Research

Cardiovascular Risk Factors and Renal Impairment among Young Adults in a Tertiary Institution in Southwest Nigeria

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Article history: Received 20 June 2022, Reviewed 9 December 2022, Accepted for publication 12 December 2022

Abstract

Background: Specific research is sparse on renal dysfunction among homogenous group of young adults. This study estimated the prevalence of renal dysfunction among apparently healthy young adults and determine association (if any) between renal dysfunction and some cardiovascular risk factors.

Methodology: Undergraduates (18-37 years) of a tertiary institution were studied on 2017 World Kidney Day. Their biodata, blood pressure, anthropometry, total cholesterol and estimated glomerular filtration rate were determined. Data was analyzed using SPSS version 20.0.

Results: A total of 640 students were studied (M:F=1:3.8). Their mean age was 23.1±2.8 years. Thirty-three (5.2%) participants had renal dysfunction (eGFR < 60ml/min/1.73m2). The mean age of subjects with renal dysfunction (eGFR < 60ml/min/1.73m2) was significantly higher with an inverse association to renal function ($p = 0.005$).

Two hundred and fifty-seven (40.2%) and 58 (9.1%) participants were pre-hypertensive and hypertensive respectively; overweight, abdominal obesity and hypercholesterolaemia were found among 12.2%, 14.2% and 8.1% of subjects respectively. The mean body mass index ($p = 0.009$) and serum total cholesterol ($p = 0.003$) were significantly higher among females. There was a higher prevalence of renal dysfunction among females even though this was not to the significant level (5.9 v 2.2%, $p = 0.12$).

Conclusions: The prevalence of renal dysfunction among young adults is lower than current global estimates. The prevalence of cardiovascular risk factors for CKD were lower than that of older adults with no significant association to renal dysfunction. Increasing age was found to be significantly associated with reduced renal function.

Keywords: prevalence, renal dysfunction, cardiovascular risk factors, young adults, Nigeria

Introduction

The young adulthood stage remains an ill-defined period of human existence to date with conflicting age ranges employed by various research groups. In the United Kingdom, it is known as "the age group with no name". This is because there is no clear-cut boundary.[1] The World Health Organization defined "young people" as adolescents and those aged 10-24 years while the United Nations and the Society for Adolescent Health and Medicine in UK agree on 18-25 years.[2,3-4] The Nigerian National Youth Policy (2009) defines youth as between 18-35 years.[5]

This study was conducted on a background knowledge that chronic kidney disease (CKD) runs a progressive course with rates of progression varying in accordance with a number of independent and sometimes, interdependent risk factors. On some occasions, mild renal dysfunction may ultimately progress to overt renal disease with significant morbidity and mortality if not identified early and addressed. Control of modifiable cardiovascular (CV) risk factors at primary and secondary levels of prevention has been found to be highly effective in retarding the onset of renal disease or its progression to end stage renal disease (ESRD).[6-7]

Print ISSN: 0189-9287

An online literature search for similar studies and reviews on this subject using the following search engines, PubMed, MEDLINE, ResearchGate, google scholar, African Journals Online (AJOL), Google, and Medscape. We used key words such as 'chronic kidney disease', 'renal dysfunction', 'youth', 'young adults', 'association', 'risk factors', 'hypertension', pre-hypertension', 'obesity', 'hypercholesterolaemia' was conducted.

The literature search identified a couple of studies describing chronic kidney disease in this age group[8-9]. Indeed, Fouad et al showed that obese young adults (aged 18-25 years) with elevated mean arterial pressure (MAP), waist/hip ratio (WC/H ratio), triglyceride/high density lipoprotein (TG/HDL) ratio, highly Sensitive-C reactive protein, and metabolic syndrome were more liable to CKD[8]. Although several general population studies exist and a number have commented on the observations according to age group, we did not find any study on CKD prevalence or determinant cardiovascular risk factors that specifically addressed an exclusive, homogenous group of young adults in Nigeria. We therefore set out to estimate the prevalence of renal dysfunction among apparently healthy young adults and (ii) determine association (if any) between renal dysfunction and cardiovascular risk factors in Nigeria.

Methods

***Study Design*:** This was a cross-sectional study of consecutive volunteers at a screening centre in the College between March 16 and April 30, 2017. Participants who presented for medical screening during the March 16, 2017 World Kidney Day celebration in conjunction with the College Health Centre, Junior Chamber International and the Red Cross were recruited into the study. The published abstract of the study results was subsequently presented at the World Congress of Nephrology in 2020[10]. Participation in the study was voluntary and, informed consent was obtained from each participant after careful explanation of the processes involved to the participants in English Language.

Study Location: The study was conducted among apparently healthy volunteers who were students of Adeyemi College of Education, Ondo City, Ondo State, south-west Nigeria. It is a federal tertiary institution with a student population of about fifteen thousand from various parts of the six geo-political zones in Nigeria.

Inclusion Criteria: All consenting consecutive apparently healthy undergraduates of the College aged between 18 and 39 years.

Exclusion Criteria: We excluded students who were at least 40 years old, those with on-going acute illnesses such as malaria, gastroenteritis or any other febrile illness or chronic illnesses such as heart failure or liver disease. Pregnant students, uncooperative students, and non-students such as lecturers and administrative staff were also excluded. Other causes of chronic kidney disease (CKD) such as chronic glomerulonephritis, polycystic kidney disease and renal artery stenosis could not be excluded as this was a community-based study.

Biodata: Their biodata was obtained using pro-forma. Different segments took care of biodata, clinical and anthropometry data and laboratory parameters.

Anthropometry: Their waist and hip circumferences (WC and HC), weight, and height were measured without shoes and with light clothing by trained personnel. During the measurement, participants stood in an upright position, with arms relaxed at the side, feet evenly spread apart, and body weight evenly distributed in accordance with the World Health Organization (WHO) expert consultation report on waist circumference and waist-hip ratio. Abdominal obesity was determined as a waist hip ratio >0.94 in men and >0.88cm in women according to the WHO definitions[11]. Weight was measured to the nearest 0.1 kg using a standard weighing scale (RGZ 160 Lincon Mark Medical, England). Height was measured to nearest 0.5 cm using a wall-mounted microtoise. Body mass index (BMI) was calculated as BMI (kg/m^2) = weight (kg)/height (m^2). General overweight and obesity were defined using the current WHO definitions: underweight: BMI < 18.5 kg/m^2, normal weight: BMI 18.5–24.9 kg/m^2, overweight (pre-obese): BMI 25–29.9 kg/m^2, and obese: BMI > 30 kg/m^2. [12]

***Blood pressure*:** Their blood pressure (BP) was measured on the right arm using the *Accosons* (Germany) mercury sphygmomanometer with a standard cuff size and subjects in sitting position after about 5 minutes of rest. Essential hypertension was classified according to the seventh Joint National Committee Report on Detection, Evaluation, and treatment of High Blood pressure (JNC 7) report.[13] Subjects with elevated blood pressure were asked to rest for at least one hour and the measurement was repeated before the exercise was concluded. Hypertension was defined by a measured BP of ≥140/90mmHg and/or use of antihypertensive. Pre-

Print ISSN: 0189-9287

hypertension was defined by Systolic BP of 120-139mmHg and Diastolic
BP of 80-89mmHg.[13]
Total Cholesterol and serum creatinine: Blood samples were drawn for serum creatinine and total cholesterol (TC). 5ml of venous blood sample was drawn into sample bottle containing lithium heparin for the analysis of plasma creatinine and total cholesterol (TC). Samples were separated and kept at -2^{0}C until analysis. Serum creatinine was estimated by spectrophotometric method based on Jaffe slot methods using commercially prepared reagents by RANDOX (United Kingdom) while total cholesterol was estimated using commercially prepared reagent by Bio-Systems (Barcelona, Spain) based on end point assay of cholesterol esterase-oxidase reaction. In accordance with the National Cholesterol Education Project-Adult Treatment Panel (NCEP-ATP III) guidelines, we defined hypercholesterolaemia as serum TC >200mg/dl (5.2mmol/L). The renal function was estimated using the Modification of Diet in Renal Disease (MDRD) calculator based on the formula for MDRD which took into consideration the following factors: age, gender and race[14]. The equation does not require weight because the results are normalized to 1.73m^2 body surface area[14]. We defined reduced renal function as an estimated glomerular filtration rate (eGFR) of <60ml/min/1.73m^2.

Ethical Approval: Ethical approval was obtained from the Research and Ethics Committee of the University of Medical Sciences, Ondo State, Nigeria (NHREC/TR/UNIMED-HREC-Ondo St/22/06/21). Each participant gave consent for our study group to obtain information on them.

Data Analysis: Data were analysed using SPSS software (version 20.0; IBM SPSS Inc, Chicago, III). The results obtained were presented as percentages, frequencies and means (±Standard Deviation). Independent sample t-test was used to determine if differences between continuous data across gender and age groups of respondents were significant. Chi square ($\chi 2$) test of association was used to identify the risk factors associated with renal dysfunction. Fisher exact test were used to determine the significance of observed differences for categorical variables where appropriate. A p value of < 0.05 was accepted as statistically significant. Participants with incomplete data sets were excluded from the final analysis.

Limitations of the study: The strength of this study lies in its moderately large sample size and its being a population-based study. Authors recognize that leaving out the full panel of lipid assay, proteinuria and blood sugar testing were significant omissions. Due to paucity of funds, renal function assessment of subjects was limited to a single serum creatinine assay, while also leaving out urinary albumin creatinine ratio assessment.

Results

A total of 640 students (age range, 18-37 years) were studied. There were 134 (20.9%) males and 506 (79.1%) females with a male to female ratio of 1:3.8 and mean age of 23.1±2.8 years. Thirty-three (5.2%) participants had renal dysfunction (eGFR < 60ml/min/1.73m2). Two hundred and fifty-seven (40.2%) and 58 (9.1%) participants were pre-hypertensive and hypertensive respectively; overweight, abdominal obesity and hypercholesterolaemia were found in 12.2%, 14.2% and 8.1% of subjects (table 1).

Table 1: Clinical and laboratory parameters of participants

Age Group	Freq(%)	Male N(%)	Female N(%)
18-21	197 (30.8%)	36 (26.9%)	161 (31.8%)
22-26	360 (56.4%)	68 (50.7%)	292 (57.7%)
27-30	78 (12.2%)	27 (20.2%)	51 (10.1%)
31-37	5 (0.6%)	3 (2.2%)	2 (0.4%)
Hypertension Stage			
Normal	325 (50.7%)	56 (41.8%)	269 (53.2%)
Pre-Hypertension	257 (40.2%)	69 (51.5%)	188 (37.2%)
Hypertension	58 (9.1%)	9 (6.7%)	49 (9.6%)
Obesity			
Underweight	125 (19.5%)	31 (23.1%)	94 (18.6%)
Normal	418 (65.3%)	90 (67.2%)	328 (64.8%)
Overweight	78 (12.2%)	11 (8.2%)	67 (13.2%)
Mild Obesity	14 (2.2%)	2 (1.5%)	12 (2.4%)
Moderate Obesity	3 (0.5%)	0	3 (0.6%)
Severe Obesity	2 (0.3%)	0	2 (0.4%)

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Age Group	Freq(%)	Male N(%)	Female N(%)
Waist-Hip Ratio			
Normal	549 (91.1%)	128 (95.5%)	457 (90.3%)
Above Normal	91 (14.2%)	6 (4.5%)	49 (9.7%)
Serum Total Cholesterol			
Normal	471 (73.6%)	115 (85.8%)	356 (70.4%)
Borderline	117 (18.3%)	10 (7.5%)	107 (21.1%)
High	52 (8.1%)	9 (6.7%)	43 (8.5%)
Renal Function Status			
≥60ml/Min/1.73m2	607 (94.8%)	131 (97.8%)	476 (94.1%)
<60ml/Min/1.73m2	33 (5.2%)	3 (2.2%)	30 (5.9%)

The mean body mass index (p = 0.009) and serum total cholesterol (p = 0.003) were significantly higher among females while the eGFR was significantly higher among males (p<0.01). There was no gender difference in the mean systolic (p = 0.159) and diastolic blood pressure (p = 0.275) (table 2).

Table 2: Gender differences between clinical and laboratory parameters of participants

Parameter	Total N = 640	Male N =106	Female N =534	P
Age (years)	23.1±2.8	23.8±3.4	22.9±2.6	0.001
MAP* (mmHg)	85.6±9.6	86.7±9.1	85.3±9.8	0.135
Systolic BP† (mmHg)	113.5±12.3	114.9±12.1	113.2±12.4	0.159
Diastolic BP† (mmHg)	71.9±10.0	72.7±9.6	71.6±10.1	0.275
Body Mass Index (kg/m²)	21.7±3.6	21.1±2.8	21.9±3.8	0.009
TC‡ (mmol/L)	4.5±1.1	4.3±1.1	4.6±1.1	0.003
eGFR§ (ml/min/1.73m²)	88.6±22.3	96.0±12.3	86.7±21.4	<0.01
Waist-hip ratio	0.80±0.08	0.84±0.09	0.79±0.08	0.001

*mean arterial pressure, †blood pressure, ‡total cholesterol, §estimated glomerular filtration rate

The mean age of subjects with eGFR < 60ml/min/1.73m2 was significantly higher than those who have eGFR > 60ml/min/1.73m2 with an inverse association to renal dysfunction {[24.4±3.2] v [23.0±2.7], p = 0.005} (table 3). The prevalence of pre-hypertension, hypertension, overweight, obesity and hypercholesterolaemia were found to be 40.2%, 9.1%, 13.2%, 3.4% and 8.1% respectively. There was no significant association between BMI, MAP, waist hip ratio, TC and reduced renal function (table 3). There was a higher prevalence of reduced eGFR among females than males (5.9 v 2.2%, p = 0.12) even though this was not to the significant level (table 3).

Table 3: Association between risk factors for CKD and renal function among participants

Risk Factors	≥60ml/min/1.73m²	<60ml/min/1.73m²	P
Age	23.0±2.7	24.4±3.2	0.005
Body Mass Index	21.7±3.7	21.2±2.5	0.613
MAP* (mean±SD†)	85.5±9.6	87.9±11.2	0.159
Waist hip ratio (mean±SD†) male	1.1±0.0	1.1±0.0	0.350
Waist hip ratio (mean±SD†) female	1.1±0.3	1.1±0.4	0.489
TC‡ (mean±SD†)	3.6±0.8	4.0±0.7	0.158
Gender			
Male	131(97.8)	3(2.2)	0.12
Female	476(94.1)	30(5.9)	
Total	607(94.8)	33(5.2)	

*mean arterial pressure, †standard deviation, ‡total cholesterol

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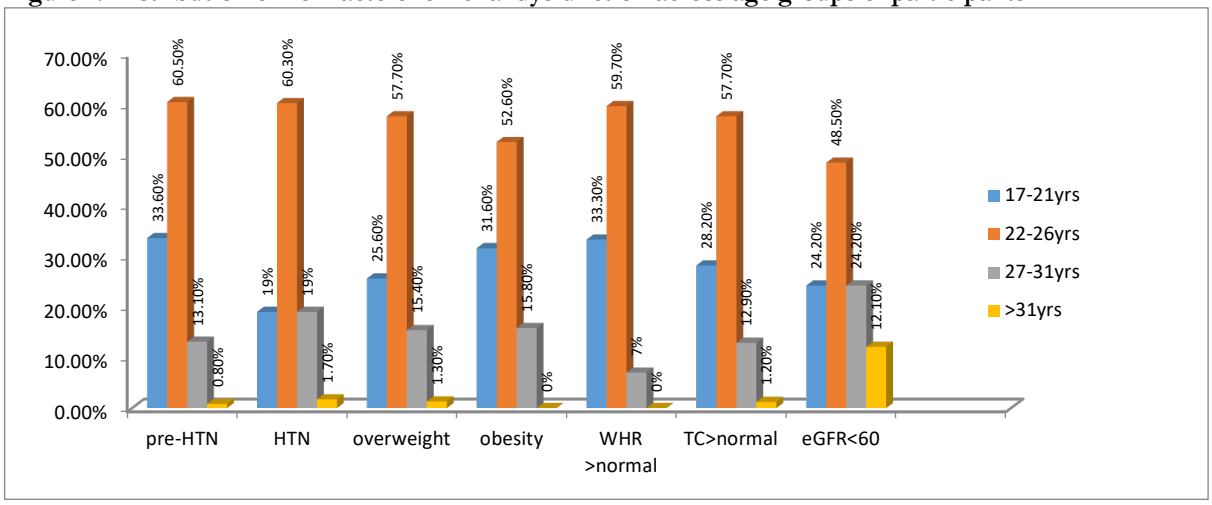
The proportion of subjects with hypertension, obesity and reduced renal function increased progressively across the age groups (figure 1).

Figure 1: Distribution of risk factors for renal dysfunction across age groups of participants



Keys: 17-21 years (n=197), 22-26 years (n=360), 27-31 years (n=80), 32-37 years (n=3)
Prehypertension (Pre-HTN), hypertension (HTN), Waist-hip ratio (WHR), total cholesterol (TC), estimated glomerular filtration rate (eGFR)

Discussion

Majority of our subjects (99.4%) were aged 30 years and below which falls within 18-35 years chosen by the Federal republic of Nigeria. [5] It also tallies with a report in Canada where over 75% of undergraduates were 17-27 years old.[15] Our finding may also be attributable to the fact that post graduate studies are not commonly offered at the institution where study was performed. We obtained a prevalence of 5.2% for renal dysfunction in our study. This is similar to 6.5% reported among tertiary students in Egypt.[8] Our figure is however higher than 2-3% reported in the United States of America among young adults aged 20 to 39 years[16]. The prevalence from our study is slightly above half of 10.1% pooled prevalence obtained for CKD in Africa[17]. This finding apparently lends support to the suggestion that early determination of CKD among young adults is important in mitigating premature progression to end stage renal disease.

Newer studies are indicating early association of CV risk factors to renal failure. For example, a recent study conducted among rural children in Southwest Nigeria indicated that age showed significant association to renal dysfunction while dyslipidemia and high body mass index have propensity to influence the development of paediatric CKD.[18] In another group, Ezeonwu et al also demonstrated the relationship between cardiovascular risk factors and renal dysfunction among the paediatric age group.[19]

Increasing age correlated with reduced renal function in our study. Age-related decline in glomerular filtration rate (GFR) is generally believed to be less than 1 ml/min/1.73 m2 per year[20]. In fact, age appears to be an independent predictor of loss of renal function. One large study showed that neither kidney function nor chronic kidney disease (CKD) risk factors could explain the strong association between age and glomerulosclerosis in healthy adults.[21] What is interesting about our finding is that unlike what normally obtains where reduction in renal function kicks off naturally at the age of 30 years, reduction appears to commence much earlier in our study where the average age of subjects with eGFR <60ml/min/1,73m^2 was 24.4±3.2 years thus suggesting that more work need be done by all parties for early detection of renal impairment.

The prevalence of hypertension in our study (9.1%) is comparable to a prevalence of 9.8% found among young Indians (18-35 years) in Hyderabad[22] even though lower when compared to a prevalence of 15% found in young adults in a community survey in Central Uganda[23] and 17.1%, 19.1% and 20.7% obtained among young Indonesians (18-25 years)[24], Israelis aged between 25 and 45 years [25] and Nigerian young adults aged 18-29 years.[26] There was no association between hypertension and

Print ISSN: 0189-9287

reduced renal function in our study. This contrasts with the Atherosclerosis Risk in Communities (ARIC) study where baseline hypertension was associated to faster decline in kidney function.[27]

Prehypertension was present in 40.2% of our subjects. This falls within the range of 40-48.9% found in Uganda, Nigeria, India and Israel.[23,28-30] Contrary to overt hypertension that is less common before 40 years of age, pre-hypertension is more commonly seen among the younger age group[31]. This finding is important because pre-emptive measures can be taken by medical personnel to prevent overt hypertension among youths as it has become a recognized risk factor for hypertension and cardiovascular diseases, including CKD[32]. It is however worthy to note that studies on the association between pre-hypertension and CKD are usually on the middle aged to elderly as shown in the landmark Ohasama study where the average age of participants was 60.3 ± 9.6 years.[33]

The prevalence of obesity in our study was 3.4%. This was higher than 1.9% found among young adults in Ghana School of Medicine and Health Sciences and much lower than 30.7% reported by Fouad et al and 22% reported in a multi-centre study involving twenty-two low- and middle-income countries.[8, 34-35] There was no significant association of obesity to renal dysfunction in our study. This contrasts with numerous studies catalogued in a seminal work by Kovesdy et al that have linked obesity to CKD.[36] Hypercholesterolaemia was found among 8.1% of our subjects. This is much lower than 49% found in participants aged 25–35 years in a study in Kerala, India[37]. Interestingly, the figure we obtained is much lower than 31.7% and 38.1% obtained in studies from Nigeria among older adults.[38-39] The differences observed may be due to differences in diet across culture and to poor feeding among undergraduates in tertiary institutions in third world countries.[40] Also, young adults are generally more physically active thus consuming a greater degree of energy that is mainly mobilized from fats. High consumption of saturated fat, red meat, eggs, and low physical activity were linked to hypercholesterolaemia in India.[41]

There was no association between hypercholesterolaemia and renal dysfunction in this study in contrast to reports elsewhere. A large, retrospective study showed that increased triglycerides and high levels of total cholesterol and low-density lipoprotein were independently associated with an increased likelihood of estimated glomerular filtration rate (eGFR) decline and development of incident chronic kidney disease in the general Zhejiang population[42]. Even though there was no significant association between gender and reduction in renal function in our study, a higher proportion of females had renal dysfunction unlike what is generally obtained where there is a slight male preponderance. This finding is similar to reports in Iran, USA, Japan and Sweden[44-47]. Indeed, Okoye et al reported a similar higher proportion of CKD in females in a rural community in Southern Nigeria[48].

Implications

Due to the high prevalence of hypertension, its early recognition through clinical evaluation at all educational levels is hereby recommended. This can be achieved by proper preadmission medical evaluation at the primary, secondary and tertiary levels of education. All young adults should undergo annual health check especially those with family history of hypertension, diabetes, or CKD. Facilities for weight reduction and exercise should be provided in all institutions from primary to tertiary levels including sport centres and parks to encourage youth participation. Importantly, the absence of any significant association between traditional risk factors and renal dysfunction in this age group underscores the need to evaluate for non-traditional risk factors of CKD in this group such as environmental exposures etc. Larger scale multicentre studies spread across the country may be more representative of young adults in Nigeria.

Conclusion

The prevalence of renal dysfunction among young adults is lower than current global estimates. The prevalence of established cardiovascular risk factors for development of CKD were generally lower than what obtains in older adults, and they had no significant association to renal dysfunction among young adults. Increasing age was found to be significantly associated to with reduced renal function.

Authors' contribution

AA Akinbodewa: conceptualization and design of the study, collection and inputting of data, data analysis, manuscript preparation and review for final submission. OA Adejumo: organization of the study, collection of data, manuscript preparation and review for final submission. OA Lamidi: collection of data, supervision of anthropometry, manuscript preparation and review for final submission. O Adeyemi: collection of data, supervision of sample collection and assay, manuscript preparation and review for final submission

Print ISSN: 0189-9287

KM Babatunde: coordination of field activity, collection of data, manuscript preparation and review for final submission

Financial Support and Sponsorship: None.

Conflict of Interest: Authors declare no conflict of interest.

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