therefore, the aims of this cross-sectional study were, first, to examine the impact of serum UA on the diagnostic of MetS, and then, to verify the relationship of serum UA with cardiometabolic risk factors in a sample of apparently healthy Brazilian middle-aged men residents in a city of Minas Gerais.

Methods

Study population

This cross-sectional study was carried out between March and December 2011, in the city of Viçosa (East Region of Minas Gerais) - Brazil. Sample size was calculated by the total number of men in the staff board of the Universidade Federal de Viçosa (UFV), in February 2011 with ages between 40 and 59 years (1,774 individuals), confidence level of 95%, 21.6 % expected prevalence of metabolic syndrome in Brazilian middle-aged men[15] and 4.5 % sampling error resulting in 273 participants as a minimal sample size required. The program Epi Info, version 6.04 for cross-sectional studies was used to estimate sample size. Subjects were selected by systematic sampling and replaced if they did not meet the inclusion criteria.

Among 884 interviewees, 586 subjects were excluded according to the following exclusion criteria: body weight alterations ≥ 3kg (n=58), increase or decrease in daily physical activities (i.e. engagement or dropout in regular programs) and/or food intake (i.e. special diet) in the three months preceding the study; occurrence of heart or cerebrovascular diseases, infectious and/or inflammatory diseases, diseases of the gastrointestinal tract, liver and chronic kidney and/or history of kidney stones, or cancer in the previous ten years (n=63), treatment using diuretics or drugs that could alter food intake and/or metabolism of nutrients (n=459), pacemaker and/or prosthetic limb users (n=2) and elite athletes (n=1) and, throughout the data collection, 14 subjects did not complete all phases. Thus, two hundred eighty-nine subjects concluded all steps of the present study.

The study is in accordance with the resolution 196/1996 from the Brazilian Ministry of Health regarding research involving human subjects and was approved by the Ethics Committee on Human Research of the Universidade Federal de Viçosa (protocol 069/2010/ECHR). All participants included in the study gave informed written consent in accordance with the Declaration of Helsinki.

Anthropometric, blood pressure and hemodynamic measurements

Anthropometric measures (i.e. weigh, height, and waist circumference) were performed using standard procedures, as previously described[16]. Systolic (SBP) and diastolic blood (DBP) pressures were measured using an automatic inflation blood pressure monitor (BP3AA1-1, G-Tech, OnboElectronicCo, Schenzen, China), registered at ANVISA (No. 80275310004), following the VI Brazilian Guidelines on Hypertension[17].

Blood samples were collected from the antecubital vein and the serum was separated by centrifugation

at 2.225 *g* for 15 min (Sigma 2-3, Sigma Laborzentrifuzen, OsterodeamHarz, Germany) at room temperature and serum aliquots were frozen at – 80 ºC to further analyses.

Glucose, total cholesterol, high-density lipoprotein cholesterol (HDL-c) and triacylglycerol were determined by standard protocols as previously described[16]. The atherogenic index was calculated as the total cholesterol to HDL-c ratio (CT:HDL-ratio)[18] and triacylglycerol to HDL-c ratio (TG:HDL-c ratio)[19].

The serum UA and high sensitivity C-reactive protein (hs-CRP) were determined by an enzymatic colorimetric and immunoturbidimetric method, respectively, with commercially available kits (Quibasa Química Básica LTDA, Belo Horizonte, MG, Brazil).

Determination of metabolic syndrome, insulin resistance and cardiometabolic risk factors

The MetS was diagnosed in individuals who exhibited three or more of the following components: waist circumference ≥ 90 cm (specific value for South American men), fasting glucose ≥ 100 mg/dL, HDL-c < 40 mg/dL, triacylglycerol ≥ 150mg/dl and/or high blood pressure (systolic ≥ 130 mmHg or diastolic ≥ 85 mmHg), according to the criteria and cutoff points suggested by Alberti et al.[2].

The homeostasis model assessment (HOMA-IR) was used to detected insulin resistance (IR) using an equation proposed by Matthews et al.[20] and cutoff value suggested by Genoleze et al.[21] (HOMA-IR ≥ 2.71). The following values were set as cardiometabolic risk factors[22] : total cholesterol ≥ 200mg/dl and; atherogenic indexes, estimated as the total cholesterol to HDL-c ratio (TC:HDL-c) and triacylglycerol/high-density lipoprotein cholesterol ratio (TG:HDL-c) with cutoffs of ≥ 5[18] and ≥ 3.5[23], respectively.

Lifestyle

The subjects who participated in this study occupied technical administrative positions, classified as levels A, B, C, D, and E, or professor (high school and college) positions. To evaluate how lifestyle and occupation influenced the serum UA they were grouped according to their education level and positions: Group 1 was composed of technical and administrative staff members, classified as A, B and C, with an education level up to high school. Group 2 was composed of technical and administrative staff members levels D and E and professors, all college-educated.

Participants were asked about smoking (yes / no) and excessive alcohol consumption was defined as intake of over 21 units/wk[24].

The habitual physical activity was estimated by the mean number of daily steps (7 consecutive days) measured by the digital pedometer (Digiwalker SW-200, Yamax Corporation, Tokyo, Japan)[25]. The number of 10,000 steps/day was considered an adequate cutoff point, since it was associated with health-related parameters as well as it was proposed to classify participants as "active"[14, 25].

A quantitative food frequency questionnaire validated for the Brazilian population was used to assess the usual dietary intake of the participants[26]. For each item in the food frequency questionnaire participants reported the frequency of regular intake (daily, weekly or monthly) and the portion size (small, medium or large), which were converted to grams of food intake per day. The energy intake and the consumption of macronutrients were assessed using the software Diet Pro® version 5.5i (AS Systems, Viçosa, Brazil), using two Brazilian nutritional composition table[27, 28], for necessary nutritional information not found in the national tables.

Statistical Analysis

Descriptive data are presented as mean values and standard deviation or median and interquartile range for continuous variables and frequency for categorical variables, as appropriate. Normal distribution of the data was determined by the Shapiro–Wilk test. Non-normally distributed variables were log-transformed before statistical analyses.

Area under curve-receiver operating curve was used to determine the serum UA concentration cutoff that could be used as an additional criterion in the diagnostic of MetS. The UA concentration of 5.25 mg/dL was the best internal cutoff value according to the Youden Index (58.3 % Sens; 70.2 % Spec; 40.6 % and 80.2 % of positive and negative predictive values, respectively – Figure 1). In this sense, the participants of the study were categorized in two groups: high UA and low UA, according to the UA internal cutoff value (5.25 mg/dL)

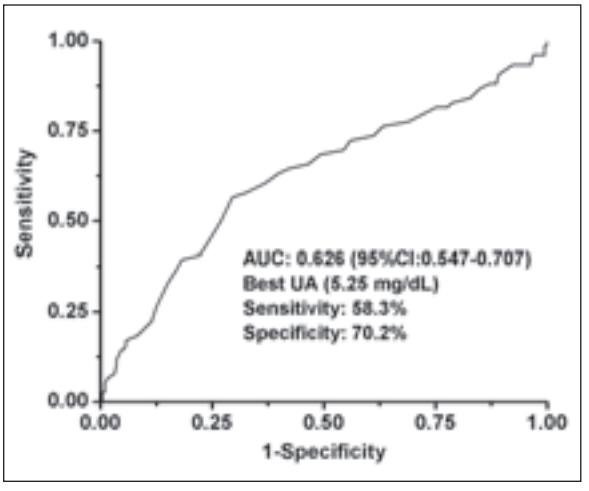

Fig. 1.—Receiver operating characteristic curve to detect metabolic syndrome by using serum uric acid concentration.

to analyze MetS occurrence as well as metabolic data variation. Such methodological procedure of distributing participants into groups of risk has been previously used in cross-sectional studies[16,29]. Therefore, to examine the impact of serum UA on the prevalence of MetS, we included the serum UA (≥ 5.25 mg/dL) as an additional component of MetS and recalculated the MetS prevalence as mentioned above.

Statistical comparisons between two groups were performed by the parametric Student t test, Mann–Whitney *U* test, chi-square test or McNemar test as appropriate. For comparisons among three or more groups, ANOVA one-way followed by Bonferroni post-hoc test was applied. The prevalence ratio was determined by Poisson regression with a confidence interval of 95 % to assess the associations of UA cutoff value found in the present study with the occurrence of MetS and with cardiometabolic risk factors (hypertriglyceridemia, dyslipidemia, insulin resistance, coronary risks, and high blood pressure). All statistical analyses were performed using SPSS 16.0 software (SPSS,Inc., Chicago, IL, USA) for Windows 7 (Microsoft, Redmond, WA, USA) and STATA 9.1. The results were considered statistically significant at the .05 level.

Results

The participants presented the following prevalence: 87.7% for dyslipidemia; 27.1 % for hypertriglyceridemia, 42 % for pre-hypertension, 21.1% for hypertension, 18.2 % for hyperglycemia and 29.1 % for MetS. In addition, 34.6 % and 31.2 % of subjects showed elevated TC:HDL-c ratio and TG:HDL-c ratio, respectively.

To analyze the study population mean serum UA concentration according to the presence of components of MetS the individuals were subdivided into four groups: no component; one component; two components or pre-MetS; and three or more components or MetS. Subjects in the MetS group showed higher concentrations of UA as compared to those in the other groups and individuals in the Pre-Mets group exhibited higher UA than those in the group with no component (Figure 2).

We used the internal serum cutoff as the serum UA concentration to be used as an additional criterion in the diagnostic of MetS. The MetS group showed more individuals with UA ≥ 5.25 mg/dL than the other groups (Figure 3) and the Pre-Mets and 1 component groups had more individuals with ≥ 5.25 mg/dL as compared to no component group ($p < .05$). In addition, as mentioned above, when using the Alberti et al.[2] criteria, the prevalence of MetS was 29.1 % among the study participants. However, when we included serum UA (≥ 5.25 mg/dL) as an additional component for MetS diagnosis, there was a significant increase of 13.0 % in the occurrence of MetS ($p < .05$; figure 4).

We also observed that those individuals with high serum UA concentration (≥ 5.25 mg/dL) exhibited higher values for body mass index, waist circumference, glucose and lipid biomarkers, blood pressure, atherogenic and IR indexes (table I). The high UA group presented a tendency for more alcohol consumption ($p=0.079$) (table II) while no between group differences in physical activity level, habitual dietary intake, smoking and work position were observed.

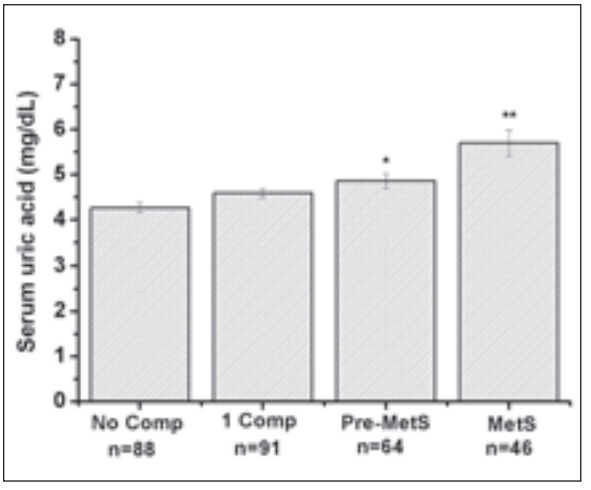

*Fig. 2.—Serum uric acid concentration in participants grouped according the number of components (comp) of metabolic syndrome (MetS). Data are means ± SEM. Pre-MetS, individuals with two components. MetS, individuals with three or more components. n, number of participants. *, statistically different from no comp group. **, statistically different from all other groups (p< .05, ANOVA followed by the Bonferroni post-hoc test).*

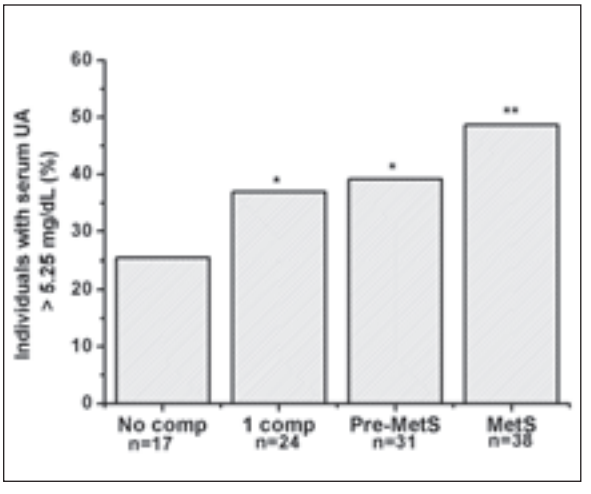

*Fig. 3.—Frequency of participants with UA ≥ 5.25 mg/dL grouped according the number of components (comp) of metabolic syndrome (MetS). Data are means ± SEM. Pre-MetS, individuals with two components. MetS, individuals with three or more components. n, number of participants. *, statistically different from no comp group. **, statistically different from all other groups (p< .05, Chi-square).*

Table I
Study population clinical and metabolic characteristics according to internal serum uric acid cutoff point (≥ 5.25 mg/dL)[a]

Variables	*Low UA (n= 179)*	*High UA (n= 110)*	*p-value[b]*
Uric Acid (mg/dl)	4.2 (3.6-4.7)[c]	5.9 (5.6-6.7)	< .001*
Age (years)	52 (46-54)	51 (47-54)	.891
Body mass index (kg/m^2)	25.2 ± 3.6	26.9 ± 3.2	< .001*
Waist circumference (cm)	87.9 ± 9.7	94.1 ± 8.5	< .001*
Glucose (mg/dL)	87 (82-92)	90 (84-99)	< .001*
HOMA-IR	0.94 (0.64-1.50)	1.51 (0.95-2.23)	< .001*
Total cholesterol (mg/dL)	207 ± 40	226 ± 42	< .001*
HDL-c (mg/dL)	45 (40-55)	43 (36-52)	.009*
Triacylglycerol (mg/dL)	102 (72-142)	133 (103-196)	< .001*
hs-CRP (mg/L)	0.70 (0.32-1.81)	1.16 (0.54-2.41)	< .001*
Systolic BP (mmHg)	124 (115-132)	128 (121-135)	.006*
Diastolic BP (mmHg)	79.5 ± 9.7	83.5 ± 9.9	.001*
Mean BP (mmHg)	92.7 (86.9-100.2)	97.9 (91.5-104.0)	.001*
TC:HDL-c	4.38 (3.59-5.10)	5.06 (4.35-6.47)	< .001*
Triglycerides: HDL-c	2.25 (1.41-3.35)	3.54 (2.02-5.66)	< .001*

n- number of participants; UA- uric acid; hs-CRP- high sensitivity C-Reactive Protein; HOMA-IR- homeostatic model assessment insulin resistance; BP- blood pressure; TC- total cholesterol; HDL-c- high density lipoprotein cholesterol; *denotes significant difference between groups;
[a] internal serum uric acid cutoff point (see methods);
[b] p-values from Student t-test or Mann-Whitney test, according to normally distribution of the variables;
[c] Data are mean ± standard deviation or median (25th-75th percentiles), according to normality distribution of the variables.

Finally, subjects with high UA (> 5.25 mg/dL) showed significantly high prevalence for central obesity, hypertriglyceridemia, dyslipidemia, hypertension, atherogenic risk, insulin resistance and MetS, regardless their age, alcohol consumption (model 1) and body mass index (model 2; table III).

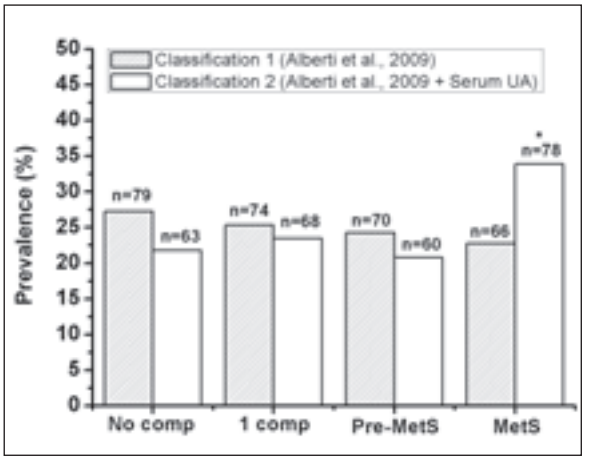

*Fig. 4.—Frequency of participants with none, one, two and three or more components of metabolic syndrome (MetS) in two classifications. Pre-MetS, individuals with two components. MetS, individuals with three or more components. UA, uric acid. n, number of participants. *, statistically different from classification 1 (p < .05, McNemar test).*

Discussion

In the present study, we found that higher serum UA values were observed in middle-aged individuals categorized as pre-MetS (i.e. two components) and MetS (i.e. three or more components) groups. In addition, by adding serum UA (> 5.25 mg/dL) to the criteria of Alberti et al., the occurrence of MetS increased by 13%. Moreover, serum UA was significantly associated with MetS and cardiometabolic risk factors, but insulin resistance, in this population.

The internal serum UA value of 5.25 mg/dL was a good cutoff to predict MetS and the prevalence of individuals with UA ≥ 5.25 mg/dL in MetS group was higher than others and, as expected, these individuals had high values for anthropometry as well as for cardiometabolic and inflammatory biomarkers than those in the low UA group. Recent studies have discussed possible explanations for the relationship of increased serum UA with MetS, even in normal range (< 7.0 mg/dL)[7, 30]. The sustained increase of fatty acids in the liver, which raises the level of serum triacylglycerol and insulin resistance, associated with the de novo synthesis of purine lead to decreases in the UA

Table II

Study population lifestyle and dietary factors according to internal uric acid cutoff point[a] (≥ 5.25 mg/dL)

Variables	*Low UA (n= 179)*	*High UA (n= 110)*	*p-value[b]*
Work position			
Group 1	117 (60.3)[c]	77 (39.7)	.415
Group 2	62 (65.3)	33 (34.7)	
Smokers (%)			
No	159 (63.6)	91 (36.4)	.194
Yes	20 (52.6)	18 (47.4)	
Alcohol consumption (n, %)			
No	119 (66.5)	59 (53.6)	.079
Yes	60 (33.5)	51 (46.4)	
PAL[d]			
< 10.000 steps	68 (59.1)	47 (40.9)	.395
≥ 10.000 steps	109 (64.1)	61 (35.9)	
Energy intake (kcal)	1391 ± 14.3	1387 ± 13.4	.943
Carbohydrate (g/d)	185.6 ± 13.8	178.6 ± 15.2	.398
Lipid (g/d)	40.7 ± 1.5	42.1 ± 1.6	.536
MUFA (g/d)	13.2 ± 1.5	13.8 ± 1.5	.348
PUFA (g/d)	6.2 ± 1.4	6.8 ± 1.7	.144
Saturated fat (g/d)	14.1 ± 1.6	14 ± 1.5	.908
Protein (g/d)	65.2 ± 1.4	67.1 ± 1.4	.459
Animal protein (g/d)	41.2 ± 1.5	43.6 ± 1.5	.237
Vegetal protein (g/d)	14.8 ± 1.5	14.6 ± 1.5	.794
Fiber (g/d)	20.8 (17.2-25.8)	20.5 (16-26.3)	.751
Cholesterol (mg/d)	197.5 ± 16.1	202.7 ± 16.1	.655

n- number of participants; UA- uric acid; PAL- physical activity level; MUFA- monounsaturated fatty acid; PUFA- polyunsaturated fatty acid; [a] uric acid A cutoff point suggested (see methods); [b] p-values from Student t-test or Mann-Whitney test, according to normality distribution of continuous variables and chi-square test for categorical variables; [c] Data are mean ± standard deviation, median (25^{th}-75^{th} percentiles), as appropriated and counts (percentage of prevalence in rows) for categorical variables; [d] n=285 [Low UA (n=142); High UA (n=143)].

Table III

Prevalence ratio (CI 95%) to cardiometabolic risk factors (dependent variables) according to occurrence of high uric acid concentrationa (independent variable).

	Model 1	*Model 2*
Central obesity (≥ 90 cm vs < 90 cm)	2.79 (1.70-4.58)*	2.74 (1.61-4.68)*
TAG (≥ 150mg/dL vs < 150 mg/dL)	2.50 (1.48-4.19)*	2.35 (1.37-4.02)*
TC (≥ 200 mg/dL vs < 200 mg/dL)	2.34 (1.39-3.83)*	2.26 (1.34-3.81)*
HOMA-IR (≥ 2.71 vs < 2.71)	1.38 (0.61-3.13)	1.04 (0.42-2.55)
TC:HDL-c ratio (≥ 5 vs < 5)	2.62 (1.59-4.32)*	2.51 (1.51-4.16)*
TAG:HDL-c (≥ 3.5 vs < 3.5)	3.51 (2.10-5.87)*	3.38 (1.99-5.73)*
High blood pressure (yes vs no)	1.40 (0.79-2.50)*	1.27 (0.70-2.30)
Metabolic Syndrome[d] (yes vs no)	3.26 (1.92-5.54)*	3.12 (1.81-5.36)*

TAG- triacylglycerol; TC- total cholesterol; HDL-c- high density lipoprotein cholesterol; HOMA-IR- homeostatic model assessment insulin resistance

[a] internal uric acid cutoff point (≥ 5.25 mg/dL); Model 1: adjusted by age (year) and alcohol consumption (no/ yes); Model 2: adjusted by model 1 and body mass index (low or high 30 kg/m^2); * denotes significant relationship.

renal excretion capacity resulting in elevated serum UA[6, 31]. It is noteworthy that such increase in the urate crystals would result in a low grade inflammation and arteriosclerosis as well as endothelial dysfunction and oxidative stress[8]. In contrast, some studies indicated UA as one important antioxidant element in human biological fluids which is responsible for decreasing over 50% of the free radicals in human blood[32]. Thus, the high serum UA found in the present study might be working as a protective response against cardiometabolic disorders. Nevertheless, the precise physiological function for UA in this context is not completely understood[33].

As of the internal cutoff (≥ 5.25 mg/dL) in our study population, in concert, a previous Brazilian population-based study[11] including men aged 25 to 60 years in a seaside town (Vitória /ES) suggested a similar internal cutoff point (5.3 mg/dL). Of note, in the present study, the internal cutoff point of serum UA was not influenced by lifestyles and eating habits. Thus, the higher prevalence of individuals with UA ≥ 5.25 mg/dL in the MetS group observed here ratify the importance of this parameter in the diagnostic of MetS.

Given the increasing impact of MetS in mortality our results may be helpful and of clinical relevance inasmuch as individuals with serum UA ≥ 5.25 mg/dL had altered blood pressure, lipid and glycemic parameters (i.e. dyslipidemia; insulin resistance). More importantly, the inclusion of serum UA as an additional component to diagnose MetS showed a significant increase (13%) in the number of individuals diagnosed with MetS such that its prevalence reached 48% in this population. This outcome highlights the usefulness of such component to diagnose MetS and could enable the prevention of acute events due to cardiovascular diseases or glucose disorders in individuals previously undiagnosed.

Along with the above mentioned, as expected, our results demonstrated significant relationship of serum UA with pre-hypertension and hypertension. In this case, it seems that high levels of serum UA activates the renin-angiotensin system and inhibits the endothelial nitric oxide actions resulting in systemic and renal vasoconstriction[34]. Nevertheless, it has been suggested that high serum UA could be associated with the activation of a defense mechanism against an inflammatory condition[35].

Despite the evidence that a serum UA ≥ 5.25mg/dL could be an independent factor to diagnose MetS and cardiometabolic disorders, this cutoff value did not show significant relationship with HOMA-IR index. It is possible that the small number of subjects above the cutoff for insulin resistance proposed by Genoleze et al.[21] made unpractical the statistical analyses. However, we observed that high serum UA was strongly associated with TAG:HDL-c. In fact, recent studies demonstrated that this index is a surrogate for insulin resistance diagnose in the South American population[23].

Finally, when we related serum UA with lifestyle and eating habits, it showed positive association with alcohol consumption (> 21 units) only. Although our results support those from previous study[7], we did not specify the purine source[30] which unable us to explain these findings and it suggests further studies.

The present study has a limitation. Because of the limited value of cross-sectional designs, it is not possible to affirm that the reported associations are causal. Although we have controlled several potential covariates, additional evidence from prospective studies is necessary before a firm conclusion in this issue.

Conclusions

In conclusion, serum UA has an important impact on the diagnostic of MetS and is associated to cardiometabolic risk factors in apparently healthy Brazilian middle-aged men. Its use in clinical practices could aggregate accuracy to diagnose MetS.

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Disclosure Statement

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