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Original Research Article

Impact of Elevated Body Mass Index (BMI) on Some Renal Functions amongst Obese Women Resident in Rivers State, Nigeria

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Abstract

The rising prevalence of obesity is known to be associated with the risks of diabetes, cardiovascular disease, and chronic kidney disease (CKD) amongst others, but the levels vary across gender and different populations. The present study therefore evaluated the impact of body mass index (BMI) status on basic renal functions in obese women resident in Rivers State of Nigeria. The least allowed sample size of 272 was determined using the Leslie Fischer's formula; exactly 334 obese and non-obese women within their 18 and 65 years of age with no critical health condition and resident in Upland and Riverine areas of Rivers State were actually surveyed by the present study. A multistage sampling technique was adopted, and subjects were surveyed across the upland and riverine locations of the State. These subjects were evenly drawn from the multi-ethnic residents of the state. Anthropometric (body mass index-BMI) data and blood sample (via antecubital vein following standard procedures) were obtained from the consenting subjects. After laboratory analyses, the numerical data were subjected to statistical analyses using the statistical package for social sciences (SPSS) version 21.0. One-way analysis of variance (ANOVA) and independent t-test with a $p< 0.05$ considered statistically significant were determined. There were generally significant ($p<0.05$) increases in the creatinine and marked ($p<0.05$) reduction in the estimated glomerular filtration rates (eGFR) in the obese subjects compared to the non-obese and also with increasing BMI. The Creatinine and eGFR values were significantly ($p<0.0$) dyregulated. In conclusion, the above results of the present study are only markers of renal risks, (e.g. chronic kidney disease, etc.) and not necessarily incidences of emergencies. It however suggestive that obese women in Rivers Sate of Nigeria, particularly the riverine residents should take caution as their obesity status could predispose them to significant renal disorders.

Keywords: Obesity, creatinine, estimated glomerular filtration rate, women, Rivers State of Nigeria, renal dysfunction.

INTRODUCTION

Abnormal or excessive weight gain that poses risks to health is referred to as "overweight" and "obesity" (WHO, 2023). In adults, overweight and obesity are preferably assessed by determining body weight in kilograms (Kg) to height in metres square (m^2) ratio, which is otherwise referred to as body mass index (BMI). Overweight is defined as a BMI of 25, and obesity as a BMI of equal to or greater than 30. Obesity is often segmented into categories: Class I (BMI of 30 to < 35); Class II (BMI of 35 to < 40); Class III (BMI of 40 or above). Class III obesity is sometimes categorized as “severe” obesity (WHO, 2021).

According to the global burden of disease, the problem has reached epidemic proportions, with more than 4 million people dying annually as a result of being overweight or obese (James, 2008; WHO, 2023). In about a decade from now, it is expected that the prevalence of obesity would increase by over 40% (Kovesdy *et. al.*, 2017; Pommer, 2018). The risks of diabetes, cardiovascular disease, and chronic kidney disease (CKD) are all affected by this rising prevalence. One of the major risk factors for newly developing CKD is a high body mass index (Kovesdy *et al.*, 2017). More so, some major effects of the disease are that, in adults, it raises the likelihood of the incidences of type 2 diabetes mellitus, hypertension, coronary heart

disease, stroke, certain cancers, etc. It also negatively affects reproductive performance (WHO, 2021).

Further, the development of obesity is known to be more common among women than in men and that this disparity is even wider in some countries (Cooper *et al.*, 2021; Kapoor *et al.*, 2021). Specifically, Chukwuonye *et al.*, (2022) reported that in Nigeria, the prevalence of obesity among men and women were 10.9% and 23.0% respectively as at the 2022. While more explanations are needed to clarify this difference (Di Tecco *et al.*, 2020), some schools of thought have attributed it to genetic or *gender differences in metabolism (e.g. carbohydrate) that may be responsible for a greater increase in triglyceride levels in women and its consequent higher adiposity* **(**Karastergiou *et al.*, 2012; Kanter and Caballero, 2012).

The rising cases of obesity is also known to be highly associated with huge comorbid conditions such as cardiovascular, dyslipidaemic, renal dysfunctions, etc. (Pommer, 2018; WHO, 2021). In the submission of Kalantar-Zadeh *et al.*, (2021), they established that a compensatory hyperfiltration occur in obese people to meet the higher metabolic demands of their greater body weight. Thus, increasing the risk of long-term kidney injury and chronic kidney disease development by the rise in intraglomerular pressure.

The present study therefore deems it fit to evaluate the impact of body mass index (BMI) status on basic renal functions in obese women resident in Rivers State of Nigeria. Moreover, considering the fact that Rivers State of Nigeria is a crude oil rich State that plays a host to many multinational companies with an attendant high level of rural to urban migration (urbanization) (Jones, 2000; RvSG, 2023), which together may constitute some of the risk factors for obesity, makes it an apt population for such study.

MATERIALS AND METHODS

Research Design

This study was a cross-sectional survey of obese women in Rivers State, Nigeria. It focused on obese women resident in upland and riverine areas of the State, using multistage sampling techniques. Ethical approval was sought and obtained from the institutional Ethics Committee of the University of Port Harcourt and properly signed consent forms were obtained from each subject before being recruited into the study.

Study Area

The study was conducted in Rivers State, Nigeria, between the upland and riverine residentsof the State. Rivers State, also known simply as Rivers, is the sixth largest and one of the 36 states of Nigeria. It is home to many indigenous ethnic groups: Abua, Ikwerre, Ekpeye, Ijaws, Eleme/Ogoni, Etche, Ogba, Engeni, Egbema, and others. The inland part of the state consists of tropical rainforest; towards the coast the typical Niger Delta environment features many mangrove swamps (Jones, 2000).

The target population of this study was female residents in Upland and Riverine Regions of Rivers State and these included adults (18 and 65 years). Adopting the method of Azuogu *et al.*, (2018), a multistage sampling technique was adopted, and a proportionate number of the study proforma were allocated to each stratified group based on their total number. During the periodic scheduled meetings the subjects, the attendance lists were used as a sampling frame. And the systematic random method was used to select participants with sampling interval of three until total number of questionnaires allocated to that group was exhausted.

Sample size determination

A minimum sample size of 272 was obtained using the Leslie Fischer's formula (Azuogu *et al.*, 2018).

Inclusion Criteria: It was obese women who are resident in Upland and Riverine areas of Rivers State, who are within their 18 and 65 years of age. And non-obese women with similar criteria as above to serve as control.

Exclusion Criteria: Were subjects as stated in the inclusion criteria but were critically ill; those who were non-residents of the study area; women below 18 years or above 65 years. And then, women who met the inclusion criteria but did not give consent to be recruited into the study.

Methods of Data Collection

The collection of data was via a well thought out proforma and laboratory analysis of the obtained biological/blood samples from the study subjects using standard methods. A lengthened meter rule and standiometer were used to determine the BMI. The classification of BMI as adopted by the present study was stipulated by the World Health Organization (WHO, 2021). Creatinine was determined by the Jaffé-Slot method (Larsen, 1972) the kits were procured from Mindray Bio-medical Electronics Co., LTD (China).

Table 1: Adopted Formula for determination of Estimated Glomerular Filtration Rate (eGFR)

CKD-EPI creatinine equation‡		
Female	≤0.7	$144 \times (Scr/0.7)^{-0.329} \times 0.993^{Age}$ [× 1.159 if black]
Female	>0.7	$144 \times (Scr/0.7)^{-1.209} \times 0.993^{Age}$ [× 1.159 if black]

(Adapted from Inker *et al.*, 2012)

Table 1 above shows the adopted formulas for the estimation of GFR using creatinine values. It were formulated by the Chronic Kidney Disease-Epidemiology Collaboration (CKD-EPI) (Inker *et al.*, 2012).

Method of Data Analyses

Numerical data received from the present study were subjected to statistical analysis using the statistical package for social sciences (SPSS) version 21.0. Statistical significance was determined using the following tools: one-way analysis of variance (ANOVA) and independent t-test. A $p< 0.05$ was considered statistically significant.

RESULTS

Table 2: Changes in Creatinine (CR) level of Obese Women in Rivers State, Nigeria

Groups	Creatinine (CR)		
	All subjects	Up-Land Residents	Riverine Residents
Non-Obese Subjects	0.87 ± 0.12	0.96 ± 0.11	0.80 ± 0.07*
Obese Class I	1.05 ± 0.17 [a]	1.03 ± 0.18	1.11 ± 0.11 [a]
Obese Class II	1.21 ± 0.16 [a, b]	1.08 ± 0.13 [a]	1.31 ±0.11 [a, b]
Obese Class III	1.30 ± 0.10 [a, b]	1.19 ± 0.08 [a, b, c]	1.36 ± 0.06 [a, b, c]

Values are expressed as Mean ± Standard Deviation (SD); n [Non-obese All=125; Upland=58; Riverine =67; Obese Class I: All=77; Upland=51; Riverine =26; Obese Class II: All=72; Upland=32; Riverine =40; Obese Class III: All=60; Upland=21; Riverine =39]. [a] Significant at P<0.05 when compared to Non-obese; [b] Significant at P<0.05 when compared to Obese Class I; [c] Significant at P<0.05 when compared to Obese Class II; * Significant at P<0.05 when values of Riverine residents are compared to those of Upland residents.

Table 3: Changes in Estimated Glomerular Filtration Rate (eGFR) of Obese Women in Rivers State, Nigeria

Groups	Estimated Glomerular Filtration Rate (eGFR)		
	All subjects	Up-Land Residents	Riverine Residents
Non-Obese Subjects	97.06 ± 19.59	81.79 ± 13.32	110.27 ± 13.63
Obese Class I	85.14 ± 97.61	91.18 ± 19.63	73.28 ± 10.80 [a]
Obese Class II	64.39 ± 10.76 [a, b]	70.16 ± 11.55	59.78 ± 7.45 [a, b, *]
Obese Class III	58.79 ± 5.45 [a, b]	61.25 ± 6.34	57.47 ± 4.47 [a, b]

Values are expressed as Mean ± Standard Deviation (SD); n [Non-obese All=125; Upland=58; Riverine =67; Obese Class I: All=77; Upland=51; Riverine =26; Obese Class II: All=72; Upland=32; Riverine =40; Obese Class III: All=60; Upland=21; Riverine =39]. [a] Significant at P<0.05 when compared to Non-obese; [b] Significant at P<0.05 when compared to Obese Class I; [c] Significant at P<0.05 when compared to Obese Class II; * Significant at P<0.05 when values of Riverine residents are compared to those of Upland residents.

The data on Table 2 represents the changes in creatinine (Cr) level of the study subjects.

The levels of Cr were seen to markedly ($p<0.05$) increase in all obese subjects; across all, upland and riverine residents. But only the non-obese of the riverine subjects had significant ($p<0.05$) reduction when compared to its upland counterparts.

In Table 3 the outcome on the estimated glomerular filtration rates (eGFR) was presented and it generally indicated almost entirely graded decreasing levels with increasing BMI amongst all the obese subjects across the three strata of subjects (all, upland and riverine). Specifically, the level of decrease in the all surveyed subjects was significant ($p<0.05$) in obese classes II and III; none in the upland residents and from obese classes I, II and III amongst the riverine residents.

Further, the eGFR value of obese class II of the riverine subjects indicated a significant ($p<0.05$) when compared to its equivalents amongst the upland residents.

DISCUSSION

The present study's outcome on evaluation of some renal parameters, including creatinine level and estimated glomerular filtration rate (eGFR) showed a general marked serum buildup of creatinine level and decrease of eGFR with increasing BMI. This is obviously an indication of predisposition to renal dysfunction by the obese subjects which is even more with those in the riverine locations of the state. The foregoing finding of the present study is in line with the submission of a related study on an entirely different population (Pommer, 2018), which stated that obesity was increasingly prevalent among CKD patients and that good management with respect to the specific role of obesity in different stages of CKD should be integrated in routine renal care (Pommer, 2018). Considering the result of this study, it is suggestive that obesity related nephropathy may provoke or exacerbate renal dysfunctions.

An interesting aspect of the finding of the present study is the incidence of greater renal risk of the riverine residents. Geographically, these subgroups of the study subjects are closer to crude oil exploration facilities that are thronged by many multinational populations. Juxtaposing this fact with the submissions of Jura and Kozak, (2016) and Li *et al.*, (2022), which stated that global health and the prevention of chronic diseases face a significant challenge as a result of the epidemic of overweight and obesity which are often promoted by economic expansion, mechanized transportation, urbanization, a rise in sedentary behavior, and a switch to processed foods and high-calorie meals in terms of nutrition. Obviously, the foregoing finding of the present study validates this line of thought; as the riverine residents by their locations in the State are more exposed to these obesity risk factors (e.g. urbanization, sedentary lifestyle, and a higher reliance on processed foods and high-calorie meals in terms of nutrition) (Li *et al.*, 2022).

In conclusion, the marked high levels of creatinine and corresponding decreases in eGFR with increasing BMI in obese conditions may be a sign that the kidneys are not filtering the blood effectively. This is so because it is known that by the time creatinine-based determination of GFR (eGFR-Cr) values are alarming, the efficiency of the kidneys may have reduced to about fifty percent (50%) (Inker *et al.*, 2012). The above results of the present study are only markers of renal risks, (e.g. chronic kidney disease) and not necessarily incidences of emergencies. It however suggestive that obese women in Rivers Sate of Nigeria, particularly the riverine residents should take caution as their obesity status could predispose them to significant renal disorders.

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