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Evaluation of Cardiovascular, Anthropometric and Electrolyte Correlates of Serum Uric Acid in Young Adult Nigerians

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Abstract **Background:** Serum uric acid levels vary with several factors and certain disease conditions. Studies have demonstrated association of elevated serum uric acid with several disease conditions. Though there exist reports on serum uric acid from Africa and Nigeria involving T2DM patients, oral cancer patients, normal pregnant women, lead-exposed workers and rural and urban populations. Reports on serum uric acid and its correlates in young adult Nigerians are rare. **Objective:** The study aimed to determine the prevalence of serum uric acid and its correlates with cardiovascular, anthropometric and electrolyte parameters in young adult Nigerians. **Methodology:** A cross sectional study involving young adults aged 17-35 years was done at a tertiary institution in Port Harcourt, Nigeria. Blood pressure, body mass index, serum uric acid and serum sodium in addition to other lifestyle variables were assessed. Parameters were assessed for correlations and prevalence of hyperuriceamia in the study population. **Results:** A total of 300 young adult undergraduate students with a mean age of 22.53±2.67 years participated in the study with males comprising 73.33% of the study population. The prevalence of hyperuricaemia [serum uric acid >420µmol/L in males and >360µmol/L in females] was 2.33%, while high normal serum uric acid [serum uric acid ≥310µmol/L in females and ≤330µmol/Lin males] was seen 3.0% of the subjects. Hyperuricaemia was significantly more prevalent in females compared to males (1.67% vs 0.67%, P= 0.018). In the male participants BMI had a significant correlation with SUA (r = 0.136, P = 0.043). Whereas, amongst the female participants in this study only age, height and serum sodium showed inverse relationships that were not significant (r = - 0.214, P = 0.056; r = - 0.210, P = 0.062 and r = - 0.205, P = 0.068), respectively. **Conclusion:** The prevalence of hyperuricaemia in this group of young Nigerian adults is relatively low with a significantly higher prevalence in females. Only BMI had significant direct correlation with serum uric acid in the male participants. Interventions to control obesity in this population maybe very important in curbing the burden of hyperuricaemia.

Keywords: *serum uric acid, young adults, Nigerians, correlates*

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1. Introduction

Uric acid (UA) is the final breakdown product of purine metabolism in humans is produced only in tissues which contain xanthine oxidase, such as liver and intestine. Serum uric acid (SUA) levels rise over time, and vary with body weight, height, alcohol intake, blood pressure, chronic ingestion of certain drugs, renal function, and certain disease states [1,2].

Normal serum concentrations of SUA are less than 7.0mg/dl (420µmol/l) in men, and <6mg/dl (360µmol/l) in women. Elevated serum uric acid levels are the result of either increased synthesis or decreased excretion. Increased generation may occur following ingestion of purine-rich diet or alcohol [3,4]. Increased UA turnover can be derived from endogenous sources, such as in certain genetic disorders (for example Lesch-Nyhan Syndrome) or in association with myeloproliferative disorders, or cytotoxic chemotherapy [5,6]. Serum uric acid levels may also be elevated if renal excretion is impaired.

In the last several years, there has been renewed interest about the nature of the association between raised SUA concentration and the risk of cardiovascular disease [1,7]. For a very long time spanning decades and maybe centuries, the UA molecule was thought to be inert. Initially perceived as an epiphenomenon reflecting its complex interactions with several cardiovascular risk factors [1,3,4].

Several studies have demonstrated association of elevated SUA with several disease conditions including hypertension [2,3], type 2 diabetes mellitus (T2DM) [5,6,12], metabolic syndrome [11,12], obesity [11], cardiovascular disease [1,7], endothelial dysfunction [4],

nephrolithiasis [10], chronic kidney disease (CKD) [8], intellectual disabilities and all-cause mortality [9].

It has been established that elevated SUA in children, adolescent and young adults is a predictor of metabolic syndrome in adult and middle age [11,13].

This makes the evaluation of UA acid and its cardio-metabolic associations in adolescents and young adults an effective strategy in the prevention of cardio metabolic diseases and its consequent morbidly and mortality.

In spite of the significant associations of UA with cardiovascular, metabolic and other parameters, most studies of UA associations and impact on cardiovascular, renal and metabolic disease in Nigeria has been done in adult populations assessing link to oral cancer [14], impact on pregnancy [15], relationship to lead exposure [16] and rural [17] and urban adult populations [18]. Very few studies on the impact of UA associations among children, adolescent and young adults have been conducted in Nigeria in comparison to the trend in developed countries [1,2,3,6,9].

In view of the overwhelming benefits of primary prevention of cardio-metabolic disease events. It is therefore important that studies evaluating UA correlations with cardiovascular and metabolic parameters be done in Nigerian young adults in order to contribute to the data for assessment of the country wide situation. Such studies also provide a reference point for follow up or case control studies which will strengthen evidence for implementation of screening and preventive action among young people in Nigeria.

This justifies the objective of this study aimed at determining the prevalence of SUA and its correlations with cardiovascular, anthropometric and electrolyte parameters in young adult Nigerians.

2. Methods

2.1. Participants and Study Design

This study was a cross-sectional design and conducted amongst young adult undergraduate students of the University of Port Harcourt. The study consisted of 300 participants (220 males and 80 females). All consecutive students who met the inclusion criteria and had none of the exclusion criteria for the study were recruited. All participants were informed about the study and gave their consent before inclusion in the study. Individuals with a recent history of surgical operation, anti-hypertensive and anti-hyperuricemic drugs intake, history of renal disease, gout, liver disease, hepatic and cardiac diseases were excluded from the study. Pregnant and lactating women were also excluded.

2.2. Demographic, Lifestyle and Anthropometric Parameters

The demographic and anthropometric parameters of age, height (metres), weight (kilograms), and BMI (Kilograms/metres^2) were measured in accordance with standards for anthropometric measurement [19]. Lifestyle information such as cigarette smoking, consumption of dietary salt, alcohol and soft drinks were obtained.

Blood pressure (BP) was measured three times consecutively on the right arm with a standard sphygmomanometer, with the participant in a sitting position after a rest period of at least 30minutes.The mean of the last two measurements, were recorded to the nearest 2 mmHg, and readings were based on the first and fifth Korotkoff sounds.

2.3. Laboratory Measurements

Fasting blood samples (5 mL) were drawn from the participants under strict aseptic precautions. Serum uric acid (SUA) and serum sodium levels were measured at the Chemical Pathology laboratory of the University of Port Harcourt teaching hospital. SUA was analyzed with the enzymatic colorimetric method using an auto analyzer.

2.4. Diagnostic Criteria

Hyperuricemia was defined as SUA concentration SUA >420µmol/L in males and >360µmol/L in females, while high normal is SUA≥310µmol/L in females and ≤330µmol/L in males.

BMI was categorized based on the WHO classification: underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2), and obese (≥30 kg/m^2).

2.5. Statistical Analysis

All data were analysed by IBM SPSS statistics version 23. Results are presented as tables and charts. Discrete data and continuous variables were presented as percentages with mean ± standard deviation and confidence intervals respectively. Comparisons of means were done using the independent t test. Proportions were compared using Z test and Chi-square test as appropriate. Pearson correlations were done to evaluate associations between variables. P value ≤0.05 was considered as significant.

3. Results

3.1. Characteristics of Subjects

A total of 300 undergraduate students of the University of Port Harcourt were studied, ages ranging from 17 to 35 years with a mean of 22.53±2.67 years. Males comprised 218 (73.33%) while 82 (26.67%) were females (Table 1).

Table 1. AGE AND SEX DISTRIBUTION OF PARTICIPANTS

Age-group [years]	Male [n=220] N (%)	Female [n=80] N (%)	Total [n=300] N (%)
< 20 (17-19)	22 (7.33)	17 (5.67)	39 (13.00)
20-29	194 (64.67)	63 (21.00)	257 (85.67)
30 and above	4 (1.33)	0 (0)	4 (1.33)
Total	220 (73.33)	80 (26.67)	300 (100.00)

The distribution of the participants by year of study showed that highest percentage of the subjects 94 (31.3%) were 400 level students, followed by 100 level students with 74 (24.7%) and the lowest was 8 (2.7%) 500 level students (Table 2).

Table 2. DISTRIBUTION OF SUBJECTS BY ACADEMIC LEVEL OF STUDY

Level of Study	Number	Percentage
100	74	24.7
200	63	21.0
300	61	20.3
400	94	31.3
500	8	2.7

3.2. Anthropometric, Lifestyle Parameters and Cardio-metabolic Parameters

The mean BMI of the study population was 23.28±2.95kg/m^2 and serum uric acid concentration was 222.43±73.34µmol/L, while the means for systolic blood pressure, diastolic blood pressure and serum sodium concentration were 117.96±9.80mmHg, 74.29±8.24mmHg and 132.25±9.21mmol/L, respectively (Table 3).

A total of 248 (82.7%) of the subjects admitted to soft drinks consumption, 85(28.3%) to alcohol consumption while only 18 (6.0%) were current cigarette smokers.

Dietary salt intake was reported to be low by 33(11.0%) of subjects, high 10(3.3%) and moderate 257(85.7%).

3.3. Means of Variables and Comparison between Males and Females in the Study Population

A comparison of means of variables between males and females in the study population are as shown in Table 3. Males were significantly older, had higher body weight and height, but mean BMI was not significantly different. Systolic and diastolic blood pressures were also significantly higher in males, while SUA level though higher in males only showed a tendency towards significance (P=0.07).

Table 3. COMPARISON OF MEANS BETWEEN MALES AND FEMALES

Variables	All Participants (n=3000) Mean ± SD	Male (n=218) Mean ± SD	Female (n=82) Mean ± SD	P-value
Age [years]	22.53±2.67	22.94±2.70	21.43±2.26	0.000
Weight [Kg]	67.27±10.09	69.71±9.53	60.55±8.47	0.000
Height [m]	1.70±0.09	1.73±0.07	1.61±0.06	0.000
BMI[kg/m^2]	23.28±2.95	23.24±2.85	23.38±3.22	0.737
SBP [mmHg]	117.96±9.80	119.71±9.90	113.15±7.72	0.000
DBP [mmHg]	74.29±8.24	75.53±7.96	70.89±8.10	0.000
Pulse Rate[bpm]	74.40±10.65	72.37±10.51	79.96±8.95	0.000
SUA concentration [µmol/L]	222.43±73.34	226.73±70.67	210.63±79.48	0.07
SNa concentration [mmol/L]	132.25±9.21	131.87±9.19	133.31±9.26	0.233

BMI-Body Mass Index, SBP- systolic blood pressure, DBP – diastolic blood pressure, SUA – serum uric acid, SNa- serum sodium

Systolic blood pressure≥ 140mmHg was recorded in 11(3.67%), systolic blood pressure in the pre-hypertension range of 120-139mmHg 73(24.33%), while diastolic blood pressure≥ 90mmHg was seen in 21(7.00%) and diastolic blood pressure of 80 to 89mmHg was reported in 25(8.33%).

The prevalence of obesity [BMI≥30kg/m^2] was 9(3.00%), while overweight had a prevalence of 57(19.00%), and the remainder of subjects had BMI less than 25kg/m^2.

Prevalence of hyperuricaemia [SUA >420µmol/L in males and >360µmol/L in females] was 2.33%, while high normal serum uric acid [SUA ≥331µmol/L and ≤330µmol/L] was seen 3.0% participants (Figure 1). Hyperuricaemia was more in females compared to males (1.67% vs 0.67%, P= 0.018). Though more males had high normal SUA level, the differences was not significant (2.00% vs1.00%, P= 0.704).

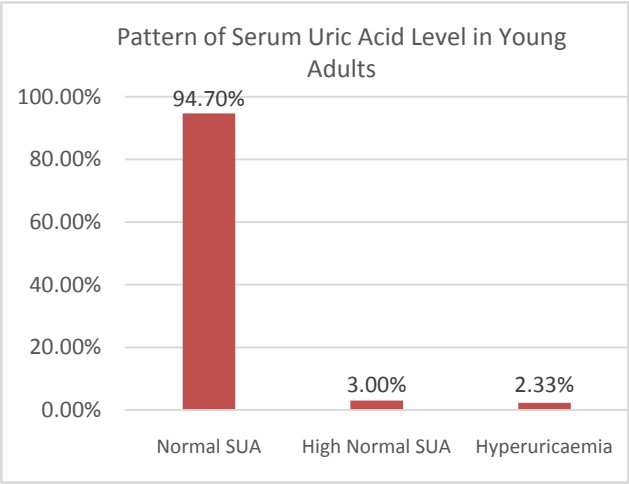

Figure 1. Pattern of serum uric level in young adults

3.4. Correlates of Serum Uric Acid

In the entire study group, of the variables tested, only body weight [r=0.145, P=0.012] and BMI [r=0.139, P=0.016] had significant positive correlation with serum uric acid. Systolic blood pressure [r=0.053, P=0.358], diastolic blood pressure [r=0.033, P=0.567] and serum sodium concentration [r=-0.088, P=0.129] had positive and negative associations with serum uric acid concentration, respectively that were not statistically significant.

Table 4. CORRELATES OF SERUM URIC ACID LEVEL IN YOUNG ADULTS

Correlates of SUA	All Subjects [n=300]	Males [n=220]	Females [n=80]
Age	r = 0.005 p = 0.927	r = 0.046 p = 0.499	r = - 0.214 p = 0.056
Height	r = 0.028 p = 0.623	r = 0.009 p = 0.893	r = - 0.210 p = 0.062
Weight	r = 0.145 p = 0.012	r = 0.120 p = 0.075	r = 0.109 p = 0.337
BMI	r = 0.139 p = 0.016	r = 0.136 p = 0.043	r = 0.152 p = 0.179
SBP	r = 0.053 p = 0.358	r = 0.013 p = 0.846	r = 0.067 p = 0.558
DBP	r = 0.033 p = 0.567	r = 0.072 p = 0.286	r = - 0.143 p = 0.205
SNa	r = -0.088 p = 0.129	r = - 0.031 p = 0.644	r = - 0.205 p = 0.068

BMI – body mass index, SBP – systolic blood pressure, DBP – diastolic blood pressure, SNa – serum sodium, r- Pearson's correlation coefficient, P – p value.

For males in the study BMI had a positive and significant association with SUA but body weight showed a direct relationship that only tended towards significance (P=0.075) as shown in Table 4. Amongst the female study subjects there were no significant associations, but age (P=0.056) and height (P=0.062) showed inverse relationships that were close to significance.

4. Discussion

This study assessed serum uric acid levels amongst young undergraduate university students at the University of Port Harcourt in the Niger delta region of Nigeria. It also examined the prevalence of hyperuricaemia and the relationship between serum uric level and body weight, BMI, SBP, DBP and serum sodium concentration.

The study population was young with age from 17 to 35 years, mean age of 22.53±2.67 years and only 1.33% were aged 30 years or more. This reflects a truly young adult population. This is similar to the age of students in Canadian universities in 2007 with median ages of male and female students of 22.9 and 22.7 years, respectively [20].

Though a consecutive (convenient) sampling method was used there was a fair distribution of students amongst the various academic years with years one to four each contributing 20-24% of the study population. The male preponderance in this study may be due to the volunteer nature of the study. Gender related issues affecting participation of women in researches may be contributory [21].

This study reports a mean serum uric acid of 222.43±3.34umol/L, which is lower than values for other populations [11,12]. Qiu et al reported 305.0±85.6umol/L for healthy adults in Northern and North eastern China; age ranged from 18 to 75 years and over.The low values could be due to low body weight and BMI or indeed poverty [22]. This is against the background of high consumption of soft drinks in both male and female participants and alcohol in the male participants. Also the prevalence of cigarette smoking was low amongst the male and zero amongst female participants.

Though mean serum uric acid in our study was higher in males compared to females, the difference was not significant (P=0.07). This may be due to the comparable BMI for males and females in our study population. Previous studies found that serum uric acid levels are higher in men than in women [11,22,23].

The present study is however in agreement with study by Olaniyan et al [24] who similarly did not find any difference in SUA levels between male and female students. Their study population was older (17-52 years) however and also had similar mean BMI for males and females.

The prevalence of hyperuricaemia (SUA >420µmol/L in males and >360µmol/L in females) in our study group was 2.3%, while high normal serum uric acid (SUA ≥310µmol/L and ≤330µmol/L) was seen 3.0%.This prevalence is lower than values from previous studies, Qiu et al in China reported a total prevalence of 13.7%. Men had a higher prevalence of hyperuricemia than women (21% vs. 7.9%; P < 0.0001) [22] while Conen et al in Seychelles reported that the prevalence of a serum uric acid level >420 µmol/L in men was 35.2% and the prevalence of a serum uric acid level >360 µmol/L was 8.7% in women [11]. Treviño-Becerra et al reported similar findings in Chronic Kidney Disease patients in Mexico [25]. Ali et al also found a higher prevalence in Bangladeshi adults [26]. The low prevalence (3.0%) of obesity in our study population maybe contributory. Previous studies have reported higher prevalence of hyperuricaemia amongst obese people [26,27]. Curiously, however and contrary to other studies [24,26] we found a significantly higher prevalence of hyperuricaemia amongst females compared to males (1.67% vs 0.67%, P= 0.018).

This higher prevalence of hyperuricaemia in females is consistent with the findings by Alli et al amongst adults in Bangladesh (9.3% with 8.4% in male and 10.2% in female participants) with a mean age of 32.5±13.3 years [26]. The female participants in that study had a higher BMI of 25.2 ± 4.3 Kg/ m^2 though not significant. Most studies however reported higher prevalence of hyperuricemia in males than females [25,27].

The result of the present study reveals a significant correlation of body weight and BMI with serum uric acid level in the entire study population (body weight[r=0.145, P=0.012] and BMI [r=0.139, P=0.016]), respectively (Table 4). However, only BMI sustained a significant positive correlation with serum uric acid level in the male participants(r = 0.136, P = 0.043) while body weight was not significant (r = 0.120, P = 0.075). Amongst the female participants in this study only age, height and serum sodium showed negative associations that were not significant (r = - 0.214, P = 0.056; r = - 0.210, P = 0.062 and r = - 0.205, P = 0.068), respectively. The significant association between BMI and serum uric acid found in male participants in this study is consistent with findings from other studies [26,27]. Systolic blood pressure and diastolic blood pressure did not show any significant relationships with serum uric acid.

This study is limited by its volunteer nature and the relatively small sample size of young adult students of a university which may not be representative of young adults in the general population.

5. Conclusion

Hyperuricaemia have been shown to have a low prevalence in this group of young adults and has close association with body mass index, especially in males. Interventions to control obesity in this population maybe very important in curbing the burden of hyperuricaemia. Further studies in young adults are needed especially in the general population to determine the prevalence and assess the correlates.

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