Hepato-renal function assessments in apparently healthy undergraduate students of Edo State University Uzairue: A Pilot study

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Abstract

The prevalence rates of chronic hepatic and renal diseases are increasing globally. Unhealthy lifestyle is a major contributor to the increasing prevalence rates. Due to the asymptomatic nature of these diseases at the early stages, diagnosis is not made early. Most studies have focused on study participants already diagnosed of these diseases; it is therefore imperative to carry out this study on apparently healthy undergraduate students who were predominantly adolescents with the view to identifying individuals at risk of these diseases. Fifty apparently healthy undergraduate students of Edo State University Uzairue, Edo State, consisting of 24 males and 26 females were randomly recruited into this cross-sectional study. They were between 16 and 25 years old. Anthropometric indices of each study participants including body weight, height, waist and hip circumferences were determined using standard procedures, while BMI was calculated. Blood and pulse pressures were also determined using automatic blood pressure monitor. Plasma obtained from 5 millilitres of fasting venous blood was used for the determination of creatinine, uric acid, albumin, aspartate aminotransferase (AST) and alanine aminotransferase (ALT). These biochemical parameters were also determined in 5 millilitres of fasting spot urine sample obtained from each participant. Student's t-test and Pearson correlation coefficient were used for comparison and association of variables, respectively and $p<0.05$ was considered statistically significant. Body height and plasma creatinine of participants were significantly higher in males compared with the females, whereas urinary uric acid was significantly higher in females compared with the males. In females, there was a positive association between diastolic blood

pressure and body weight. While in males, diastolic blood pressure correlated positively with hip circumference. The differences in the body height, plasma creatinine and plasma uric acid in the study participants appears physiological. The non-statistically significant differences in the other variables could be attributed to the apparently healthy state of the study participants

Keywords: Hepato-renal function, Alanine aminotransferase, aspartate aminotransferase, creatinine, uric acid, apparently healthy undergraduates

Introduction

The young adult stage of life is critical and has been variably defined using different age ranges. The World Health Organization described young people as those between the ages of 10 and 24 years old, hence, adolescents. 18-25 years old is the age range for young adults by the United Nations as well as the Society of Adolescent Health and Medicine. In Nigeria, youth is defined by 18-35 years of age (Akinbodewa *et al*., 2022). Studies on the health status of this category of individuals have not received the much-needed attention, considering the centrality of this phase of life.

Chronic renal disease (CRD) is a major non communicable disease with significant death rate in the last 20 years (Sotubosotomiwa *et al*., 2023). The early stages are often asymptomatic, while oftentimes, diagnosis is made at the advanced stage of the disease (Avila et al., 2023). Identified risk factors include obesity, hypertension, diabetes mellitus and elevated total cholesterol among others (Sotubosotomiwa *et al*., 2023). Chronic renal disease's prevalence is on the rise, worldwide, with a global prevalence of 13% (Avila et al., 2023). In Nigeria, the prevalence ranges between 1.6-12.4%, while a prevalence rate of 16% was recorded for West Africa (Sotubosotomiwa *et al*., 2023). Studies on the prevalence of CRD in Nigerian adolescents and young adults are currently sparse. Healthy lifestyle could go a long way in reducing an individual's risk, moreover, early diagnosis of CRD is also important for effective management.

Liver transaminases: alanine aminotransferase (ALT) and aspartate aminotransferase (AST) are veritable markers of hepatocytes inflammation. Their activities suggest the functionality of the liver (Buechter and Gerken, 2022). Of significance is ALT, which is crucial in the diagnosis and management of hepatic diseases (Valenti *et al*., 2021). Their cost effectiveness and ease of assay make

them ideal for screening (Buechter and Gerken, 2022).

Several studies have focused on the general population with respect to hepatic and renal function both in health and disease. The paucity of information on the hepato-renal function of apparently healthy Nigerian young adults is the major rationale for the conduct of this study.

Materials and Methods

Study Population

Fifty (50) apparently healthy undergraduate students of Edo State University Uzairue comprising 24 males and 26 females aged between 16 and 25 years old were recruited into this cross-sectional study using random sampling. They gave a written consent after the aim of the study was explained to them.

Exclusion criteria

Participants with any reported ailment, those not within the required age range and those unwilling to participate in the study were excluded from the study.

Anthropometric indices and blood pressure measurement

Body weight, height, waist and hip circumferences were determined while body mass index was calculated for each participant. Systolic, diastolic and pulse pressures were also determined. Determination of anthropometry and blood pressure were as described by Ugbenyen and Ajayi (2023). Ethical approval for the study was granted by EDSU Ethics review committee (EDSUREC24/0030).

Sample collection and biochemical analysis

Five millilitres (5 ml) of fasting venous blood and 5 ml of fasting urine spot sample were obtained from each study participant. The blood sample was dispensed into lithium heparin bottle, which was centrifuged at 3000 revolutions/minute for 15 minutes. The plasma for the determination of creatinine, albumin, AST, ALT and uric acid was separated into plain bottle and kept in the freezer pending analysis. Urine sample from each participant was dispensed into sterile plain universal bottle for the determination of urinary creatinine, albumin, AST, ALT and uric acid.

Spectrophotometry method was used for the determination of plasma and urinary analytes with adherence to the manufacturers' instruction as stated in the leaflet of each reagent kit. Methods for the determination of activities of ALT and AST using Randox kits (Ireland) were described by JohnKennedy *et*

al (2011) using Randox kit. Creatinine, uric acid and albumin using Precision kits (India) were determined by methods described by Amin *et al* (2014), Timerga and Haile (2021) and Adamolekun *et al* (1994), respectively.

Statistical analysis

Data were analyzed using SPSS version 21. Student's t-test was used for the comparison of quantitative variables while association among variables was determined using Pearson correlation coefficient. $p < 0.05$ was considered statistically significant.

Results

Table 1 shows the comparison of age, blood pressure, anthropometric and biochemical indices between male and female participants. Height and plasma creatinine were significantly higher in male compared with female participants. Conversely, urine uric acid was higher in females in comparison to males. However, there were no significant differences in the other parameters.

Table 1: Age, Anthropometric Indices and Biochemical Parameters in Study Participants

Parameter	Male (N=24)	Female (N=26)	t-Value	P- Value
Age (Years)	20.17±4.04	19.46±3.08	0.698	0.489
Weight (Kg)	78.04±17.54	76.08±17.33	0.398	0.692
Height (m)	1.75±0.08	1.71±0.07	2.160	0.036*
BMI (Kg/m^2)	25.38±5.28	26.12±5.85	-0.468	0.642
Waist Circumference (cm)	86.13±14.26	81.35±12.82	1.248	0.218
Hip Circumference (cm)	102.29±12.26	105.12±13.56	-0.770	0.445
Systolic Blood Pressure (mmHg)	116.21±11.45	112.19±17.45	0.953	0.345
Diastolic Blood Pressure (mmHg)	74.79±13.57	75.42±11.91	-0.175	0.862
Pulse Rate	83.92±13.61	90.38±11.61	-1.813	0.076
Plasma Creatinine (mg/dl)	1.11±0.39	0.90±0.71	1.300	0.010*
Urinary Creatinine (mg/dl)	1.46±0.75	1.09±0.58	1.781	0.149
Plasma AST (µ/L)	5.68±3.68	5.77±3.69	-0.086	0.902
Urinary AST (µ/L)	3.93±0.73	6.45±0.89	-2.141	0.302
Plasma ALT (µ/L)	3.52±2.09	4.10±3.27	-0.703	0.450

Urinary ALT (µ/L)	1.99±0.43	1.30±0.31	1.318	0.148
Plasma Albumin	4.82±0.42	4.87±0.39	-0.440	0.928
Urinary Albumin	0.08±0.02	0.08±0.02	0.171	0.649
Plasma Uric Acid (mg/dl)	4.22±1.87	3.62±1.23	1.344	0.411
Urinary Uric Acid (mg/dl)	38.03±13.69	38.59±9.12	-0.161	0.042*

Value expressed as mean±Standard deviation. * $p< 0.05$ was considered statistically significant. BMI: Body mass index, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase, mmHg: milligrams mercury, U/L: Units per litre, mg/dl: milligram per decilitres

Table 2 shows the relationship between age, anthropometric indices, blood pressure and biochemical indices in the study participants. In male participants, age correlated positively with urine albumin. Body weight also correlated positively with body mass index (BMI) and pulse rate. Height correlated positively with urine uric acid. BMI correlated positively with waist circumference (WC), hip circumferences (HC) and pulse rate. BMI however correlated inversely with plasma albumin. Waist circumference correlated positively with body weight and HC. Hip circumference correlated positively with body weight, WC and pulse rate but inversely with plasma albumin. Systolic blood pressure (SBP) correlated inversely with urine creatinine and urine aspartate aminotransferase (AST). Diastolic blood pressure (DBP) correlated positively with HC

In females, age correlated positively with urine albumin while body weight, expectedly, correlated positively with BMI. Height correlated positively with urine uric acid while BMI correlated positively with body weight, WC, HC, SBP and DBP respectively. WC correlated positively with body weight and HC respectively while HC correlated positively with body weight, WC and pulse pressure respectively. SBP correlated positively with body weight, BMI, WC and HC individually. DBP correlated positively with body weight and SBP respectively while urine creatinine correlated positively with plasma alanine aminotransferase (ALT) which in turn correlated inversely with pulse pressure but positively with plasma AST and urine uric acid respectively. Plasma AST correlated positively with urine uric acid, while urine AST correlated inversely with urine uric acid

Table 2: Association of age, blood pressure, anthropometric and biochemical indices in the study participants

		Male Participants		Female Participants	
Index	Index	r-value	P-value	r-value	P-value
Age	Urine Albumin	0.937	0.000*	0.409	0.047*
Weight	BMI	0.896	0.000*	0.933	0.000*
	Pulse Rate	0.426	0.038*	0.039	0.851
	Plasma Albumin	-0.406	0.050	-0.006	0.977
Height	Urine Uric acid	0.632	0.004*	0.632	0.001*
	Plasma Uric Acid	-0.264	0.213	-0.393	0.057
BMI	Weight	0.896	0.000*	0.933	0.000*
	WC	0.886	0.000*	0.860	0.000*
	HC	0.932	0.000*	0.933	0.000*
	SBP	0.285	0.178	0.668	0.000*
	DBP	0.128	0.550	0.495	0.010*
	Pulse Rate	0.443	0.030*	0.114	0.580
	Plasma Albumin	-0.451	0.027*	-0.097	0.637
WC	Weight	0.850	0.000*	0.850	0.000*
	HC	0.889	0.000*	0.821	0.000*
HC	Weight	0.907	0.000*	0.936	0.000*
	WC	0.889	0.000*	0.821	0.000*
	Pulse Rate	0.442	0.031*	0.092	0.654
	Plasma Albumin	-0.488	0.015*	-0.036	0.860
SBP	Weight	0.382	0.065	0.596	0.001*
	BMI	0.285	0.178	0.668	0.000*
	WC	0.276	0.192	0.447	0.022*
	HC	0.306	0.146	0.538	0.005*
	Urine Creatinine	-0.493	0.032*	-0.052	0.812
	Urine AST	-0.489	0.046*	-0.234	0.350
DBP	Weight	0.099	0.645	0.440	0.025*
	SBP	0.151	0.480	0.777	0.000*
	HC	0.442	0.031*	0.092	0.654
Urine Creatinine	Plasma AST	-0.313	0.238	0.516	0.014*
Plasma ALT	Pulse Rate	-0.367	0.078	-0.484	0.012*
	Plasma AST	0.161	0.486	0.453	0.023*
	Urine Uric Acid	0.028	0.909	0.448	0.028*
Plasma AST	Urine Uric Acid	0.246	0.358	0.424	0.044*
Urine AST	Urine Uric Acid	-0.277	0.282	-0.476	0.046*

r:Pearson Correlation Coefficient, p:Probability, * $P<$ 0.05 was considered statistically significant , AST: Aspartate aminotransferase, ALT: Alanine aminotransferase, WC: Waist circumference, HC: Hip circumference, BMI: Body mass index, DBP: Diastolic blood pressure, SBP: Systolic blood pressure

Discussion

In this study, there was no significant difference in the age of the study participants, gender-wise. This observation was similar to our earlier report which reported no difference in the ages of male and female participants (Ajayi *et al*., 2022)**.** The participation of undergraduate students that met the study's inclusion criteria may be the reason for this observation.

Height was significantly higher in male compared to female participants in this study. This appears to be physiological and can be due to the growth-enhancing potential of the androgens, particularly the testosterone (Ajayi and Okhani, 2023). On the average, men are known to be taller than women and this has also been associated with economic wellbeing (Schappi *et al*., 2022)

Plasma creatinine was significantly higher in male compared to female participants in this study. Males have higher muscle mass than females and creatinine, a byproduct of muscle metabolism, is therefore produced more in males than females (Levey *et al*., 1999).

In this study, uric acid was significantly higher in females than males. Tani *et al* (2020) reported the possible involvement of elevated level of serum uric acid in abdominal obesity and the risk of metabolic syndrome in females. Hyperuricaemia has also been implicated in insulin resistance (Dai *et al*., 2021). Although, there was no statistical difference in plasma uric acid, blood pressure and anthropometric indices with the exception of height of the participants in terms of the genders in this study, since urine is a filtrate of blood plasma, our observation therefore suggests subtle contribution of uric acid to cardio-metabolic risk in females. Higher levels of uric acid in males compared to females have been reported. This was attributed to the suppressive effects of oestradiol on uric acid in females. However, this position has been contrasted by a report which showed that the suppression of uric acid by oestradiol only occur in adult females and not in adolescents females (Wang and Charchar, 2021).

Statistically significant relationships between anthropometric indices and blood pressures differ between the two genders. In the male participants, there was a positive correlation between body weight and pulse rate. There was also a positive correlation between HC and pulse rate. A positive correlation between BMI and pulse rate was also observed. DBP correlated positively with HC, while BMI correlated positively and significantly with pulse rate at $p \leq 0.05$.In the female participants, DBP positively correlated with SBP and body

weight respectively while BMI correlated positively with DBP. On the other hand, SBP correlated positively with weight, BMI, WC and HC respectively. These parameters are predictors of cardiovascular health. It is difficult to conclude that the variations of these associations are gender-specific, considering the sample size. Further studies with larger sample sizes may be required to validate these observations.

The association of obesity with renal function has been reported (Kovesdy *et al*., 2017, Prasad *et al*., 2022). BMI which correlates positively with obesity was reported as an independent predictor of renal function (Duan *et al*., 2019). In this study, BMI and HC were inversely correlated with plasma albumin in male participants only. Mosli and Mosli (2017) reported that obesity and morbid obesity strongly predict hypoalbuminaemia . The reason for this observation is unclear, but suggests the relationship of obesity with hypoalbuminaemia which may not be specific to males alone.

The relationship between serum creatinine and cardiovascular risk has been reported (Chen *et al*., 2023). There is however paucity of information on this relationship in apparently healthy adolescents. There was an inverse association between SBP and urine creatinine as well as urine AST activity in male participants.

In female participants in this study, statistically significant associations were observed. Urine creatinine correlated positively with plasma AST activity. Plasma ALT correlated inversely with pulse but positively with plasma AST and urine uric acid respectively. Furthermore, plasma AST positively correlated with urine uric acid, but urine AST correlated inversely with urine uric acid. It is uncertain if these associations are specific to the female gender since such associations were not observed in the male participants.

Conclusion

The statistically significant differences in the body height, plasma creatinine and urine uric acid in the study participants, gender-wise appears physiological. There are indications that the non-significant differences in the other variables could be due to the apparently healthy status of the study participants. This a pilot study with significant results which suggest that this investigation should be carried out on a larger sample size.

Study Limitation

The small sample size is a limitation of this study. It should be noted that the study is a

pilot study of an ongoing study with a larger sample size.

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