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Assessment of the relationship between Central Adiposity measures, Percentage Body Fat and Body Mass Index among Women from Kaduna and Rivers States of Nigeria

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ABSTRACT

This study determined which central adiposity measure can better predict percent body fat (PBF) and Body mass index and the incidence of obesity, overweight , normal weight and underweight in women from Rivers and Kaduna, Nigeria.A total of 788 (Rivers state, n=401 and Kaduna, n=387) apparently healthy females participated in this study. Weight and height were measured using weighing scale and stadiometer respectively. Subjects were classified as underweight, normal, overweight, obese using WHO standard. Participants were grouped into ages 18-20, 21-23, 24-26, 27-30 years. Minimum waist circumference (WC) and maximum hip circumference (HC) were measured to the nearest 0.1cm using a non stretchable tape. Percentage body fat (PBF) was measured using bio impedance analyser (Tanita, Japan).This study showed the incidence of underweight, normal weight, overweight and obesity were (38) 9.8%, (249) 64.3%, (78) 20.2%, and (22) 5.7% respectively for women from Kaduna; (40) 10%, (253) 63.1%, (80) 20% and (28) 7.0% respectively for women from Rivers. Results also showed that age had a significant association with BMI (River: χ^2=38.585, p=0.000; Kaduna: χ^2=19.323, p=0.023). WC showed the strongest significant ($p < 0.001$) partial correlation with BMI and PBF (r= 0.83 and 0.83, respectively) among Kaduna women, while in Rivers women WC had a partial correlation with BMI and PBF (r = 0.69 and 0.74 respectively). The correlation coefficient of WC with BMI and PBF was higher than the correlation coefficient of other central adiposity measures with BMI and PBF.WC should be preferred over other measures of central adiposity in clinical assessment of obesity among Kaduna and Rivers women, since it had the highest correlation coefficient with %BF and BMI. Population validated equations were constructed using WC,WHR or HC to assess percentage body fat and BMI.

Key Words: Obesity, Underweight, Overweight, Normal Weight, Percentage Body Fat.

INTRODUCTION

Obesity is a term used to indicate excessive deposition of fat in the body. It is the most common nutritional disorder in the developed countries and, is assuming a significant proportion in the developing countries[1]. Body mass index is the anthropometric variable frequently used in clinical research to investigate the relationship between weight excess and psychopathology.

The weight status of children, adolescence and adults is often measured using Body mass index (BMI). BMI is an anthropometric index of weight and height that is defined as kg/m^2[2]. BMI is a measure of overall adiposity, whereas[3; 4] reported that waist circumference (WC) and waist hip ratio (WHR) are reliable proxy measures of abdominal fat.

BMI, WC with WHR could be used independently to identify overweight and obesity[5]. These measures of adiposity have been associated with major cardiovascular and metabolic risk, hence, it is widely recommended for epidemiological survey. There is little consensus as to which of these measures is preferable in studies dealing with adiposity as reported by[6; 7; 8].

BMI and the total body fat as well as its distribution pattern are related to metabolic syndrome[9], it is therefore important to understand the relationship between central adiposity measures (this includes WC, HC and WHR) with total adiposity and body fat content. The study on the interrelationship of WC, WHR and BMI is needed to identify not only those who have high BMI, but also those who have low BMI but high WHR by using the simple measure of WC[10]. Higher BMI has also been shown to be associated with both central adiposity and higher WHR along with the non communicable diseases that appear at lower BMI ranges in Indian population 11.

In Nigeria, Ekezie *et al.*[12] reported that there is a greater tendency for married people to be overweight when compared to their counterparts who are single. Higher rates of obesity and hypertension have been noted among Igbos in urban settings[13]. Oketayo *et al.* [14] reported that adolescent obesity may have adverse academic consequences and that targeting obesity reduction policies may not only improve health outcomes but also have a positive impact on improving their academic performance and human capital accumulation.

A simpler adiposity measurement other than BMI and PBF is needed to serve as a predictor of BMI and PBF. This is most important, for the fast and effective implementation of public health development programmes in limited resource set ups. This study determined which central adiposity measure can better predict percent body fat (PBF) and Body mass index and the incidence of obesity, overweight , normal weight and underweight in women from Rivers and Kaduna, Nigeria.

MATERIALS AND METHODS

Study Population

Participants of the study were indigenes of Kaduna state who are predominately Hausas and indigenes of Rivers state who are predominately Ijaws. A total of 788 (Rivers state, n=401 and Kaduna, n=387) apparently healthy females participated in this study. The following were excluded in this study: pregnant women, women with physical deformities and women who did not give their consent. All the subjects were adult females within the age range of 18-30 years. These subjects were all students of tertiary institution. The participants were divided into the following age groups: 18-20 (n = 173, 37.2%), 21-23 (n = 113, 24.3%), 24-26 (n = 97, 20.9%), 27-30 (n = 52, 11.2%).

Data Collection

Ethical approval was obtained from Ahmadu Bello University Teaching Hospital, Shika, Zaria. The school authorities were informed before commencement of the study. Samples were randomly selected from four tertiary institutions: University of Port Harcourt, Choba ; Rivers state University of Education, Rivers state; Kaduna state University, Kaduna state and Ahmadu Bello University,, Zaria Nigeria.

Anthropometric Measurements

Weight and height were measured using weighing scale and stadiometer respectively to the nearest 0.1 kg and 0.5 kg respectively. Subjects were classified as underweight (BMI < 18.5 Kg/m^2), normal (18.5-24.9 Kg/m^2), overweight (25-29.9 Kg/m^2), obese ($\geq$ 30 Kg/m^2 using WHO standard.

WC (in cm) index of visceral fat, and HC an extension of the buttocks, were measured to the nearest 0.1cm using a non stretchable tape while the subject was standing erect. The tape was wrapped over the maximum circumference of the buttocks to obtain the HC. Also, the tape was wrapped around the waist at the midpoint between the lowest rib and the iliac crest to obtain the WC.

For WHR, the index for regional fat distribution was calculated as the ratio of the circumference of waist to hip. Percentage body fat (PBF) was measured using Bio Impedance Analyser *(Tanita, Japan)*.

Data Analyses

Chi square test was used to test for the relationship between age and BMI in both Kaduna and Rivers women. Pearsoncorrelation test for the relationship between central adiposity measures with BMI and PBF. Pearson correlation was used to test for the central adiposity measure that best predict BMI and percentage body fat. All statistical analyses were undertaken using the SPSS Statistical Package, version 16.0. Statistical significance was set at $p < 0.05$.

RESULTS

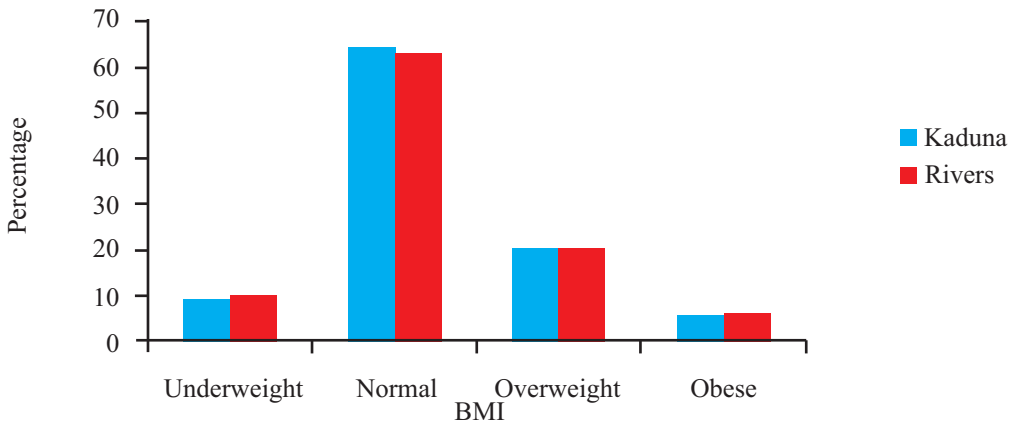

Figure 1: Incidence of underweight, overweight and obesity.

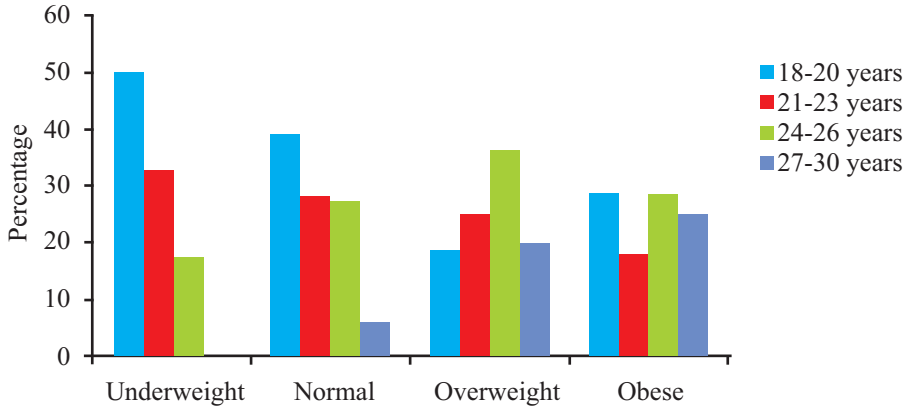

Figure 2: Chart showing BMI based on age group among Rivers women.

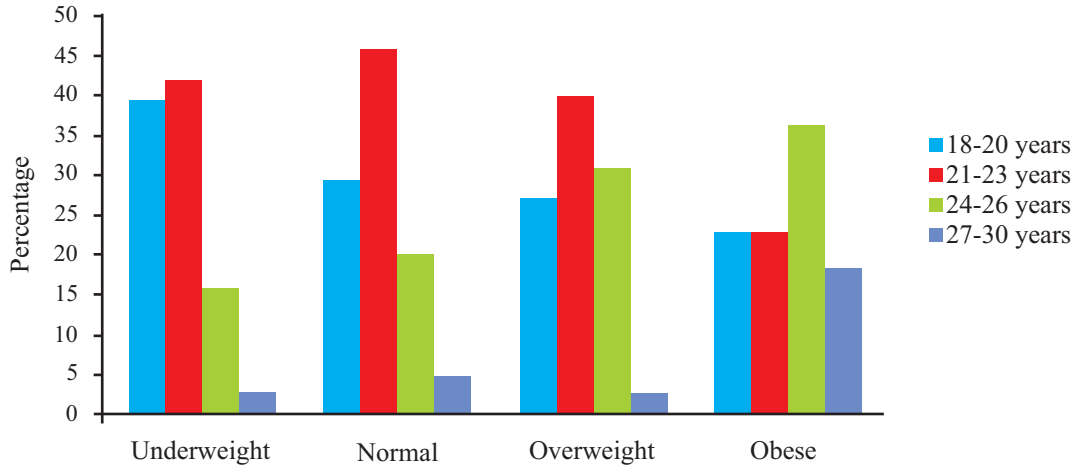

Figure 3: Chart showing BMI based on age group among Kaduna women.

This study showed the incidence of underweight, normal weight, overweight and obesity were (38) 9.8%, (249) 64.3%, (78) 20.2%, and (22) 5.7% respectively for women from Kaduna; (40) 10%, (253) 63.1%, (80) 20% and (28) 7.0% respectively for women from Rivers (Figure 1).

Figure 2 and 3 shows that the percentage of women who were underweight or normal decreases beyond 20 to 23 years, while obesity was maximum within 24-26 years for both states, overweight was maximum within 23-26 years (χ^2= 38.59, p=0.000); (χ^2=19.323, p=0.023) for Rivers and Kaduna women respectively.

Table 1: Correlation between percentage body fat and BMI with Central Adiposity measures

Variables	BMI	PBF
Kaduna		
Waist circumference	0.83***	0.83***
Hip circumference	0.72** *	0.75** *
Waist hip ratio	0.28**	0.23**
Rivers		
Waist circumference	0.69** *	0.74** *
Hip circumference	0.16** *	0.19***
Waist hip ratio	0.19**	0.19**

* p<0.05; ** p<0.01, *** p<0.001

Table 2: Linear Regression of Percentage Body Fat (%BF) and BMI from Central Adiposity Measures

Parameters	Predictive equation	P value
Kaduna		
BMI	BMI = (-26.783) + (0.036) WC	0.816
	BMI = (-26.783) + (0.345) HC	0.008
	BMI = (-26.783) + (16.256) WHR	0.266
PBF	PBF = (-88.424) + (-0.125) WC	0.664
	P BF = (-88.424) + (0.901) HC	0.000
	PBF = (-88.424) + (43.950) WHR	0.104
Rivers		
BMI	BMI = 14.319 + (0.466) WC	0.000
	BMI = 14.319 + (-0.024) HC	0.000
	BMI = 14.319 + (-32.224) WHR	0.000
PBF	PBF = 12.591 + (0.466) WC	0.000
	P BF = 12.591 + (-0.024) HC	0.000
	PBF = 12.591 + (-64.102) WHR	0.000

WC showed the strongest significant ($p < 0.001$) partial correlation with BMI and PBF ($r = 0.83$ and 0.83, respectively) among Kaduna women, while in Rivers women WC had a partial correlation with BMI and PBF ($r = 0.69$ and 0.74 respectively) (Table 1). Thus, WC was found to be more reliable in estimating BMI and PBF in both Kaduna and Rivers state women.

Linear regression of percentage body fat (%BF) and BMI from central adiposity measures revealed that hip circumference has the strongest impact on both BMI and PBF in Kaduna women, implying that hip circumference can be used to estimate percentage body fat (%BF) and body mass index. However, in Rivers women waist and hip circumference and waist hip ratio can be used to estimate both BMI and %BF, since significant difference was observed between these central adiposity measures and BMI, %BF (Table 2).

DISCUSSION

In this present study, the mean BMI was 22.98 kg/m^2 and 22.78 kg/m^2 for Kaduna and Rivers state women respectively. Results revealed that over 64.3 % of Kaduna and 63.1 % of Rivers women had normal weight. The prevalence of obesit0079 obtained in this study was higher than reported by Izuora [15] and Adesina *et al*[16] in Lagos and Port Harcourt respectively. Areas with low prevalence of obesity may also have decrease health problems, cardiovascular diseases high blood pressure and sleep apnea as reported by Cunningham and Mackerras[17] and NIH[18].

Prevalence of underweight females in this study was lower than those reported by Madriaga *et al.*[19] in Philippines and Adesina *et al*[16] in Port Harcourt. The differences in the prevalence of underweight obtained in the study from previous reports could be due to the age range of individuals and sample size used. Madriaga et *al*[19] used a larger sample size (6,079), while Adesina *et al*[15] sampled adolescent females between the ages of 10-19 years old.

Moreso, prevalence of overweight females in the present study (25 < BMI > 29.9) was higher than those reported by Madriaga *et al*. [19] and Ukegbu *et al*[20] in the Philippines and Nigeria respectively. However, the result of overweight females in this study was similar to that reported by AI-Sheed *et al*[21] in Saudi Arabia. It is presumed that the difference in overweight females obtained in both studies could be due to the methodology used, sample location and ages of individual sampled Heald and Gong [22]. Ukegbu *et al*[20] sampled secondary school boarding students, while AI-Sheed *et al*[21] sampled females within the age range of 6-17 years. The overweight rate is said to be higher among pre-adolescences as reported by Heald and Gong [22].

There are controversies on which central adiposity measure better predicts body fat or BMI. It is important to have a simpler method for evaluating body fat than BMI and %BF but at the same time a good predictor of the latter two. This will be useful for fast and effective implementation of public health development programmes. Bjorntorp [23] and Seidell *et al*[24] reported WC as the best to assess intra abdominal fat in contrast to subcutaneous fat. Neovious *et al*[7] reported BMI and WC as a diagnostic for fatness, while WHR was less useful in the diagnosis for fatness. This study, evaluated the contribution of WC, WHR and HC to percentage body fat in Kaduna and Rivers women, and it was observed that WC strongly correlated with BMI and %BF than other central adiposity measures. A recent study in Bengalee population among adult females reported that WC had the highest correlation with total body fat Ghosh and Bandyopadhyay [25]. Some authors reported that WC had a better efficacy in determining overweight than WHR Moy and Atiya [26] and BMI Molarius *etal*. [27]. In this study, it was observed that WC has the highest partial correlation with percentage body fat than WHR and HC, which were in agreement with the report of Ghosh and Bandyopadhyay [25] and Chakraborty and Bose [28]. WC seems to have the highest potential in examining abdominal adiposity in the field situation and for emergency clinical diagnosis. Since, WC reflects more of the fat mass than the muscle mass, and then it can be proposed that BMI values of these women represent more fat than muscles.

CONCLUSION

WC should be preferred over other measures of central adiposity in clinical assessment of obesity among Kaduna and Rivers women. Standard measures of body fat such as the use of bioimpedence analyser, DXA, BII or CT are difficult to use in field situation or in emergency clinical diagnosis. Therefore, population validated equations were constructed using WC,WHR or HC to assess percentage body fat and BMI.

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