ORIGINAL RESEARCH

EVALUATION OF URIC ACID, CREATININE, AND ESTIMATED GLOMERULAR FILTRATION RATE IN ELDERLY AND ADOLESCENT POPULATIONS IN NNEWI METROPOLIS

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ABSTRACT

Background: Kidney efficiency declines with age due to cumulative cellular damage, while adolescence involves rapid physiological and hormonal changes that impact uric acid levels. Elevated uric acid is associated with gout, metabolic syndrome, and kidney diseases. Creatinine, a key marker of glomerular filtration, is influenced by muscle mass, while eGFR, a commonly used indicator of kidney function, naturally declines with age

Aim: This study compared the levels of uric acid, creatinine, and estimated glomerular filtration rate (eGFR) among elderly and adolescent populations in Nnewi, Anambra State, Nigeria

Materials and Methods: The study recruited 90 participants, comprising 45 adolescents (15–25 years) and 45 elderly individuals (60 years and above). Serum uric acid and creatinine levels were measured spectrophotometrically, and eGFR was calculated using the Modification of Diet in Renal Disease (MDRD) equation. Data were analyzed using independent t-tests and Pearson correlation coefficients at <0.05 level of significance.

Results: The results showed significant differences in uric acid, creatinine, and eGFR levels between adolescents and the elderly. The elderly had lower uric acid levels (264.19 ± 97.56 mg/dL) Vs adolescent(272.78±61.99mg/dL) higher creatinine levels (92.72 ± 18.37 µmol/L)Vs adolescent(73.57±15.19 µmol/L), and lower eGFR (68.99 ± 14.83 mL/min/1.73m²) compared to adolescents(111.00±17.00mL/min/1.73m²)(P <0.05). Blood pressure and anthropometric measurements also differed, with the elderly showing higher blood pressure values. Correlation analysis highlighted significant links between uric acid levels and anthropometric indices, particularly in the elderly group.

Conclusion: These results emphasize age-related differences in renal function markers, with elderly individuals showing elevated creatinine levels and decreased eGFR, suggesting a decline in kidney function compared to adolescents.

Keywords: Kidney Function, Uric acid, Creatinine, Adolescent, eGFR

INTRODUCTION

Elderly individuals are typically classified as those aged 65 years and older, with subcategories including youngest-old (65–74 years), middle-old (75–84 years), and oldest-old (85 years and above)[1]. Biologically, aging is characterized by cumulative cellular and molecular damage over time, leading to reduced physical and mental capacity, increased disease risk, and eventual mortality. These changes are nonlinear and vary among individuals[2]. Adolescence, the transition from childhood to adulthood, involves significant physical, behavioral, cognitive, emotional, and social changes. It is divided into three stages: early (10–13 years), middle (14–17 years), and late adolescence/young adulthood (18–21 years and beyond)[3].Serum creatinine (SCr), serum uric acid (SUA), and estimated glomerular filtration rate (eGFR) are vital markers for assessing kidney function, used to monitor disease progression and guide prognosis[4]. The kidneys are crucial in filtering blood and excreting waste as urine; impaired function can result in serious health issues[5]. Renal function tests measure various blood and urine components to evaluate kidney efficiency, focusing on GFR[6]. Advancements in estimating kidney function contribute to identifying therapeutic targets and novel biomarkers for early kidney injury detection[4].

Purine metabolism produces uric acid, which is mainly eliminated by the proximal tubules. Changes in excretion or production lead to abnormal levels[7],[8].

Elevated uric acid, or hyperuricemia, is linked to gout, metabolic syndrome, and various diseases. Normal adult levels are >416 µmol/L (7.0 mg/dL) for males and >357 µmol/L (6.0 mg/dL) for females[9]. Children's uric acid levels rise with age, peaking during puberty due to hormonal shifts[10].

Creatinine, derived from muscle metabolism, reflects GFR and varies with muscle mass, complicating its interpretation in individuals with abnormal muscle composition[11]. Its concentration increases linearly with age, showing gender differences in patterns of change over time. Reference ranges differ between men (0.63–1.16 mg/dL) and women (0.48–0.93 mg/dL)[11]. eGFR estimates kidney filtration efficiency using equations like MDRD and Cockroft-Gault, though none are perfect. Normal eGFR exceeds 90 in adults but declines naturally with age[12].

The level of uric acid increases with age. Gender differences in uric acid levels occur after the onset of puberty. Additionally, linear regression reveals a positive correlation between the uric acid level and Body Mass Index (BMI)[13]. Serum creatinine concentration increased steadily with age; in females from the age of 40 years and 60 years for males while the estimated glomerular filtration rate lowered in the elderly[14].

Materials and Methods

This study was a cross-sectional design aimed at assessing the levels of serum uric acid, creatinine, and estimated glomerular filtration rate (eGFR) in elderly individuals (aged 60-80 years) and adolescents (aged 15-25 years) in Nnewi Metropolis, Anambra State, Nigeria. A total of 90 participants were enrolled, consisting of 45 elderly and 45 adolescents. Participants were selected using simple random sampling, where all elderly and adolescent individuals in Nnewi Metropolis were assigned numbers. Odd-numbered individuals were excluded, while those with even numbers were included in the study. A 5 ml blood sample was collected from each participant, transferred into plain tubes, and allowed to clot. The samples were then centrifuged at 3000 rpm for 10 minutes to isolate the serum, which was stored at 2°C until analysis. Uric acid and creatinine levels in the serum were subsequently measured. Creatinine was determined spectrophotmetrically as described by[15,16]. The body mass index (BMI) was calculated using the anthropometric method. Blood pressure was measured using the oscillometric method[17], and eGFR was calculated using the MDRD equation as described by[16]. Statistical analysis was conducted using an independent Student's t-test, with results considered significant if $p < 0.05$. The correlation between the parameters was assessed using Pearson's correlation coefficient.

RESULTS

The Mean Values of Uric Acid, Creatinine and Estimated Glomerular Filtration Rate in Elderly and Adolescents' Groups (MEAN ± SD)

The results revealed a statistically significant difference in uric acid levels, with the test group showing lower mean values (264.19 ± 97.56 mg/dL) compared to the control group (272.78 ± 61.99 mg/dL) ($p<0.05$). The test group also had significantly higher mean creatinine levels (92.72 ± 18.37 µmol/L) than the control group (73.57 ± 15.19 µmol/L) ($p<0.05$). Additionally, the mean estimated glomerular filtration rate (eGFR) was significantly lower in the test group (68.99 ± 14.83 mL/min/1.73m²) compared to the control group (111.00 ± 17.00 mL/min/1.73m²) ($p<0.05$).

Table 1 The Mean Values of Uric Acid, Creatinine and Estimated Glomerular Filtration Rate in Elderly and Adolescents' Groups (MEAN ± SD)

Parameters	Test group (elderly) (N=45) Mean ± SD	Control group (adolescent) (N=45) Mean ± SD	T- test	P- value
Uric acid (mg/dl)	264.19±97.56	272.78±61.99	-0.499	0.001
Creatinine (umol/l)	92.72±18.37	73.57±15.19	5.387	0.269
eGFR (ml/min/1.73m^2)	68.99±14.83	111.00±17.00	-12.614	0.079

Key:
eGFR=estimated glomerular filtration rate

Anthropometric Measurements and Blood Pressure In Elderly and Adolescent Groups (MEAN ± SD)

The test group exhibited a significantly lower mean BMI (25.46±5.78 kg/m²) compared to the control group's mean BMI (28.07±6.81 kg/m²) ($P<0.05$), and showed significantly higher mean values for HC (36.40±4.21 cm), WC (31.65±4.09 cm), SBP (137.56±22.17 mmHg), and DBP (88.22±15.85 mmHg) than the control group, with mean values of HC (34.60±3.70 cm), WC (28.58±3.16 cm), SBP (122.44±9.6 mmHg), and DBP (83.11±11.64 mmHg) ($P<0.05$).

Table 2: The Anthropometric Measurements and Blood Pressure In Elderly and Adolescent Groups (MEAN ± SD)

Parameters	Test Group (N=45) Mean ± SD	Control Group (N=45) Mean ± SD	T-test	P- value
BMI (kg/m^2)	25.46±5.78	28.07± 6.81	-1.97	0.950
WC (cm)	31.65± 4.09	28.58± 3.16	3.99	0.185
HC (cm)	36.40± 4.21	34.60± 3.70	2.15	0.271
SBP (mmHg)	137.56± 22.17	122.44± 9.63	4.19	0.001
DBP (mmHg)	88.22± 15.85	83.11± 11.64	1.74	0.167

Statistical significance at $p<0.05$
Key:
BMI=Body Mass Index
SBP= systolic blood pressure
DBP= diastolic blood pressure

HC= hip Circumference
WC= Waist Circumference

The correlation of parameters measured in the test group (elderly)

A weak positive correlation was observed between the parameters UA and Cr (r = 0.427, p = 0.003) and a strong negative correlation-between eGFR and Cr (r = -0.756, p = 0.001) in the test group ($p < 0.05$). However, no significant correlation was found between the parameters UA and eGFR (r = -0.139, p = 0.361).

TABLE 3: Correlation of parameters measured in the test group (elderly)

PARAMETERS	R	p-value
UA vs Cr	0.427	0.003
UA vs eGFR	-0.139	0.361
eGFR vs Cr	-0.756	0.001

Statistical significance of $p<0.05$
Keys
eGFR=estimated glomerular filtration rate
Cr = creatinine
UA = uric acid

Correlation of the parameters measured in the control group (adolescents group)

There was no significant correlation observed between the parameters UA and Cr (r = -0.035, p = 0.821) and between UA and eGFR (r = 0.079, p = 0.605) in the control group. However, a strong negative correlation existed between eGFR and Cr (r = -0.748, p = 0.001) in the control group.

Table 4. Correlation of the parameters measured in the control group (adolescents group)

PARAMETERS	R	p-value
UA vs Cr	-0.035	0.821
UA vs eGFR	0.079	0.605
eGFR vs Cr	-0.748	0.001

Statistical significance of $p<0.05$

Correlation of the biochemical analytes with the anthropometric indices and blood pressure in the test

A significant negative weak association existed between UA (mg/dl) and BMI(kg/m2)(r=-0.356, P=0.016), UA (mg/dl) Vs SBP (mmHg) **(r =-**0.304, P= 0.043), UA (mg/dl) Vs H**C (cm) (r=-**0.045, P=0.002**),** while a moderate negative association was seen in UA (mg/dl) Vs **WC (cm) (r=-**0.537, P=0.001**),** but no relationship was seen in UA (mg/dl) Vs DBP (mmHg) (r **=** -0.259, P= 0.086**)**

Table 5: correlation of the biochemical analytes with the anthropometric indices and blood pressure in the test

PARAMETERS	BMI(kg/m2)	SBP(mmHg)	DBP(mmHg)	WC(cm)	HC(cm)
UA(mg/dl) r value	-0.356	-0.304	-0.259	-0.537	-0.0450
p value	0.016	0.043	0.086	0.001	0.002
Cr(umol/l) r value	-0.180	-0.231	0.004	-0.182	-0.187
p value	0.236	0.127	0.980	0.231	0.219
eGFR(ml/min/1.73m2)					
p value	-0.074	0.076	-0.034	-0.062	-0.034
	0.627	0.622	0.827	0.687	-0.824

Statistical significance of $p<0.05$

Keys

eGFR=estimated glomerular filtration rate

Cr = creatinine

UA = uric acid

Correlation of the biochemical analytes with the anthropometric indices and blood pressure in the control (adolescence group)

The association was observed between UA(mg/dl) and BMI (kg/m^2) (r= -0.261, P= 0.083), UA (mg/dl) Vs SBP (mmHg) (r=-0.075, p=0.622), UA (mg/dl) Vs DBP (mmHg) (r=0.082, p=0.592),UA (mg/dl) Vs WC (cm) (r=-0.023, p=0.883), UA (mg/dl) Vs HC (cm) (r= -0.054, p=0.724), Cr (umol/l) vs BMI (kg/m^2) (r= -0.053, P= 0.729), Cr (umol/l) vs SBP (mmHg) (r=-0.078, p=0.611), Cr (umol/l) vs DBP (mmHg) (r=0.011, p=0.942),Cr (umol/l) vs WC (cm)(r=-0.145, p=0.343), Cr(umol/l) vs HC(cm)(r=-0.147, p=0.335), eGFR(ml/min/1.73m2) vs BMI(kg/m^2)(r= -0.306, p=0.041),eGFR(ml/min/1.73m2) vs SBP(mmHg)(r=0.209, p=0.169), eGFR(ml/min/1.73m2) vs DBP(mmHg)(r=0.213, p=0.160),eGFR(ml/min/1.73m2) vs WC(cm)(r=-0.204, p=0.179), eGFR(ml/min/1.73m2) vs HC(cm)(r=0.030, p=-0.847)

Table 6: Correlation of the biochemical analytes with the anthropometric indices and blood pressure in the control (adolescent group)

PARAMETERS	BMI(kg/m2)	SBP(mmHg)	DBP(mmHg)	WC(cm)	HC(cm)
UA(mg/dl) r value	-0.261	-0.075	0.082	-0.023	-0.054
p value	0.083	0.622	0.592	0.883	0.724
Cr(umol/l) r value	-0.053	-0.078	0.011	-0.145	-0.147
p value	0.729	0.611	0.942	0.343	0.335
eGFR(ml/min/1.73m2)	-0.306	0.209	0.213	-0.204	0.030
p value	0.041	0.169	0.160	0.179	-0.847

Statistical significance of $p<0.05$

DISCUSSION

The evaluation of serum uric acid (SUA), creatinine, and estimated glomerular filtration rate (eGFR) was conducted in both elderly and adolescent populations. The results revealed a statistically significant difference in the mean uric acid levels between the two groups, with the elderly group exhibiting lower levels compared to the adolescent group. This finding aligns with Kurahashi et al.'s research, which suggested that during adolescence, an increase in androgens, particularly testosterone, promotes muscle anabolism, and muscle mass is a significant source of purines[19]. Serum uric acid rises as a result of high testosterone levels. Additionally, higher muscle mass boosts adenosine triphosphate metabolism, releasing more purine intermediates, which further affects uric acid levels, contributing to higher levels in adolescents compared to older individuals[19]. This observation is also supported by Dai et al., whose study on age- and gender-specific reference intervals for uric acid levels concluded that uric acid levels rise rapidly in children and adolescents, coinciding with puberty development[13].

The mean creatinine levels were significantly higher in the elderly group compared to adolescents, reflecting reduced renal function in older adults. This aligns with established knowledge of age-related declines in kidney function, as creatinine serves as a key marker of glomerular filtration rate (GFR)[20]. The elevated creatinine levels in the elderly suggest decreased GFR and are associated with functional limitation, consistent with prior literature that has demonstrated reduced physical performance in persons with kidney disease[20], which is further supported by the significantly lower estimated GFR (eGFR) observed in this group relative to adolescents. Previous studies also showed a consistent increase in serum creatinine with physiological advancements in age[21,22].

A significantly higher difference was observed in the mean values of hip circumference, waist circumference, systolic blood pressure, and diastolic blood pressure in the test group compared to the control group ($P<0.05$), which may help explain the observed differences in kidney function markers between the groups.

The correlation analysis revealed significant relationships between biochemical analytes and anthropometric indices in the elderly, with BMI, systolic blood pressure (SBP), and waist circumference (WC) showing a positive correlation with uric acid levels. This finding is consistent with previous studies[22], which highlighted a positive correlation between uric acid levels and BMI. Overweight or obese individuals are more likely to have elevated uric acid levels due to increased production and reduced renal excretion. In contrast, no significant correlations were observed between these parameters in adolescents, except for a positive correlation between BMI and eGFR.

CONCLUSION

This study concludes that elderly individuals exhibit higher creatinine levels and lower eGFR, indicating diminished kidney function compared to adolescents. Also, the findings suggest that age-related changes in kidney function significantly influence serum uric acid, creatinine levels, and eGFR.

Conflicts of Interest: The authors declare that they have no conflicts of interest.

Contributors: IAC, DFC, and OPC conceived and designed the research proposal. OCU, ORO, IOA, and IAC performed sample collection, experiments, and data analysis. OCU, IAC, ORO, and IOA contributed to the final version of the manuscript. All authors have read and approved the final manuscript.

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Ethical approval: The study sought and obtained ethical approval from the Ethics Committee of the Faculty of Health Sciences and Technology College of Health Sciences Nnamdi Azikiwe University with reference no. FHST/REC/024/590

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