A Study Of Correlation Between Derived And Basic Anthropometric Indices In Type 2 Diabetes Mellitus

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Citation

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Abstract

Introduction: Obesity and diabetes are related disease with genetics, environmental and dietary factors implicated in there genesis. Basic anthropometric measeurements are use as indicators for the presence of these diseases. Derived measurements from these basic measures are being use more frequently with some of the basic ones at the verge of been discarded as assessment in clinical practice. The study assesses the correlations between the basic and the derived measurement in Type 2 Diabetic subjects.Materials and Method: Diabetic patients were recruited from the investigative clinic of the hospital for this cross-sectional study. The basic anthropometric measurement of height, weight, hip circumference, waist circumference and the derived measures BMI, WHR, WHtR were determined from this basic measures.Results: Correlations between the derived and basic measures were determined using SPSS statistical software was use. There was a significant correlation between WC and HC and the derived variables BMI, WHR and WHtR among the nonobese DM compared to the obese DM. HC has a poor correlation with the the derived variables among the obese DM.Conclusion: The HC assessment in nonobese DM patients is more relevant than in the obese DM patients.

INTRODUCTION

Central obesity is an independent risk factor for cardiovascular disease, particularly in women. In most developed countries, the prevalence of obesity is increasing steadily, and has reached epidemic proportion in some populations with a resultant increase in cardiovascular disease burden. The fundamental basis of the association between obesity and type 2 DM is a subject under intense scrutiny. Genetic susceptibility, environmental and dietary factors, and sedentary life style have all been implicated. Individuals with type 2 DM are at particular risk of the adverse consequences of obesity, and the interaction of both disorders with other components of the metabolic syndrome culminate in an increase in macrovascular and microvascular complications and the associated reduction in quality of life. [1,2,3] Body mass index (BMI), which relates weight to height, is the most widely used and simple measure of body size and it is frequently used to estimate the prevalence of obesity within a population. BMI does not reflect body fat distribution, whereas the intra-abdominal deposition of adipose tissue is a major contributor to the development of hypertension, insulin resistance, DM and dyslipidemia. [4] Thus, other anthropometric indices such as waist circumference (WC), hip circumference (HC), waist-to-height ratio (WHtR), and waist-to-hip ratio (WHR) have been used as alternatives to BMI. Waist circumference is increasingly being accepted as the best anthropometric indicator of abdominal adiposity and metabolic risk. [5,6,7] On the other hand, some studies have proved that waist to height ratio (WHtR) [8,9,10] and abdominal height (AH) [11,12,13] (measured as the distance from the exam table to the top of the belly when the patient is lying supine), has been shown to be a better predictor of cardiovascular disease than any other anthropometric measurement including BMI [body mass index], waist circumference, waist-hip ratio (WHR), and skin-fold thickness.

This study is aim at determining the correlations between the derived and basic anthropometric indices in type 2 DM Nigerians managed in rural tertiary institution.

MATERIALS AND METHODS

This cross-sectional study was carried out at the department of chemical pathology Federal Medical Centre, Ido-Ekiti, Ekiti State in the western region of Nigeria. The centre is tertiary health institution provided by the government of the country to serve as a referral centre. After adequate education on the purpose of the study, a total of 113diabetic subjects who gave their consent and are not on insulin were recruited. The ethical committee of Federal Medical Centre gave approval for the study.

Blood pressure was measured on left arm by auscultatory method using mercury sphygmomanometer. Each individual was made comfortable and seated at least for five minutes in the chair before measurement. Hypertension was defined as systolic blood pressure (SBP) >140 mmHg and/or diastolic blood pressure (DBP) >90 mmHg as per US Seventh Joint National Committee on Detection, Evaluation and Treatment of Hypertension (JNC VII) criteria. [14]

Body weight was measured (to the nearest 0.5 kilogram) with the subject standing motionless on the bathroom weighing scale. [15] The weighing scale was standardized every day with a weight of 50 kg. Height was measured (to the nearest 0.1centimeter) with the subject standing in an erect position against a vertical scale of portable stadiometer and with the head positioned so that the top of the external auditory meatus was in level with the inferior margin of the bony orbit. BMI was calculated as weight in kilograms divided by squared height in meter. Conventional BMI cutoff points were applied to classify the study populations into underweight (BMI<18.5 kg/m ^{2}), normal BMI (18.5≥BMI<25 kg/m ^{2}) and overweight (BMI≥25 kg/m ^{2}).

Waist and hip circumferences were measured twice to the nearest centimeter and the mean was used for subsequent analysis. Waist Circumference (WC) was measured half way between the xiphisternum and the umbilicus while hip circumference (HC) was measured at the level of the greater trochanters. The waist hip ratio (WHR) and the waist to height ratio (WHtR) was then computed for each patient. Elevated WC was defined as WC=102cm for men and 88cm for women [16] , while elevated WHR was defined as WHR=0.95 for men and 0.88 for women [17] .

The statistical software SPSS (version 15) was use for data analysis. The mean values of WC, HC, BMI, WHR, WHtR and BP was determined. Correlations between the variables were examined using the Pearson correlation coefficients.

RESULTS

The base line characteristics of the patients with type 2 DM in this study are shown in Table 1. Of the 113 persons, studied 70 were female while 43 were male giving a male to female ratio of 1:1.6. The mean age, duration of DM, BMI, SBP and DBP was similar in both sexes. The waist circumference, hip circumference and waist height ratio were significantly higher among the female subjects. An elevated waist circumference (as defined based on gender) was present in 61 (54%) of the studied population.

Figure 1

Table 1: Baseline Characteristics of the subjects

Characteristics	Men	Women	Pvalue
Number of subjects	43	70	
Age (years)	62.1±12.2	60±11.5	0.36
Duration of DM (years)	3.71±2.3	3.92±3.6	0.73
Body Mass Index (kg/m^2)	26±6.1	27.32±5.7	0.25
Systolic blood Pressure (mm of Hg)	145.6±25.2	141.6±24.8	0.42
Diastolic Blood Pressure (mm of Hg)	91.16±15.2	86.1±12	0.057
Waist Circumference (cm)	94.3±13.1	101.5±13.1	0.005
Hip circumference (cm)	99.3±13.5	106±13.7	0.003
Waist hip ratio	0.95±0.005	0.95±0.005	0.8
Waist height ratio	0.569±0.009	0.644±0.009	0.0001

The distribution of patients across BMI categories (kg/m2) was as follows: underweight 4(3.5%), healthy 54(47.8%), overweight 32(28.3%) and obese 23 (20.4%). The prevalence of obesity in this study was 20.3% (23 of 113) overall. Table 2 shows the distribution of the patients into obese and non-obese based on the BMI cut off point of 30.0kg/m2.

Figure 2

Table 2: Distribution of Subjects into Obese and non-obese using the BMI cut point 30kg/m

Characteristics	Obese	Non-obese	Pvalue
Number of subjects	23	90	
Age (years)	66.1±11.3	59.4±11.5	0.014
Duration of DM (years)	2.52±2.01	4.17±3.30	0.024
Systolic blood Pressure (mm of Hg)	154.6±17.7	140±25.8	0.017
Diastolic Blood Pressure (mm of Hg)	94.6±13.5	86.3±13	0.0084
Waist Circumference (cm)	120±7.06	93.4±8.37	0.0001
Hip circumference (cm)	126±8.41	98.3±8.71	0.0001
Waist hip ratio	0.95±0.005	0.95±0.005	0.97
Waist height ratio	0.670±0.005	0.578±0.006	0.0001

The mean age (66.1±11.3 v 59.4±11.5, p= 0.014), waist circumference (120±7.06 v 93.4±8.37, p= 0.0001), systolic blood pressure (154.6±17.7 v 140±25.8, p= 0.017), diastolic blood pressure (94.6±13.5 v 86.3±13, p= 0.0084), hip circumference (126±8.41v 98.3±8.71, p= 0.0001) and waist to height ratio (0.670±0.005 v 0.578±0.006, p= 0.0001) were significantly higher among the obese than the non-obese patients respectively; the duration of diabetes mellitus was significantly shorter among the obese than the non-obese (2.52±2.01 v 4.17±3.30, p= 0.024).

Table 3 shows the Pearson correlation between the derived and basic anthropometric indices.

Figure 3

Table 3: Pearson Correlations between Derived and basic anthropometric indices in type 2 DM

	BMI(kg/m^2)		WHR		WHTR	
	OBESE	NONOBESE	OBESE	NONOBESE	OBESE	NONOBESE
WC	0.362	0.782**	0.423*	0.348**	0.637**	0.924**
HC	0.363	0.764**	-0.205	-0.320**	0.289	0.701**

* Significant at p<0.05

** Significant at p<0.01

Among the obese there was significant correlation between the WC and WHR; WC and WHtR, and a poor correlation between WC and BMI; however the HC correlated poorly with BMI, WHR, and WHtR. Among the non-obese there was significant correlation between WC and BMI, WC and WHR; WC and WHtR. The HC correlated significantly with the BMI and WHtR while there was a significant negative correlation with WHR.

DISCUSSION

This study describes a cohort of adult Nigerian with type 2 DM attending the investigative department of a laboratory in a rural tertiary institution. There were more females than their male counterpart as is usually the case in a rural setting where more females are known to attend hospital than male. [181920] However this finding may also be following a well known trend where diabetes and obesity is more prevalent among women. [2122]

The duration of diabetes was longer in the non obese diabetics compared to the obese diabetics. The association between obesity and type 2 DM is well recognised and weight gain may precede and precipitate type 2 DM, coincide with its development or aggravate existing diabetes, this may account for the earlier presentation among the obese patient in this study.

BMI alone is not as strong an indicator of cardiovascular risk as other anthropometric indices of obesity a measure that may be faulty [232425] , other indices that are more closely correlated with cardiovascular risk were assessed in this study. More objective methods like impedance plethymography, densitometry, computerised tomography and magnetic resonance image are not readily available, thus making these measures invaluable in our environment because of the relative ease of measurement, economy, convenience and availability. A comparison was thus made between the basic indices (waist circumference and hip circumference) and the derive indices (body mass index, waist hip ratio and waist to height ratio).

In this study it was found that waist circumference as measure of intraabdominal obesity had a poor correlation with BMI among the obese diabetic patients compared to a strong correlation among the non-obese, while WC and WHR had a good correlation in both the obese and non-obese diabetics, Adediran et al [26] also found a strong correlation between BMI and WC, and WC and WHR in both diabetic patients with and without metabolic syndrome. Wei et al. [27] investigated the predictive power of waist circumference, BMI, WHR and other anthropometric indices for type 2 diabetes in Mexican Americans and found that although BMI, WHR, and waist were independent predictors for type 2 diabetes, waist circumference was the strongest and most consistent. Thus it was concluded that abdominal fat localization often indicated by waist measure was more important than total amounts of body fat or subcutaneous adipose tissue in predicting type 2 diabetes. In an attempt to elucidate the role of obesity, numerous investigations have sought to define the best anthropometric determinants of obesity and how obesity relates to hypertension and diabetes. Despite these efforts, the best anthropometric methods for obesity have not been fully determined. Traditionally, BMI and WHR are the most cited indices in literature because they approximate adiposity and fat distribution. [28293031] Opinions vary as to whether or not waist circumference is as good a predictor as other anthropometric parameters. The best argument in favor of waist as predictor for these diseases is that it is a cumulative measurement of the absolute amounts of total and abnormal fat distribution, which is more relevant to cardiovascular diseases than total body fat.

The hip circumference is one of the anthropometric indices that is at the verge of being phased out in clinical practice because of the better indicator of waist circumference in predicting cardiovascular disease, diabetes and others. However Seidell et al. [32] reported that men and women with narrower than expected hips had a 2- to 3-fold excess risk of being diabetics, after adjustment for waist circumference; also Hartz et al. [33] reported that women with wide hips were less likely to report hypertension, diabetes, and gallbladder disease, after adjustment for relative weight and waist circumference. In the Hoorn Study where the contribution of thigh circumference and hip circumference to measures of glucose metabolism independent of waist circumference was investigated; it was found out that, thigh circumference in women and hip circumference in both sexes are negatively associated with markers of glucose metabolism independently of the waist circumference, BMI, and age. [34] Lissner showed that smaller hip circumferences predicted the incidence of self-reported diabetes in women in a prospective study. [35]

The WHR is also a practical index of regional adipose tissue distribution and has been widely used to investigate the relations between regional adipose tissue distribution and metabolic profile. [36] Chan et al [37] found that WHR was reasonably correlated with the mass of all adipose tissue in men. However, the WHR value does not account for large variation s in the level of total fat and abdominal visceral adipose tissues. [38]

WHtR is a recently introduced index to assess central fat distribution. An increased waist circumference is most likely associated with elevated risk factors because of its relation with visceral fat accumulation, and the mechanism may involve excess exposure of the liver to fatty acids. [39] The combination of WC and height that is W/Ht could manifest better the morphology of an enlarged abdomen with inappropriate short stature. [40]

Thus the use of the basic measure of anthropometry should not be discarded in totality but should still be use particularly in nonobese DM patients.

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