

# Utility of the Abdominometer: A Novel Contribution to Cardiovascular Anthropometry

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## Abstract

Obesity is a CVD risk factor that can be modulated for massive reduction in morbi-mortality. Traditional indices measuring it have been inconsistent and the most commonly used; BMI has proved inappropriate for Africans, not attending specifically to body fat and its distribution. With the consensus that intra-abdominal fat is the most critical for cardio-metabolic diseases, various attempts were made to measure it for risk estimation. These however require costly equipments not easily amenable for population studies. The abdominometer conceptualized by BNO has shown promise in isolated cases. This pilot study was undertaken in this restricted population to compare its utility with existing anthropometric measures of cardiovascular disease.

## Keywords

Obesity, Abdominometer, Anthropometry, Africa

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## 1. Introduction

Obesity is a disease [1] which is a harbinger of death given its contribution to morbidity and premature death [2]. Its clinical and metabolic consequences result in heart failure, stroke, kidney failure and myocardial infarction; leading to death and disability. It is also related to reduced mobility, peripheral artery disease, sexual dysfunction, some cancers, cosmetic encumbrances and degenerative diseases of the joints. These impair the quality of

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life by their physical and psychological impacts. It has been on the rise all over the world. More than one third United States of America adults are obese [3]. It has also risen in some sub-Saharan native groups [4]. The rapid rise in obesity rates and the costs for treating it and its cardio-metabolic consequences make obesity research be crucial [5].

Its previous indices of measurement such as Body Mass Index (BMI) and Waist Circumference (WC) are not equally applicable to all ethnic groups [2] and current cut-off values may not be appropriate for Africans [6]. BMI has for long served as a useful proxy determinant of obesity but its deficiency is in its inability to distinguish contribution of body frame size, muscle mass and body fat to overall weight [7]. In fact, it misses subjects with increased cardio-metabolic risk factors related to increased adiposity [8]. WC as a measure of abdominal obesity is more useful in assessing cardio-metabolic risks, and is a stronger measure in some ethnic groups [9]. Since body fat especially intra-abdominal with its attendant insulin resistance is central to all cardio-metabolic risks, there has been a shift to using anthropometric measures to target it for routine assessment of metabolic and cardiovascular disease (CVD) risk [10]. With the finding that percentage body fat tracks blood pressure better than BMI in an African population [11], and the position that abdominal height is a better predictor of CVD than any other anthropometric measurement [12], one of us (BNO) thought of how to measure it in our population using simple and adaptable equipment. This gave rise to the “abdominometer”.

Measurement of abdominal height (AH) that some workers refer to as sagittal abdominal diameter has shown better correlation with CVD risk factors than WC and BMI [13], and stronger measure of abdominal fat than WC [14]. This is because WC does not always mirror visceral obesity as it may have a bearing on abdominal sub-cutaneous fat [15]. The beauty of this implement called the “abdominometer” is its portability. Its use is simple. Once the anatomical landmarks are recognized, any one without much education can use it. Unlike the Brazilian apparatus measuring the sagittal abdominal diameter [16], it is not fixed to the couch. That way, it could be used in the field and moved about easily. We therefore used this implement in the course of this community service to see its utility in cardiovascular screening.

Ezinihitte is one of the 5 clans that make up Mbaise in present Imo State of Nigeria. Its people are Ibos, and almost complete Christians of various denominations. In 2013, natives of Ezinihitte resident in Jos and belonging to Ezinihitte Development Association Jos Branch were screened for CVDs. This followed a series of death of members related to CVDs. The team was led by BNO who had conceptualized the “abdominometer”, used to measure abdominal height and used as part of the evaluation. Following the invitation by members in a general meeting early in 2013 to BNO to screen them for hypertension related diseases following a string of hypertension related deaths in members, a team made up of all Ezinihitte born doctors in Jos University Teaching Hospital was raised. It was agreed that the meeting of August 2013 would be dedicated to this. All the 56 members (51 M, 5 F) who turned up for the meeting were invited for screening.

## 2. Methodology

All the equipments were checked for accuracy and members of the team tried out their hands on abdominal height measurement with the “abdominometer” to ensure uniformity with its use. The session began with instruction to members on the procedure to be adopted and request of informed consent to participate. All the 56 members of the association who were in attendance at that monthly meeting of August 2013 were invited to participate. Inclusion criteria were being a member of Ezinihitte Development Association in Jos and being present at the August 2013 meeting which had earlier been agreed to be set aside for the cardiovascular disease screening. Only those who voluntarily declined participation were excluded. The protocol had earlier been approved by the Research Ethics Committee of Jos University Teaching Hospital. They then came orderly through different desks manned by one member of the team as follows.

Desk 1: Name, age, gender, history of smoking and Diabetes Mellitus were documented.

Desk 2: Blood pressure measurement in standard sphygmomanometric fashion (ACCOSON BRAND with appropriate cuff).

Desk 3: Abdominal height measurement with the “abdominometer”. It is made of wood in L shape (**Figure 1**). The short arm rests in the small of the back at the level of the iliac crest which corresponds to the space between the 4<sup>th</sup> and 5<sup>th</sup> lumbar vertebrae. The longer arm has a sliding and swinging mechanism that moves anteriorly to come to rest on the anterior abdominal wall at the level of the umbilicus or the anterior most point of the abdomen at that level; for those with pendulous abdomen. This level is then read off on the laminated graduated scale in centimeters (**Figure 2**).



**Figure 1.** The abdominometer in closed position. The short arm rests in the small of the back and the long arm with the measuring scale and sliding and swinging mechanism completes the motion for AH measurement.



**Figure 2.** BNO showing on himself the position of the abdominometer on the anterior abdominal wall at the level of the umbilicus for reading off of AH.

Desk 4: Height measurement using a stadiometer in standard fashion; read off in metres.

Desk 5: Weight and percentage body fat (%BF) were measured using an electronic scale (body fat bath scale—Nature’s Gift for Life, 13303 Summer Terrace Drive, Sugar Land, Texas 77497 USA). BMI was derived as quotient of weight in kilograms and the square of height in meters.

Data were analysed using SPSS Version 16 statistical software. Data are presented as mean (SD) and subjected to Pearson correlation as appropriate. Significance was set at  $p \leq 0.05$

### 3. Results

Fifty four people (49 M and 5 F) had complete data for BMI, AH and BP while 29 had data for %BF. Mean (SD) values were 26.18 (4.14), 24.65 (4.06), 135.79 (22.91), 84.28 (15.81) and 28.09 (8.11) for BMI, AH, SBP, DBP and %BF respectively. They were largely artisans and traders with a few being employed in the formal sector of the economy. Their ages ranged from 30 to 75 years, 7 were smokers, 1 had diabetes mellitus and 20 were hypertensive. Among the 29 with all data (27 M, 2 F), AH correlated significantly with BMI (Pearson correlation coefficient,  $R = 0.803$ ) and %BF ( $R = 0.797$ ) at  $p = 0.01$ . Whereas BMI did not significantly correlate with both SBP and DBP, AH correlated with SBP ( $R = 0.307$ ;  $p = 0.05$ ) while %BF correlated with both SBP and DBP ( $R = 0.402$  and  $0.421$  respectively;  $p = 0.05$ ).

### 4. Discussion

Excess fat defines overweight/obesity status; and when in ectopic foci like the visceral compartment is dysfunctional [17]. Obesity leads to several co-morbidities, the severity of which is proportional to excess body fat [18]. The current definitions of obesity using BMI have shown not to apply well for Africans [6]. While widely used to monitor prevalence of obesity, it does not consider distribution [19] which varies by ethnic groups. Because different anthropometric measures factor in body fat differently, their use in screening for CVD has yielded inconsistent results [20].

As different populations have differences in the predictive values of %BF at given BMI, the need for population specific anthropometry became compelling [21].

Our study is preliminary; and used the “abdominometer”, a new apparatus to measure AH as a cardiovascular anthropometric index. That it correlated significantly with BMI and %BF, long standing cardiovascular anthropometric measures, shows that AH determined by this apparatus is effective. When each of the cardiovascular anthropometric measures in this study was correlated with SBP and DBP, BMI did not attain significance. This would confirm the observation that BMI misses subjects whose cardio-metabolic risk is related to increased adiposity [8] and is inappropriate for Africans [22]. Sagittal abdominal diameter was shown to correlate better with CVD risk factors than BMI [13]. Given its greater contribution to prediction of BP than other measures of central obesity, AH was recommended for use to assess a component of visceral fat that other anthropometric measures miss [23]. %BF appeared to be the best measure but it requires electronic equipment which is expensive and needing battery replacements. Our “abdominometer” readings tracked SBP at the same level as %BF, but lagged behind for DBP. This may not be a significant disability as SBP has been acclaimed the predominant risk factor in middle aged and older adults on both conventional and blood pressure measurement [24].

This study is limited by a small sample size and restricted ethnic representation. It however holds a promise of being a simple, mobile and efficient cardiovascular screening measure that targets abdominal visceral fat; the major contributor to cardio-metabolic complications [15].

### 5. Conclusion

In conclusion the abdominometer-measured AH is better than traditional cardiovascular anthropometric measures in this African cohort, and should be used more widely to authenticate its benefit.

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