Association Between Glomerular Filtration Rate And Body Mass Index Among Orthopaedic Patients In Kano-Nigeria

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Abstract

Any association between body mass index and kidney disease has so far proved inconclusive. Therefore, this study is aimed to provide association between glomerular filtration rate and body mass index among orthopaedic patients. A total of sixty (60) patients irrespective of gender were recruited. Weight and height were measured prior to the sample collection. A structured questionnaire was administered to obtain the demographic data of the subjects. Blood samples were collected from each patient by venepuncture from the antecubital vein of the forearm using disposable syringes. Serum creatinine was determined by method of Rosano *et al*. Body Mass Index and Glomerular Filtration Rate (eGFR) were calculated using creatinine-based equation of Modification of Diet in Renal Disease. Mean BMI was found to be higher in females (25.48±5.65) than their male counterparts (21.44±4.52), while eGFR was found to be higher in males (184.14±53.23) than in females (152.06±32.71). Subjects with eGFR ≥60 were observed to be more frequent (98.30%); normal weight individuals had higher frequency (48.33%). Positive correlation exists between BMI and eGFR in males whereas negative correlation was found in females which indicates association between body mass index and kidney function is gender related.

Keywords: BMI, Creatinine, Orthopaedic and Renal disease

Introduction

Body Mass Index (BMI) is a person's weight in kilograms divided by the square of height in meters. A high BMI can be an indicator of high body fatness. BMI can be used to screen for weight categories that may lead to health problems but it is not a diagnostic tool for the determination of body fatness or health of an individual (Center for Disease Control and Prevention (CDC), 2015). However, body mass index is commonly used to diagnose obesity (Agarwal *et al.*, 2010).

Glomerular filtration rate (GFR) is the volume per unit of time at which ultra filtrate is formed by the glomerulus; approximately 120 ml are formed per minute (Nankivell, 2001). Renal function can be evaluated by measuring the GFR. Renal damage or alterations in glomerular function affect the kidneys' ability to remove metabolic substances from the blood into the urine (Nankivell, 2001). It is a direct measure of renal function that is reduced before the onset of symptoms of renal failure and is related to the severity of the structural abnormalities in chronic renal disease (Nankivell, 2001). As Glomeruler filtration rate declines, a wide range of disorders develops, including fluid and electrolyte imbalance such as hyperkalemia, metabolic acidosis, volume over load and hypophosphatemia (Wallia *et al.*, 1986).

Although creatinine clearance can be calculated from urine creatinine concentration measured in a 24 hour urine collection and a concomitant serum Creatinine concentration, a more practical approach in the office is to estimate GFR (estimated GFR or eGFR) from the serum creatinine concentration, using either the Cockcroft-Gault or the Modification of Diet in Renal Disease (MDRD) Study estimating equations (Robert *et al*., 2008).

Kidney dysfunction in orthopaedic cases may be as a result of kidney injury due to fracture, burns, osteomyelitis, spinal injury, spinal tuberculosis, sickle cell disease and various forms of arthritis among others (Adamu *et al*., 2016). Any association between the body mass index (BMI) and kidney disease has so far proved inconclusive (Cohen *et al*., 2013). Therefore, this study is aimed to provide association between glomeruler filtration rate and body mass index among orthopaedic patients.

Methodology

In this hospital based clinical prospective study, we investigated patients attending National Orthopaedic Hospital Dala Kano with various orthopaedic conditions for three months in 2016. Ethical clearance was obtained from the research ethics committee of the hospital and patients were consented prior to the enrolment in the study. Patients between the ages of 20-80 years and their weight and height could be measured were included while those that could not meet up this criteria were excluded. A total of sixty (60) patients from both sexes were recruited.

Weight and height were measured prior to the sample collection as adopted from the protocol of State of Alaska Department of Health and Social Services (2012). A structured questionnaire was administered to obtain the demographic data of the subjects. Blood sample was collected from each patient by venepuncture from the antecubital vein of the forearm using disposable syringes. Five milliliters of blood was delivered into a clean, labelled plastic centrifuge tubes and allowed to stand for 30 minutes for proper retraction and clotting and then centrifuged for five minutes at 3000 rpm. The serum was separated into dry and labeled cap sample tubes. Serum creatinine was determined by method of Rosano *et al*. (1990). Body Mass Index (BMI) was calculated as weight (Kg)/ Height (m^2). Glomerular filtration Rate was calculated using creatinine-based equation of Modification of Diet in Renal Disease (MDRD) and expressed in milliliters per minute per 1.73 m^2 (Stevens *et al.,* 2006). The data was analyzed using the Statistical package for the Social Sciences (SPSS) Version 16.0 (2007) by Polar engineering and consulting. Data were presented as mean± standard deviation and frequencies. The Pearson's correlation was used.

Results

Table 1 shows association between eGFR and BMI in relation to gender. Mean BMI was higher in females (25.48±5.65) than in males (21.44±4.52), while eGFR was found to be higher in males (184.14±53.23) than in females (152.06±32.71); positive association was observed in males while negative association was observed in females.

Socio-demographic factors were related to frequencies of eGFR and BMI as illustrated in table 2. Taking eGFR into consideration, subjects with ≥60 were more frequent (98.30%), and for BMI, normal weight individuals were observed to have higher frequency (48.33%). With regards to gender, more males (71.70%) were observed than females (28.30%). Considering age, donors 20-40 years of age were found to be more frequent (55.00%), whereas 61-80 years age group were less (16.70%).

Table 1: Association between eGFR and BMI in relation to gender

Sex	BMI (kg/m^2)	eGFR (ml/min/1.73m^2)	Pearson's Correlation
Males	21.44±4.52	184.14±53.23	0.617
Females	25.48±5.65	152.06±32.71	-0.334

Males (n=43); Females (n=17)

Table 2: Socio-demographic factors in relation to frequencies of eGRF, BMI and Sex and Age

Characteristics	Frequency (%)
eGFR (ml/min/1.73m^2)	
≤ 60	1 (1.70)
≥60	59 (98.30)
BMI (kg/m^2)	
Underweight	13(21.67)
Normal	29(48.33)
Overweight	12(20.00)
Obese	3(5.00)
Sex	
Male	43(71.70)
Females	17(28.30)
Age Group (years)	
20-40	33(55.00)
41-60	17(28.3)
61-80	10(16.70)

Discussions

In this study, sixty subjects were recruited of which 71.70% were males while 28.30% were females; 55.00% are within 20-40 years age brackets and 16.70% were 61-80 of age. Positive correlation between BMI and eGFR was found in males whereas negative correlation in females which is inconsistent with the study of Cohen *et al.* (2013) that found no association in males and yet it persisted for women and this correlation in women was attributed to the subcategory of severely obese women with a BMI of ≥ 35 kg/m^2 and they are first to suggest that morbid obesity may be an independent factor related to chronic kidney disease (CKD) in women. Similarly, BMI was also found to be higher in female than male in this study which is consistent with the findings of Nalado *et al.* (2012) among civil servants in Kano and that of Gallagher *et al*. (1996). However, Wachukwu *et al.* (2015) reported contrary in the southern part of Nigeria that males are higher in BMI than females; this may be connected with the differences in the socio-demographic factors between the regions. Body mass index and prevalence of obesity with kidney disease were found to be higher than in those without the disease in both genders (Nomura, *et al*., 2009).

The study of Kawamoto *et al.* (2008) reported independent association between eGFR and BMI and concluded that increased BMI is strongly associated with decreased eGFR in community-dwelling healthy persons which concord with this study. However, Okafor *et al* (2016) found positive correlation between eGFR and BMI among oil producing communities in Nigeria. This difference may be as a result of higher prevalence of kidney disease reported in these oil producing communities whereas this study reported lower prevalence among the orthopaedic patients in Kano which is non oil producing area. Furthermore, He *et al.* (2016) reported positive relationship between BMI and mildly decreased eGFR among Chinese adults and concluded that higher BMI may play a role in the onset and progression of renal damage and maintaining a BMI in the healthy range which may contribute to the prevention of chronic kidney disease. In a study carried out by Li *et al*. (2013) associated lower eGFR with worse prognosis of kidney disease regardless of BMI levels was ascertained whereas Iseki *et al.* (2004) found that increasing BMI was associated with an increased risk of the development of ESRD in men.

BMI can be influenced by muscle mass and its ability to diagnose obesity can vary considerably by predictors of muscle mass such as age, sex, and race (Agarwal *et al.,* 2010). In this study, the mean BMI of males is within the normal range while that of female is within overweight as given by WHO (1995).

Conclusion

Positive correlation exists between BMI and eGFR in males whereas negative correlation was found in females which indicates association between body mass index and kidney function is gender related.

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