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Correlative Evaluation of the anthropometric Variables of Obesity with echocardiographic parameters in relation to gender

*Mbadiwe Nkeiruka C.[1], Anisiuba Benjamin C.[1], Onwubere Basden JC.[1], Ejim Emmanuel C[1]., Mbadiwe Okezie M.[2], Ulasi Ifeoma I[1] and Ike Samuel O.[1]
[1] Department of Medicine, University of Nigeria, Ituku/Ozalla, Enugu.
[2] Department of Surgery, University of Nigeria, Ituku/Ozalla, Enugu.
* All correspondence to Mbadiwe Nkeiruka C., nkeiruka.mbadiwe@unn.edu.ng

ABSTRACT

In spite of the rising global epidemic of obesity, and increasing number of studies on obesity, the relationship between the anthropometric variables with echocardiographic parameters in relation to gender have not been fully explored up to date. The aim of this study was to evaluate the relationship between the anthropometric variables with echocardiographic parameters in relation to gender. A total of 224 subjects participated in the study. 144 obese and 80 non-obese (control). No correlation was found with right ventricular dimension (RVD). No correlation was found also with left ventricular end diastolic diameter (LVEDD). BMI and WC had similar strengths of correlation with left ventricular mass index (LVMI) in male and female subjects. In conclusion, BMI and WC had similar strengths of correlation with left ventricular mass index (LVMI) in male and female subjects.
Keywords: Anthropometric, variables, echocardiographic, parameters, gender

INTRODUCTION

The word Obesity is the nominal form of ‘Obese’ which comes from the latin word Obesus which means “Stout, fat or plump” [1]. Obesity is a condition in which the natural energy reserve, stored in the fatty tissue of humans and other animals is increased to a point where it is a risk factor for certain health condition or increased mortality [1, 2]. It is the normal physiological response to an environment in which energy intake exceeds energy output. It is an adaptive mechanism. Major environmental changes that support this adaptive mechanism are the greater availability of foods especially in the developed countries, and the increase in sedentary life-style [3]. The social environment has moved from being obesity retardant to being obesity conducive. This has important implications on patients with certain genotypes. Metabolic rates differ between persons and may be important in determining who becomes obese [4,5,6]. Historically, in several human cultures, obesity was associated with physical attractiveness, strength and fertility. Some of the earliest known cultural artifacts, known as *venus figurines,* are pocket-sized statuettes representing an obese female figure. Although their cultural significance is unrecorded, their widespread use throughout pre-historic Mediterranean and European cultures suggests a central role for the obese female form in magical rituals, and suggests cultural approval of (and perhaps reverence for) this body form. This is most likely due to the general perception that they were fertile and could survive famine [7,8,9,10].

In modern western culture, the obese body shape was widely regarded as unattractive [11,12,13,14]. Obese bodies are rarely positively represented in mainstream media. Many negative stereotypes are commonly associated with obese people, such as the belief that they are lazy, dirty, stupid, or even evil. Some point to gluttony. Obese children, teenagers and adults face a heavy social stigma. Obese children are frequently the targets of bullies and are often shunned by their peers. Obesity in adulthood can lead to a slower rate of career advancement [15]. Not all contemporary cultures disapprove of obesity. There are many cultures, which are traditionally more approving (to varying degrees) of obesity, including some African, Arabic, Indian and Pacific Island cultures. Especially in recent decades, obesity has come to be seen more as a medical condition in modern western culture [16]. As with many medical conditions, the caloric imbalance that results in obesity often develops from a combination of genetic and environmental factors. Polymorphism in various genes controlling appetite, metabolism, and adipokine release predispose to obesity, but the condition requires availability of sufficient calories, and possibly other factors to develop fully [17]. In Africa, and West African sub region in particular, there are few studies on the relationship between obesity and cardiovascular diseases. Worse still, there are only very few studies on the relationship between the measures of obesity and body size and the cardiovascular risk factors [18].

RATIONALE FOR THE STUDY

In the developed countries of Europe and America, studies on the topic of obesity abound. But in the developing nations of Africa, and particularly, the West African sub region, only a few studies have been reported. Therefore it is needful to carry out more studies in order to enrich our obesity data base in this part of the world. Secondly, considering that we live in an environment with scarce resources and limited manpower, it would be useful to know which of the anthropometric measures of obesity best indicates risk of cardiovascular disease, so that emphasis could be rightly placed on the particular measure(s) in the evaluation and management of obesity. This will ultimately help in the reduction of the global burden of cardiovascular diseases.

AIM OF THE RESEARCH

The aim of this research was to evaluate the Relationship between Anthropometric measures of Obesity with Echocardiographic parameters in relation to gender.

MATERIALS AND METHODOLOGY

Design

The study was cross-sectional, descriptive and hospital based.

Setting

Place of study

This was at the University of Nigeria Teaching Hospital, UNTH, Enugu, South Eastern Nigeria, a 760 bed tertiary institution serving Enugu and neighbouring states.

Sample population

Eligible and consenting patients were drawn from the medical out-patient department of the UNTH from March 2006 to November 2006. Most of the patients were Ibos,a tribe in the South Eastern part of Nigeria, with a relatively high literacy level, although majority of them were traders.

Ethical clearance

Ethical clearance was obtained from the Ethics committee of the UNTH, Enugu (see Appendix).

Basis of Diagnosis

Obesity

- Subjects with BMI of $30kg/m^2$ and above were taken as obese; those with BMI of less than $30kg/m^2$ were taken as non obese.
- Abdominal (waist) circumference of 88cm for women and >102 for men were taken as central/visceral obesity.
- Waist-hip ratio of >0.85 for women and >0.9 for men were also taken as central/visceralobesity.

Hypertension

A mean blood pressure of ≥ 140 mmHg (systolic) and/or ≥ 90 mmHg (diastolic) was regarded as Hypertension.

Sample Size

Patient (sample) population

The prevalence of obesity in adult Nigerians is estimated at 10.5% Using the WHO formula for sample size determination in a finite population (Fischer's formula):

$$n = \frac{Z^2 Pq}{d^2}$$

Where n = the minimum sample size

P = prevalence rate (in a previous study)

Z = Standard deviation value at 95% confidence interval

d = Sample error tolerated (5.0%)

The sample size is thus calculated to be 144.

Control Subjects

Eighty (80) non-obese patients were recruited consecutively along side the obese patients. These served as a control for the study.

Consent

Informed consent was obtained from subjects, both sample and control groups. Those who were not literate enough to sign their signature were free to use thumb printing.

Study Criteria

Inclusion Criteria

The study included adult patients of both sexes, up to 18 years and above but not more than 75 years, who were not pregnant and had no chronic debilitating diseases like tuberculosis, metastastic cancers and other diseases mentioned in the exclusion criteria.

Exclusion Criteria

- Age below 18 years and above 75 years
- Smokers
- Pregnant women
- Women on oral or parenteral contraception.
- AIDS patients.
- Tuberculosis patients
- Patients who have metastatic cancer and patients on cytotoxic therapy.
- Patients with chronic renal failure, nephrotic syndrome, chronic glomerulo-nephritis etc.
- Oedematous patients
- Patients with congestive cardiac failure, cardiomyopathies and structural heart diseases including valvular heart diseases.
- Patients who have kyphoscoliosis.
- Amputees
- Patients who could not stand.

Withdrawal Criteria

- Verbal withdrawal of consent
- Failure to turn up for laboratory tests.

MATERIALS

Equipment for study

(a) Stadiometer (Hospitex brand)
(b) Weighing balance (incorporated in the stadiometer)
(c) Tape measure.
(d) The mercurysphygmomanometer (Accoson brand) with standard cuff size 15cm x 55xm, and Lithmans stethoscope.
(e) Standard 3 – channel electrocardiograph (ECG) machine (cardiette authoruler) with 12 leads.
(f) Glucometer (Accutest)
(g) Autoanalyzer
(h) 2 Dimensional Echocardiography machine (Hewlett Packard m2406A Ultrasonic system)

METHODOLOGY

Procedure

Anthropometric data (weight, height, waist circumference and hip circumference) of all eligible patients who attended the medical outpatient clinic during the period of study were collected. To obtain the anthropometric measurements, each subject or control was asked to stand on the stadiometer bare foot and with minimal clothing, without shoes in a special room set out for the purpose. The weight and height were thus measured. Then the waist circumference (WC) was measured using the tape measure, with the patient standing bare foot on the floor. The WC was taken at the level of the iliac crests [16], passing along the umbilical level of the unclothed abdomen; and the hip circumference was measured at the level of the external margins of the anterior superior iliac spines [17]. The mean of two readings was taken. Patients whose BMI were up to 30kg/m^2 and above were recruited for the study, and those with BMI <30kg/m^2 were recruited as controls, if they satisfied the inclusion criteria, and gave their consent. Data collection sheet was pre-tested on about 10 consecutive patients. These were reviewed and then applied to consenting subjects. Blood pressure was measured in the sitting position, with the patient's index arm resting on the consulting table, after patient must have relaxed for at least 10 minutes. The right arm was used for every patient for the purpose of uniformity. The 1st Korotkoff sound was used to determine the systolic blood pressure, and the disappearance of the sound (or muffling if the sound does not disappear) was used to determine the diastolic blood pressure. Two readings were taken at 10 minutes interval, and the mean of the two reading was recorded as the blood pressure. About 8 am, after an overnight fast: a drop of capillary blood was used for fasting blood glucose test, by means of glucometer. 5 millilitres of blood sample was also drawn for laboratory tests [18].

Data Analysis

Analysis of data was done using SPSS version 11, while statistical calculations were carried out with the computer software PEPI (programme for Epidemiologists), version 4.0. Categorical variables were compared using the non parametric chi-square (χ^2), while parametric variables were compared using the student t-test. The relationship between anthropometric variables and the cardiovascular risk factors was analyzed by Pearson's correlation coefficient test, while the relationship between anthropometric variables and echocardiographic parameters was evaluated by Spearman's rho coefficient of correlation test, Pearson's correlation coefficient and Stepwise regression analysis. Partial correlation was used to correct for differences in age and to control for blood pressure.

RESULTS

Table 1: Correlation of the anthropometric variables with echocardiographic parameters in relation to gender

Echocardiographic Parameter	Gender	BMI r (p-value)	WC r (p-value)	WHR r (p-value)
❖ LAD	M (n = 43)	0.193 (0.220)	0.068 (0.670)	-0.019 (0.904)
	F (n = 101)	0.345 (0.000)***	0.387 (0.000)***	-0.122 (0.228)
❖ RVD	M (n = 43)	0.098 (0.536)	0.193 (0.223)	0.291 (0.061)
	F (n = 101)	0.042 (0.675)	0.093 (0.355)	0.109 (0.283)
❖ LVEDD	M (n = 43)	-0.124 (0.433)	0.082 (0.605)	0.052 (0.744)
	F (n = 101)	0.116 (0.251)	0.128 (0.206)	0.073 (0.474)
❖ LVMI	M (n = 43)	-0.745 (0.000)***	-0.705 (0.000)***	-0.224 (0.153)
	F (n = 101)	-0.698 (0.000)***	-0.698 (0.000)***	-0.136 (0.178)
❖ LVE/A Ratio	M (n = 43)	0.095 (0.553)	0.070 (0.659)	0.194 (0.218)
	F (n = 101)	-0.313 (0.002)**	-0.373 (0.000)***	-0.052 (0.607)
❖ RVE/A Ratio	M (n = 43)	0.274 (0.079)	-0.350 (0.023)*	-0.314 (-.042)*
	F (n = 101)	-0.506 (0.000)***	0.512 (0.000)***	-0.152 (0.131)
Ejection Fraction	M (n = 43)	0.251 (0.109)	0.304 (0.050)	0.303 (0.051)
	F (n = 101)	0.497 (0.000)***	0.459 (0.000)***	0.141 (0.162)

* $P < 0.05$, ** $P \leq 0.02$, ***$P \leq 0.001$ M = male F = female

❖ LAD = left atrial dimension, RVD = right ventricular dimension (end diastolic), LVEDD = left ventricular end diastolic dimension, LVMI = left ventricular mass index, LVE/A = left ventricular E:A ratio, RVE/A = right ventricular E:A ratio

After correcting for difference in age: left atrial dimension has significant correlation with BMI and WC in the female subjects (r = 0.345; p = 0.000 and r = 0.387; p = 0.000 respectively). But further analysis showed that WC had the best correlation with LAD (p = 0.014), and not BMI (p = 0.697). No correlation was found with right ventricular dimension (RVD). No correlation was found also with left ventricular end diastolic diameter (LVEDD). BMI and WC had similar strengths of correlation with left ventricular mass index (LVMI) in male and female subjects ((m) r = -0.745; p = 0.000, (f) r = -0.698, p = 0.000) and ((m) r = -0.705; p = 0.000, (f) r = -0.698, p = 0.000 respectively). When these were subjected to further analysis, WC showed more significant correlation with LVMI (p = 0.014) than BMI (p = 0.022) in females, whereas in males BMI showed more significant correlation with LVMI (p = 0.000) than WC (p = 0.048); no correlation with WHR. Left ventricular E/A ratio, in the females showed significant correlation (negative) with WC (r = -0.373; p = 0.000) and BMI (r = -0.313; p = 0.002), and further analysis showed WC to have the best correlation with LVE/A ratio (p=0.013). No significant correlation was found for LVE/A ratio in males.

RVE/A ratio had significant correlation with WC (r = -0.350; p = 0.023) and WHR (r = -0.314; p = 0.042) and none with BMI, in males. Further analysis showed WC to have best correlation with RVE/A ratio (p=0.005). In females, WC and the BMI had significant correlation (negative) with RVE/A ratio (r = -0.512; p = 0.000) and r = -0.506; p = 0.000 respectively), and further analysis also showed WC to have the best correlation with RVE/A ratio (p = 0.000). Ejection fraction had significant correlation with BMI and WC in females only (r = 0.497; p = 0.000 and r = 0.459, p = 0.000 respectively). Further analysis did not yield significant relationship with the two (p = 0.106 and p = 0.227 respectively).

DISCUSSION

The finding of strong correlation between waist circumference and most of the altered echocardiographic parameters found in the obese subjects even after controlling for blood pressure, especially the left ventricular mass index (LVMI), the left ventricular end diastolic dimension (LVEDD) and the trans-mitral and trans-tricuspid flow velocity ratios (i.e. LVE/A and RVE/A) which evaluate left and right ventricular diastolic dysfunction respectively, is substantially in keeping with those of [19,20] in which they found increased visceral adipose tissue to be much more correlated with altered echocardiographic parameters than subcutaneous adipose tissue. It also agrees with the result of [21] in which waist circumference was strongly correlated with left ventricular mass index (LVMI) in elderly obese subjects.

CONCLUSION

In conclusion, BMI and WC had similar strengths of correlation with left ventricular mass index (LVMI) in male and female subjects.

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