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Full Length Research Paper

Defining obesity using three anthropometric parameters, being components of two diagnostic criteria, amongst Nigerian women

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Abstract

The study was to compare the results of obesity assessment as a component of metabolic syndrome diagnosis using two different diagnostic criteria amongst apparently healthy female adults. A hundred and twenty-six(126) adult females aged 40- 70 years were evaluated concurrently for obesity using waist circumference as defined by Adult Treatment Panel III(ATP III criteria), waist-hip ratio(WHR) and body mass index(BMI), the latter two as defined by the World Health Organization(WHO) criteria. These subjects were drawn from individuals attending the metabolic research unit of University College Hospital (a tertiary level referral health institution in Nigeria), for routine medical evaluation. The prevalence of obesity as defined by waist circumference using ATP III criteria was found to be 31.7%, whereas prevalence rates using WHR and BMI under WHO criteria were 21.4% and 23.8% respectively amongst the subjects. These findings on correlation analysis, showed a strong level of association between the three parameters as indices of obesity with the strongest agreement noted between BMI and WC(r=0.878) This study showed a good measure of agreement in the assessment of obesity in these female subjects when two major diagnostic criteria are applied. This is especially important in view of the lack of national surveys to arrive at ethno-specific and gender-based cut-offs for anthropometric measurements such as WC and WHR specific to our environment. Obesity being a major criterion in both the ATP III and WHO criteria for diagnosing metabolic syndrome, these findings have implications in this environment given the importance of screening for metabolic syndrome and/or obesity vis-à-vis their roles as cardiovascular risk factors.

Keywords: Obesity, anthropometric, metabolic, cardiovascular, correlation.

INTRODUCTION

Obesity is an abnormal accumulation of body fat in proportion to body size. Until recently, adipose tissue was looked at as a passive storage site for energy. Increasing evidence points to an important role for adipocytes as a complex and active endocrine organ whose metabolic and secretory products (e.g. hormones, cytokines, enzymes) play a major role in whole- body metabolism(Aldhalin and Hamdy, 2003). Cytokines and other molecules of adipose tissue origin include, tumour necrosis factor α (TNF α), interleukin 6 (IL-6), resistin, adiponectin, plasminogen activator – inhibitor – 1 (PA1-1), angiotensin II and leptin(Sowers and Frohlich, 2004; Aldhalin and Hamdy, 2003). And the interplay between these factors plays a vital role in the prevention or development of obesity and its' consequent complications of glucose dysregulation, insulin resistance, dyslipidaemia, proinflammatory and prothrombotic states, etc (Sowers and Frohlich, 2004; Aldhalin and Hamdy, 2003; Stephens and Pekala 1991; Yamauchi et al, 2001; McGarry and Dobbins, 1997).

Ideally, an obesity classification should be based on a practical measurement of body fat, accurately predict disease risk and have application to patients from diverse ethnic backgrounds. The most direct measures of body fat such as underwater weighing or dual-energy x-ray absorptiometry (DEXA) scanning are impractical for use in a clinical setting (Jonathan, 2003). Indirect estimates of body fat are more clinically practical.

These indirect estimates include body mass index (BMI) which is obtained by dividing the body weight (kilograms) by height (meters) squared, or fat distribution indices like waist-hip ratio (WHR) and waist circumference (WC). It is of note that indirect estimates of regional fat have been done using computed tomography (CT), magnetic resonance imaging (MRI) and ultrasonography. However CT and MRI which are gold standards have limited applicability due to non-availability of equipment, costs and radiation exposure(Stolk et al., 2003). Also the ease of application of ultrasound measurement to routine clinical assessments and epidemiological studies is still in doubt. Given the foregoing such simple measurements like waist circumference, BMI and waist-hip ratio remain the bedrock indices of obesity assessments.

Obesity is a powerful risk factor for type 2 diabetes mellitus and cardiovascular diseases (both clinical outcomes of the metabolic syndrome) across populations. However, substantial heterogeneity exists in the relationship between metabolic and cardiovascular abnormalities, and the degree of obesity (Kissebah et al., 1982). This has warranted the introduction of ethno-specific indices of obesity in some diagnostic criteria by some authorities (IDF, 2005; Azziz et al., 2003; Tan et al., 2004). Unfortunately these ethno-specific indices have little or no application to sub-Saharan Africans given that they are determined by population wide studies done mostly amongst Caucasians and Asians. The enormity of the cost of undertaking these surveys being the most likely reason for the paucity of data from our environment does not obviate the urgent need for such studies. Given the variations in results shown by some studies between assessments of obesity using different anthropometric indices (Abate and Garg, 1995), it is imperative that studies are carried out in our environment to determine the most suitable anthropometric parameter(s) and in addition, applicable gender and ethnic cut-points for indices of obesity vis a vis risk stratification and outcomes.

This study was done to assess the level of agreement or variability between two major criteria for evaluation of obesity in the context of metabolic syndrome in a small cohort of apparently healthy female subjects within a health facility.

MATERIALS AND METHOD

A total of 126 female subjects in apparent stable health were recruited into the study. These subjects were part of a cohort for a study on metabolic syndrome within the same setting at the Metabolic Research Unit of the University College Hospital Ibadan. These subjects were aged between 40 to 70years.

The subjects were assessed for obesity using the National Cholesterol Education Program: Adult Treatment Panel III (ATP III) and World Health Organization (WHO) criteria derived from their guidelines for diagnosis of metabolic syndrome (Table 1). The study was conducted with the subjects in a fasting state.

Waist circumference (WC) was measured using a flexible tape on bare skin with the tape horizontal and parallel to the floor, using as landmark the midpoint between the tenth rib and the iliac crest at the mid-axillary line.

The hip circumference was measured with the same tape measure as above, applied horizontal and parallel to the ground at the level of the greater trochanter.

Waist-hip ratio (WHR) was calculated as a direct ratio of the waist versus hip circumference.

The weight was measured to the nearest 0.1kg using a vertical beam balance scale with the subjects wearing only very light body clothing and bare footed. The height was subsequently measured to the nearest 0.5cm on the measuring scale composite part of the beam balance.

Body mass index (BMI) was derived using the formula; BMI= weight/(height)^2 (kg/m^2).

Analysis was done using simple summary descriptive characteristics of the findings.

RESULTS

The mean age of the study participants was 57.6 years. Findings from the study showed that using the waist circumference (ATP III criteria), obesity was seen in 40 out of the 126 subjects studied showing a prevalence rate of 31.7%.

Obesity as defined by WHR and BMI showed prevalence rates of 21.4% and 23.8% respectively.

The mean WC, WHR and BMI were 87.1cm, 0.81 and 25.3kg/m^2 respectively (Table 2). The maximum WC recorded was 105cm while the highest WHR was 0.95. Applying the general widely accepted categorization of obesity using BMI, none of the subjects had 'gross' obesity(obesity class III) as the maximum BMI recorded was 33.1kg/m^2 .

On pair-wise correlation analysis, a high agreement ratio or correlation coefficients was noted amongst the three diagnostic parameters. The strongest level of agreement was noted between WC and BMI while the least in strength, albeit still of high agreement ratio, was between WHR and BMI (Table 3).

DISCUSSION

The prevalence rates of obesity gotten from this study using BMI and WHR is similar to previous studies done in our environment (Puepet et al., 2002; Sanya et al., 2009). Though the study by Sanya et al., had lower a prevalence rate than that of this study for obesity utilizing WHR, it is noteworthy that that it was a crude rate for both men and women. When the gender-specific rate for women is analyzed, the rate approaches the findings of our study.

Table 1. ATP III and WHO criteria for obesity as a component of metabolic syndrome.

	Obesity Definition for women	
Parameter	**NCEP- ATP III**	**WHO**
WC	> 88cm	-
WHR	-	> 0.85
BMI	-	> 30kg/m^2

WC = waist circumference
WHR= waist/hip ratio
BMI = body mass index

Table 2. Brief summary descriptive characteristics

	WC(cm)	WHR	BMI(kg/m^2)
Mean	87.1	0.81	25.3
SD	5.61	0.057	3.97
Std Error	0.499	0.005	0.354
Miniumum value	74	0.68	18.7
Maximum value	105	0.95	33.1

SD= standard deviation
Std Error= standard error

Table 3. Correlation analysis of the anthropometric indices for obesity.

	WC	WHR	BMI
WC	-	*	*
WHR	0.869	-	*
BMI	0.878	0.865	-

*= already stated in a different column.

Most studies on obesity evaluation in our environment have been done utilizing BMI. Some of those studies have similar findings as regards prevalence rates as in this study (Adediran 2003; Ojofeitimi et al., 2007; Kolawole et al., 2011, Amole et al., 2011). These studies showed prevalence rates ranging from 19.5% -24%. However it is important to point out that the study by Adediran was on type 2 diabetics. However some other studies have shown lower prevalence rates (Olatunbosun et al., 2011 ; Adedoyin et al., 2009). However these lower rates could be as a result of the mean age of the subjects in those studies as compared to this study.

The strong correlation between the three parameters of WC, WHR and BMI for evaluation of obesity is in contrast from a few studies wherein the level of agreement seen in this study was absent (Martinez-Larrad et al., 2003, Tan et al., 2004, Adediran, 2003). This has been the basis for the calls for the greater utilization of WC for defining obesity instead of BMI given that a lot of studies have shown it to be a better predictor index of the complications of obesity (Rimm et al., 1995; Sowers, 1998). However it is important to note that a lot of other studies have contrarily shown good correlations between BMI, WC and WHR (Ford et al., 2003; Wei et al., 1997; CODA study group, Duval, 2004).

From this study it was shown that though there were generally good correlations between these three parameters, there was a stronger correlation between WC and BMI, than between WHR and any of the former. This brings to the fore the widely held belief about hip sizes of women of certain tribes of African descent being a factor that may reduce the efficiency of WHR to accurately define obesity when applied solely. This especially important in view of previous studies from Asia (Tan et al., 2004; McGill, 1986).

This relatively slightly diminished strength of correlation between WHR and the other two parameters would have been better appraised if the sample size was larger than that utilized here. It is also possible that a larger sample size could have highlighted, if any, changes in level of association between WC and the other two parameters given its' higher prevalence rate as a diagnostic tool for obesity noted in this study.

CONCLUSION

This study shows that there is good level of correlation between BMI, WC and WHR as indices of obesity. However there is the import for larger studies to further validate the findings, and in addition create ethno-specific cut-points for WC and WHR measurements given the multi-ethnic nature of our environment which has a bearing on stature, build etc.

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