Assessment of arterial blood pressure and some biochemical markers of renal function of apparently healthy young adults in Southern Nigeria

*Anthony F. Uwah[1], Jessie I. Ndem[1], Nsikak E. Udokang[2], Glory S. Etiekak[1]

[1]Department of Medical Biochemistry, Faculty of Basic Medical Science, College of Health Sciences, University of Uyo, Uyo, Akwa Ibom State
[2]Department of Medical Physiology, Faculty of Basic Medical Science, College of Health Sciences, University of Uyo, Uyo, Akwa Ibom State

Abstract

Context: Reports on chronic hypertension and its attendant complications in young adults are increasing. Kidney diseases, associated with hypertension, are currently emerging as global public health problem. Despite their significance as the active work force in the country, there is a dearth of data on the blood pressure and renal status of young Nigerian adults.

Aim: To measure mean arterial blood pressure and some biochemical indices of renal function of apparently healthy young adults aged between sixteen and thirty-five years, having blood pressure below 140/90 mmHg

Settings and design: A total of 650 attendees were randomly selected from five religious congregations across three major cities of Akwa Ibom in Nigeria and used in a cross-sectional study.

Material and methods: Arterial blood pressure, serum electrolytes, urea and creatinine of the subjects were determined using standard procedures. Glomerular filtration rate was calculated using the values of serum creatinine.

Results: The mean systolic and diastolic blood pressure of tested population were 132.50±4.16 and of 84.36±4.35mmHg respectively. The population mean GFR was 64.56 ±3.28 mL/min/1.73m2, while that of the male and female were 70.50±4.11 mL/min/1.73m2 and 58.20 mL/min/1.73m2 respectively. The values of 144.11±3.34, 5.65± 0.31, 103.04±3.02, 23.81±0.14. 4.74±0.08 and 142.04±3.22 were obtained in mmol/L for sodium, potassium, chloride, bicarbonate, urea and creatinine respectively for males, while the values obtained for females were 141.25±3.58, 4.93±0.11, 101.53± 2.18, 22.18±0.63, 4.02±0.03 and 137.05±4.16 respectively for sodium, potassium, chloride, bicarbonate, urea and creatinine,

Conclusion: It was concluded that Nigerian young adults have average arterial blood pressure within the JNC pre-hypertensive range, with mild to moderate derangements in the tested renal function parameters.

Key-words: Renal function, young adults, hypertension, renal failure

Introduction

Hypertension continues to be among the major causes of morbidity and mortality globally, most especially among blacks and low- and middle- income regions. The world Health Organization reported a prevalence of 1.13 billion in 2015, with African region having the highest prevalence of 27%. A meta-analysis of prevalence rate of hypertension in Nigerian populations showed a minimum prevalence of 12.4% and maximum of 34.8% with a combined prevalence rate of 22%. Hypertension has been described as a silent killer disease because most people with the disease do not manifest obvious symptoms and often do not know

Corresponding Author: Dr. Anthony F. Uwah

*Department of Medical Biochemistry,
Faculty of Basic Medical Science, College of Health Sciences,
University of Uyo, Nigeria.
E-mail: anthonyuwah@uniuyo.edu.ng, Tel: 08038888814*

that they have the disease.[1] There has been reported increasing incidence of hypertension among young adults.[2,3] Among young adults (18–39 years), approximately 20% of men and 15% of women have been diagnosed of hypertension in United States.[3] This has been attributed to increased prevalence of traditional risk factors in the young adults, including obesity, diabetes mellitus, and renal disease and psychosocial factors.[2,3] Studies showed that young adults with uncontrolled hypertension are at risk for chronic kidney disease.[3-5] Prevalence of hypertension among patients attending the general outpatient clinics of a tertiary hospital in Uyo, with mean age of respondents of 37.7 years was 30.1%. Published data on prevalence of hypertension among attendees of faith-based centres in Abak township showed that 50% of young adults (18 – 45 years) had blood pressure above 140/90 mmHg. There are no published data for other cities in Akwa Ibom State. There has been a general surge in the reported incidence of chronic renal disease in the recent times.[5,6] It has been observed that the magnitude of the problem of chronic kidney disease is enormous, and is currently emerging as a global public health problem.[7-9] The prevalence of impaired kidney function was estimated to range between 10% and 20% of the adult population in most countries worldwide.[8] The National Kidney Foundation estimated that 20 million Americans have chronic kidney disease and at least a further 20 million people have an increased risk.[10] There is reported lack of epidemiological information from different African countries on renal disorders.[6] In most developing countries like Nigeria, the prevalence of chronic renal failure and preventable kidney diseases is unknown, more particularly, that of the young adults population.[11,12] This situation has been attributed to due to lack of national registries of kidney disorders and limited surveys.[12] There is also paucity of information the prevalence of renal impairment by age and gender in Nigeria.[6] However, it was reported that at least 36.8 million Nigerians (23%) of the nation's over 170 million population were suffering from various degrees of renal disorders.[10] A prevalence of 19.9% of undetected renal diseases has been reported for a rural populace in Nigeria.[13] While an incidence of 45.5% of impaired kidney function was reported among hospitalized hypertensive patients in Maiduguri.[14] Odubanjo et al observed that the actual prevalence of renal disorders are significantly higher than these reports as most studies are hospital-based and fail to include the many patients who do not have access to hospital care.[15] Other studies have reported the incidence of chronic renal diseases in Nigerian adults to range between 1.6% and 12.4%.[16-19]

Initial evidence of kidney damage or a reduction in kidney function can be detected through routine blood analysis of some biochemical markers.[10,20] Biochemical markers play an important role in accurate diagnosis and also for assessing risk of preventable renal diseases, and adopting therapy that improves clinical outcome of the condition.[16] The most common biochemical indicators of kidney damage include raised levels of urea or creatinine (a waste product of protein metabolism) in the blood.[20] At some stage during the course of renal damage, routinely measured substances often become abnormal and the extent of the abnormality generally depends on the severity of the disease. Toxicologically important analyses of kidney function include serum electrolytes, urea and creatinine, serum urea/creatinine ratio, creatinine clearance, serum protein and urinalysis. The present study aimed at evaluating the renal status of young Nigerian adults aged between sixteen and thirty-five years, using some biochemical indices.

Materials and methods
This was a cross-sectional study of biochemical evaluation of the renal function indices of young adults between the ages of sixteen and thirty-five years. Religious assemblies were used as points of data collection. Fidel Good Health Initiative, a non-profit, non-governmental organization held free medical services and screening for attendees to religious worship centres at Abak, Ibiono and Uyo, all in Akwa Ibom State, between December 2016 and December 2018. A total of 650 (290 males and 360 females) attendees to religious centres across these towns who were randomly selected from 5 different congregations, were used in this study. Subjects between the ages of 16 and 25 years were 280 (125 males and 155 females), while those between the ages of 26 and 35 years were 370 (170 males and 200 females).
Biodata of subjects were recorded after the

necessary informed consents were obtained. Relevant medical history and physical examination were respectively obtained and carried out, with emphasis on recent history of significant trauma, fluid loss, febrile illness and drugs ingestion. Subjects whose symptoms and medical history were suggestive renal disorder were excluded. Individuals below 16 years and above 35 years of ages were also excluded. Data were only collected from apparently healthy individuals. Blood samples were not collected from individuals with blood pressure above 140/90mmHg and those having history of hypertension.

An aliquot of 5ml venous blood was obtained from each individual by venepuncture into plain screw-caped sample tube, which was allowed to clot and retract at room temperature between 22 - 27°C for two hours. Sera were separated using a bench top centrifuge (MSE Minor England), spun at 3000rpm for five minutes. The sera were store in a refrigerator at temperature -6°C, until required for analysis. All analyses were carried out within 24 hour of sample collection.

The resting arterial blood pressure of each subject was measured at sitting position with a mercury sphygmomanometer using standard techniques.

Serum levels of sodium and potassium were determined by routine flame photometry,[21] while serum chloride and bicarbonate estimation were determined by the titrimetric method.[22,23] Serum creatinine was determined by the Jaffe reaction method as described by Narayanan and Appleton,[24] and serum urea was determined by the Fearon reaction method as described by DiGiorgio.[25] Estimated glomerular filtration rate (eGFR) of each subject was calculated from the value of serum creatinine obtained from the laboratory, using the modification of diet in renal disease (MDRD) formula,[26] validated by the National Kidney Foundation.[27] Serum creatinine determination procedure was calibrated to be traceable to IDMS. The staging of kidney dysfunction was based on the Kidney Disease Out-come Quality Initiative (KDOQI) recommended classification system28 as follows: stage one: GFR >90 ml/min/1.73m^2; stage two: GFR= 60–89 ml/min/1.73m^2; stage three: GFR = 30–59 ml/min/1.73m^2; stage four: GFR =15–29 ml/min/1.73m^2 and stage five: GFR <15 ml/min/1.73m.[28,29]

Data collected were analyzed using the Statistical Package for Social Sciences (SPSS) for Windows software version 16. Student's t-test was used for continuous variables. A P value of <0.05 was taken to be statistically significant

Ethical clearance was obtained from the Research and Ethical Committee of Faculty of Basic Medical Sciences, College of Health sciences, University of Uyo, Akwa Ibom State.

Results

As shown in Table 1, a total of 650 normotensive individuals with mean age of 25.5 years assessed had average systolic blood pressure of 129.25± 4.16 mmHg and diastolic of 83.13 ± 4.35mmHg. Those with BP within the JNC normal range of <120/80 mmHg were 261, which was 40.2% of the tested population. Subjects aged 16 – 25 years were 280, with mean systolic blood pressure (SBP) of 126.52 ± 7.60 mmHg and diastolic pressure (DBP) of 81.45± 7.08 mmHg. The mean blood pressure of 370 subjects aged 26 – 35 was 131.98 ± 4.37mmHg and 84.81 ± 4.92 mmHg for systolic and diastolic pressure respectively. The systolic blood pressure of subjects aged 26 – 35 years was significantly (P < 0.05) higher than those aged 16 – 25 years, but not statistically different from the population mean SBP. The group aged 16 – 25 years had 52.9% (148) within the JNC normal, while 47.1% (132) were within prehypertension range. Those aged 26 -35 years had 30.5% (113) within the JNC normal group and 69.5% (257) were within the prehypertension range. Out of the 290 male respondents, 37.9% (110) were JNC normal while 62.1% (180) were within prehypertension. The female respondents were 360, out of which 47.2% (170) were within the JNC normal and 52.8% (190) were within prehypertension range.

Mean serum electrolytes recorded for the population were 141.35 ± 3.48, 5.17± 0.28, 101.62 ± 2.68, 22.53 ± 0.38 in mmol/L for Na, K, Cl and HCO3 respectively. Subjects aged 16 -25 recorded mean serum electrolytes values of 139.44 ± 4.31, 5.00 ± 0.26, 100.74 ± 3.77 and 22.96 ± 1.24 for sodium, potassium, chloride and bicarbonate respectively. Those aged 26 – 35 had electrolytes levels of 84.81 ± 4.92, 143.25 ± 3.18, 5.33 ± 0.31 and 102.49 ± 2.62 in mmol/L for sodium, potassium, chloride and bicarbonate respectively. There were

Table 1: Distribution of blood pressure of normotensive young adults according to age and gender

Age (Years) /Gender	Number of Subjects	Mean BP (SBP/DBP)	Normal (<120/80 mmHg)		Prehypertension (120 – 139/80 -89)	
			Subjects	**%**	**Subject**	**%**
[m]25.5 ±7.5	650	129.25± 4.16/ 83.13 ± 4.35	261	40.2	389	59.8
16 – 25	280	126.52 ± 7.60/ 81.45± 7.08	148	52.9	132	47.1
26 – 35	370	131.98 ± 4.37/ 84.81 ± 4.92	113	30.5	257	69.5
Male	290	136.80 ±4.05/ 85.90 ± 4.61	110	37.9	180	62.1
Female	360	128.23 ±4.28/ 82.30 ± 4.20	170	47.2	190	52.8

[m] = Mean age of population
BP= Blood pressure
SBP = Systolic blood pressure,
DBP = Diastolic blood pressure,

Table 2: Blood pressure, electrolytes, urea, creatinine and glomerular filtration rate of apparently healthy Nigerian young adults

Age (Years)	Number of Subjects	SBP (mmHg)	DBP (mmHg)	Na (mmol/L)	K (mmol/L)	Cl (mmol/L)	HCO₃ (mmol/L)	Urea (mmol/L)	Cr (mmol/L)	eGFR (mL/min)
16 – 25	280	126.52 ± 7.60	81.45 ± 7.08	139.44 ± 4.31	5.00 ± 0.26	100.74 ± 3.77	22.96 ± 1.24	4.02 ± 0.32	139.52 ± 4654	65.70 ± 5.11
26 – 35	370	131.98[b] ± 4.37	84.81 ± 4.92	143.25 ± 3.18	5.33 ± 0.31	102.49 ± 2.62	22.09 ± 1.13	4.77 ± 0.13	134.35 ± 3.16	63.62 ± 2.62
[m]25.5 ±7.5	650	129.25 ± 4.16	83.13 ± 4.35	141.35 ± 3.48	5.17 ± 0.28	101.62 ± 2.68	22.53 ± 0.38	4.40 ±0.05	136.95 ±4.11	64.66 ±3.28

SBP = Systolic blood pressure,
DBP = Diastolic blood pressure,
[m] = Mean age of population
[b] = significantly different at P < 0.05

Table 3: Gender variation in blood pressure, electrolytes, urea and creatinine of apparently healthy Nigerian young adults

Gender	Number of Subjects	SBP (mmHg)	DBP (mmHg)	Na (mmol/L)	K (mmol/L)	Cl (mmol/L)	HCO₃ (mmol/L)	Urea (mmol/L)	Cr (mmol/L)	eGFR (mL/min)
Male	290	136.80 ±4.05	85.90 ± 4.61	144.11 ± 3.34	5.65 ± 0.31	103.04 ± 3.02	23.81 ± 0.14	4.74 ± 0.08	142.04 ±3.22	70.50 ± 4.11
Female	360	128.23 ±4.28	82.30 ± 4.20	141.25 ± 3.58	4.93 ± 0.11	101.53 ± 2.18	22.18 ± 0.63	4.02 ± 0.03	137.05 ±4.16[a]	58.20 ± 2.62[a]

SBP = Systolic blood pressure,
DBP = Diastolic blood pressure,
[a] = significantly different at P < 0.05

no statistically significant changes in electrolytes levels among the different age groups and the population.

Mean serum urea and creatinine in mmol/L of the population were 4.40±0.05 and 136.95±4.11 respectively. The mean GFR of the population was 64.66 ± 3.28 mL/min.

Assessment based on gender (Table 2), the 290 male subjects evaluated had average systolic blood pressure of 136.80 ± 4.05mmHg and diastolic of 85.9 ± 4.61mmHg, while the 360 female subjects evaluated had mean systolic blood pressure of 128.23 ± 4.28 mmHg and diastolic of 82.30 ± 4.20 mmHg. The population mean serum electrolytes obtained were 142.62 ± 3.48, 5.29 ± 0.28, 102.29 ± 2.68 and 22.99 ± 0.38 mmol/L for sodium, potassium, chloride and bicarbonate respectively. 4.25 ±0.05 mmol/L and 139.55 ±4.11 mmol/L were obtained for urea and creatinine respectively, while 64.56 ±3.28 mL/min/1.73m2 was the average population GFR. The mean GFR of the male subjects studied was 70.50±4.11 mL/min/1.73m2, while that of the females was 58.20 mL/min/1.73m2. The mean values of 144.11±3.34, 5.65± 0.31, 103.04±3.02, 23.81±0.14. 4.74±0.08 and 142.04±3.22 were obtained in mmol/L for sodium, potassium, chloride, bicarbonate, urea and creatinine respectively for males, while the values obtained for females were 141.25±3.58, 4.93±0.11, 101.53± 2.18, 22.18±0.63, 4.02±0.03 and 137.05±4.16 respectively for sodium, potassium, chloride, bicarbonate, urea and creatinine (Table 2).

Discussions

The mean arterial blood pressure of the majority of the evaluated population averaging 25.5 ±7.5 fell within the JNC pre-hypertensive range of 120 – 139 mmHg systolic and 80 – 89 mmHg diastolic.30 The study by Bello et al reported a mean systolic blood pressure of 131±22.9 mmHg and a mean diastolic of 83.0 ±14.1 mmHg for adults averagely aged 39.2 years in three Local Government areas in Lagos.[31] The mean arterial blood pressure of the young adult population studied increased with age, and the male population had a higher mean value in comparison to the female of the same age range (Table 1 and Table 2). The finding corroborates with the reports for other Nigerian communities by other scholars.[31,32] Sacks and Campos reported that

sustained increases in blood pressure above 115/75 mmHg increased morbidity. These data underscore the need to intensify blood pressure checks and control modalities among Nigerian young adults so as prevent early development of associated complications.[33] Increased prevalence of hypertension in urban areas, like in other countries in Africa, is strongly linked to changes in individual's and societal lifestyle like reduced physical activity, excessive alcohol, cigarette consumption, adoption of "Western" diets high in salt, refined sugar and unhealthy fats and oils, and lower fruits consumption. Such factors like ignorance, lack of health education, over-dependence on spiritual solutions on health issues and low socioeconomic status are also implicated.[34,35] For the young adults in the investigated population, excess alcohol and hemp intake, aggression-related jobs such as tricycle and motorcycle commercial driving, unemployment, excess salt and junk foods, consumption and religious indoctrination may be implicated in the raised blood pressure observed.

Sustained increases in arterial blood pressure can either result from or cause chronic kidney disease, as several studies have established an association between hypertension and kidney damage.[33] The GFR value for the young adult male population investigated showed mild decrease and correlated with KDOQI stage two chronic renal dysfunction, while the females mean GFR value correlated with the KDOQI stage one kidney disease.[36] A study on prevalence of chronic renal disease in apparently healthy retired civil servants in Asaba, Nigeria, carried out in 2014, reported a mean GFR of 64.5 ml/min. The mean serum creatinine showed slight elevation, while mean serum urea was at the highest limit of acceptable normal value. Mean serum electrolytes results showed slight hypernatraemia and hyperkalaemia for the studied population (Table 2). Mean serum bicarbonate and chloride were within normal limits reported by Vasudevan and Sreekumari.[37] The observed derangements in biochemical indices studied increased with age (Table 2). The female young adults had relatively better renal indices compared to the males of the same age range (Table 3). It was earlier reported that in sub-Saharan Africa, chronic kidney disorder is a prevalent and potentially escalating disease, with

both communicable and non-communicable risk factors.[37] Factors that may contribute to the observed results include increased blood pressure,[38] habitual alcohol intake, indiscriminate use of herbal concoction and overreliance on faith-based health practices.[34,35] Certain poverty-related factors such as infectious diseases secondary to poor sanitation, inadequate supply of safe water, environmental pollutants and high concentrations of disease-transmitting vectors were earlier reported to play an important role in the development of kidney dysfunction in low-income countries.[6,39]

Conclusion

Based on the data generated from the study, the blood pressure of a significant percentage of young adult population studied was within the JNC pre-hypertensive range. Although the data may not represent the entire population of young adult in the studied area since data was collected at religious assemblies, it underscores the need for health education, regular medical checks and lifestyle modification. Environmental and socioeconomic factors may be associated with the observed high mean of blood pressure among these young adults. There were some derangements in biochemical markers of renal function of the apparently young Nigerian adults tested, suggesting some degree of renal function impairment in this population. Socioeconomic and environmental factors may be implicated in the observed conditions. There is therefore, an urgent need for health education and awareness campaigns by relevant bodies and organization towards curbing and reversing the observed trend.

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