# CORRELATION OF VARIOUS ANTHROPOMETRIC INDICES AMONG NIGERIANS WITH TYPE 2 DIABETES MELLITUS

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**Abstract**

**Background:** Obesity has been described as the major driving force for the development of type 2 diabetes mellitus (DM). Various parameters have been measured to give some estimates about the levels of adiposity. It is therefore very pertinent to know the best index for the measurement of obesity among patients with type 2 DM who had MSX and those without it.

**Objective:** To determine the correlations, if any, of the various anthropometric variables among Nigerians with type 2 DM who had metabolic syndrome X (MSX) and those who did not have MSX.

**Materials and Methods:** One-hundred and ninety-two patients with type 2 DM attending Diabetic clinic of the Lagos University Teaching Hospital (LUTH), Lagos were randomly enrolled for the study. Ninety-six of the patients had metabolic syndrome X (presence of hypertension and obesity in addition to type 2 DM), while the rest had only type 2 DM. History was obtained through a questionnaire and patients were physically examined. Anthropometric indices were obtained using standards from the WHO Technical Report Series-854 on physical status 1995.

**Results:** Body mass index (BMI) correlated well with waist circumference (WC) and subscapular skinfold thickness (SST) ($r=0.63$ and $<0.01$) but not with waist: hip ratio WHR ($r=0.11$ and $=0.4$). In addition, WC correlated well with WHR and SST ($r=0.53$ and 0.54, respectively with $<0.01$). However, SST did not have a good correlation with WHR ($r=0.02$ and $>0.05$). The patterns of relationships between patients with MSX and control subjects were similar

**Conclusion:** WC correlated well with all other measured indices of obesity among the two groups studied.

**Introduction**: Measurements of height and weight circumferences of the chest, waist, hip; and skinfolds in the triceps, biceps, subscapular, abdominal, thigh, calf, and sometimes other regions are relatively inexpensive to perform, and have been widely used in epidemiologic studies to assess total body fat, fat distribution, and the degree of overweight. Of these techniques, height and weight can be measured with the greatest accuracy. Circumferences can also be measured accurately, but skinfolds have more variability in their measurement. Anthropometric measurements provide several kinds of information. The degree of overweight can be calculated from the height and weight. The waist circumference alone and the ratio of the circumference of the waist divided by the circumference of the hips have provided useful epidemiologic tools for estimating the health risk associated with central fat distribution. The skinfold measurements can be used to quantitate subcutaneous fat distribution and for determining the relative amount of truncal and peripheral fat. Obesity can be defined as accumulation of excess adipose tissues in the

body. It can be classified into generalized and central obesity. In generalized obesity, the bulk of the adipose tissues is located subcutaneously and usually estimated clinically by using body mass index (BMI). The BMI (weight in kilograms divided by the square of the height in metres), is promulgated by the World Health Organization as the most useful epidemiological measure of obesity.[1] It is nevertheless a crude index that does not take into account the distribution of body fat, resulting in variability in different individuals and populations. Central obesity on the other hand is a measure of visceral fat deposit. Waist circumference has also been recommended as a simple and practical measure for identifying overweight and obese patients, and population-specific criteria have been tabulated[1]. In addition, more sophisticated tools can be use to measure central obesity, these include computerized tomography (CT) scan, magnetic resonance imaging (MRI) and dual energy x-ray absorptiometry (DEXA). Obesity is a relatively arbitrary point where there is increased risk of morbidity and mortality. It is a major risk factor for diabetes mellitus and about 80% of patients with Type 2 DM are obese[2]. Obesity is considered as part of Metabolic Syndrome X in pathogenesis of Type 2 DM.

Numerous studies in subjects of all ages have demonstrated that increased visceral fat is associated with increases in fasting and postprandial plasma insulin levels and impaired glucose tolerance (IGT) [3]. Furthermore, it has been observed that WHR in the lower deciles had little risk for developing Type 2 DM and 20-fold increases in individuals in the upper deciles for developing type 2 DM[3]. It has also been observed that there were modest to strong correlations among the various anthropometric variables as a predictor of Type 2 DM[4]. The objective of this study is to determine the correlations, if any, of the various anthropometric variables among Nigerians with type 2 DM who had metabolic syndrome X (MSX) and those who do not have MSX.

**Materials and Methods**

One hundred and ninety-two patients with type 2 DM between the ages of 30-70 years attending Diabetic clinic of Lagos University Teaching Hospital (LUTH), Lagos were randomly selected for the study. Half of the study population had MSX while the other half (control) did not. They all completed a self-administered questionnaire from which their biodata and other history were obtained. They were physically examined. The diagnosis of MSX was made in the presence of systemic hypertension (BP 140/90 or patients on anti-hypertensive medication) and obesity (BMI 30kg/m$^2$ and/or WHR in male 0.9, in female 0.85) in addition to the presence of type 2 DM.[5] The control subjects, however, had only type 2 DM without hypertension and obesity (both visceral and generalized). The anthropometric indices were obtained using the WHO Technical report on physical status[6] as follows: The height of the patients was measured standing on a flat surface, with heels together in front of a vertical board with an attached metric rule and a horizontal headboard that was brought into contact with the uppermost point on the head in the sagittal plane. The height was measured to the nearest 0.1cm. The weight was measured with the patients standing still in the centre of a weighing scale's platform with the body weight evenly distributed between both feet. Only light indoor clothing was worn. Weight was recorded to the nearest 0.1kg. The BMI was calculated as the percentage of the weight divided by the squared height. The hip circumference was measured with the subjects wearing non-restrictive clothing. The subjects stood erect with arms at the sides and feet together. Hip circumference (HC) in centimeters was measured at the level of the greater trochanters using a flexible tape. The measurements were recorded to the nearest 0.1cm. The waist circumference was taken while the subjects stood comfortable with their weight evenly distributed on both feet and feet about 25-30cm apart. Waist circumference (WC) in centimeters was

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**Table 1:** Relationship between various anthropometric indices among patients with metabolic syndrome X and the controls.

| | MSX Subjects | | Controls | |
|---|---|---|---|---|
| Index | r | t (p) | R | t (p) |
| WC v WHR | 0.53 | 6.1 (<0.01) | 0.5 | 5.16 (<0.01) |
| WC v BMI | 0.63 | 7.9 (<0.01) | 0.6 | 7.27 (<0.01) |
| WC v SST | 0.54 | 6.2 (<0.01) | 0.4 | 4.23 (<0.01) |
| WHR v BMI | -0.11 | 1.1 (>0.05) | 0.1 | 0.88 (>0.05) |
| WHR v SST | 0.02 | 0.2 (>0.05) | -0.1 | 0.78 (>0.05) |
| BMI v SST | 0.63 | 7.9 (<0.01) | 0.4 | 4.23 (<0.01) |

BMI: Body mass index, WHR: Waist hip ratio, SST: Subscapular skin fold thickness, WC: Waist circumference
r – Correlation Coefficient.

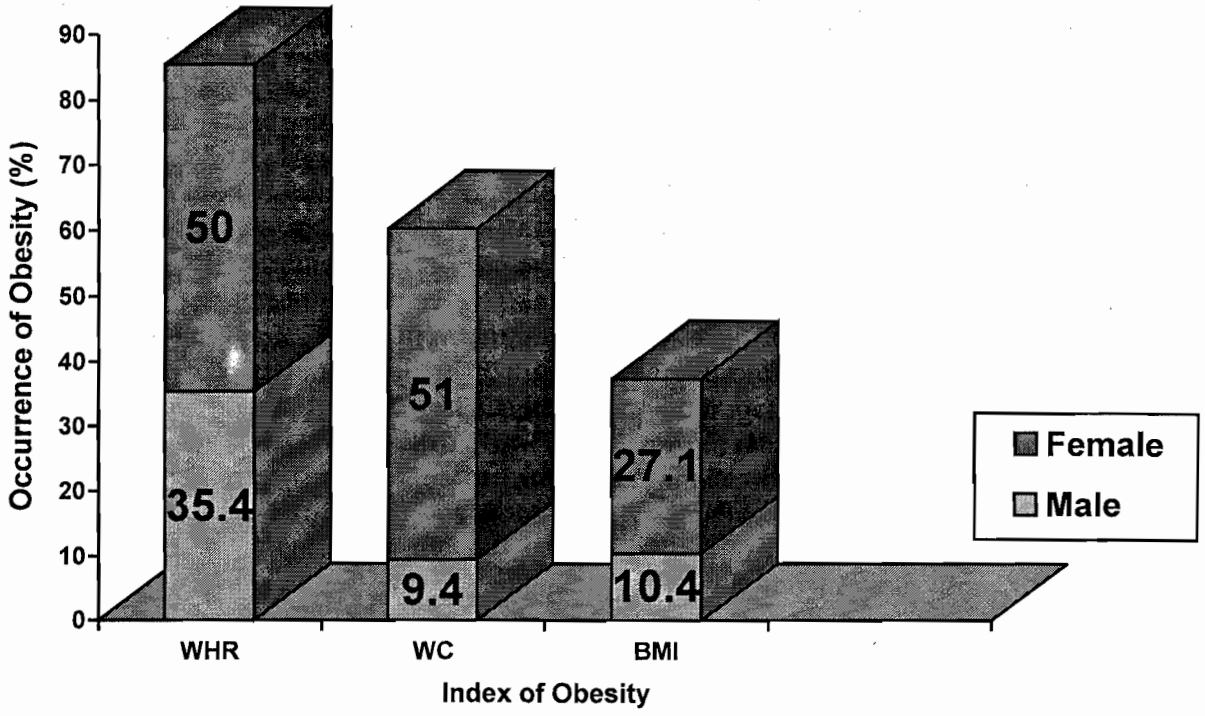


**Figure 1: Relative frequency of obesity among metabolic syndrome X subjects** . WHR: Waist hip ratio, WC: Waist circumference, BMI: Body mass index
Criteria: - WHR: >

**Discussion**

The occurrence of obesity using WHR was more (85.4%) than using WC (60.4%) and BMI (37.5%) among patients with MSX in this study. High waist-to-hip ratio and fasting insulin levels were significant predictors of developing metabolic syndrome[7]. There was significant correlation between the various anthropometric indices with WC correlating best with all other clinically measurable indices of obesity. This is in agreement with prospective study among Mexican American where modest to strong correlations was found between anthropometric variables, in which waist circumference was the strongest predictor of NIDDM[4]. The predictive power of a single measurement of waist circumference was at least equal to that of WHR and BMI combined[4]. A study by Stevens et al.[8] of almost 13,000 African Americans and whites ages 45 to 64 years also showed that the predictions of type 2 diabetes (one of the metabolic syndrome components) by BMI and by waist circumference were similar, with waist circumference being slightly stronger than BMI. Body mass index has been used extensively to classify obesity highlighting associated health risks. The various cut-off points, however, cannot provide accurate information about fat distribution as the relationship between BMI and body fat content varies according to body build and body proportion[1,9] . The intra-abdominal (visceral) deposition of adipose tissue, which characterizes upper body obesity, is a major contributor to the development of hypertension, insulin resistance, diabetes mellitus and dyslipidaemia (components of MSX) [10] in comparison with the more peripherally distributed gluteo-femoral obesity[11]. Liese et al[12] study of 6000 middle-aged African Americans and European Americans showed that high values of insulin, BMI, and waist-to-hip ratios were predictive of increased incidence of metabolic syndrome over 5 years. Waist circumference can predict Type 2 diabetes, hypertension and dyslipidaemia in Jamaican and Mexican populations[13,14]. Waist circumference, WHR and BMI are also associated with cardiovascular risk factors and can predict the metabolic syndrome in Chinese and Mexican populations[10,15]. Waist circumference has become the preferred measure for abdominal

obesity. James advocates that waist measurements provide a simple discriminator of risk, in combination with BMI[16]. Waist circumference is the best surrogate measure for visceral fat mass, as estimated from computed tomography[16,17] and dual-energy x-ray absorptiometry[18]. The WHO has echoed these principles and supports the measurement of waist circumference[1]. In general, waist measurement is a practical method for self-assessment of health risks because of its ease of measurement and its simple concept of fat distribution. Changes in waist circumference are very sensitive to weight changes, and health benefits from waist reduction have been shown in relation to improved metabolic and cardiovascular risk factors[19]

In conclusion, measurement of waist circumference should be seen as a very important tool in assessing obesity and cardiovascular risk in patients with type 2 DM and of course, the general population. It is very easy and convenient to measure, yet gives out very pertinent information.

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