Conicity Index an Anthropometric Predictor of Diabetes and Cardiovascular Diseases Amongst Young Adults

Uzoeghelu, Chinaza Precious and Ugbenyen, Anthony Moses*
Department of Biochemistry, Faculty of Basic Medical Sciences, Edo State University, Uzairue, Edo state, Nigeria.
**Corresponding Author's Emails: ugbenyen.anthony@edounivesity.edu.ng ; ugbenyenanthony@gmail.com*

Abstract

Measurement of an individual's anthropometric indices is one of the many methods for determining physical health status; others include measurement of biochemical markers and clinical indices. Little information is known about the relationship between conicity index in predicting diseases. The study was aimed at finding the association between conicity index, biochemical and clinical indices in predicting disease conditions. This study was carried out on 87 undergraduates of Edo State University, Uzairue with 44 of them being males and 43 of them being females. The Socio-demographic data were collected using a structured questionnaire, and the anthropometric indices, biochemical and clinical indices were measured. There was a statistically significant difference in the comparison of male and female respondents in their weight, height, waist circumference, fat, visceral fat, water and muscles at ($p < 0.05$). Conicity Index (CI) was statistically significant and positively correlated with obesity, muscle and diastolic blood pressure at ($p < 0.01$), positively correlated with systolic blood pressure and visceral fat ($p <0.05$) and a correlation with blood glucose and cholesterol level. The results of the study showed that Conicity Index had a correlation with clinical and biochemical indices. This makes it a factor for predicting cardiovascular disease, hypertension and central obesity and may be a predicting factor for diabetes mellitus and dyslipidaemia.

***Keywords**: Anthropometric indices, Biochemical and Clinical indices, Conicity Index*

1.0 Introduction

A variety of interrelated factors complicate the clinical investigation of the spectrum of human disease conditions. Thus, to establish causal relationships, we need well-designed studies and powerful analytical tools, such as anthropometric indices like Body Mass Index (BMI) and Conicity Index (CI) (Quitéria, 2017) and other indices, such as biochemical indices (glucose, cholesterols, albumin, prealbumin, urea, creatine, and bilirubin) and clinical indices (blood pressure, SPO_2, pulse rate, and pulse pressure). Conicity Index (CI) is a straightforward anthropometric index used to measure central adiposity. It could be used to evaluate obesity and body fat distribution on the basis that central obesity, as opposed to general obesity, is associated with cardiovascular disease (Valdez, 1991). In 1991, Valdez Radolfo introduced the Conicity Index (CI) to measure obesity and body fat distribution and to link central obesity with cardiovascular disease. The measurements used in calculating conicity index are weight, height, and waist circumference, which are based on the development of the double-cone body form with fat accumulating around the waist (Valdez, 1991). The Conicity Index might potentially be utilized to determine body form. The Conicity Index is based on the notion that people with more abdominal fat have a double cone form, whereas those with less abdominal fat have a cylindrical shape (Mbelege *et al.*, 2021). Conicity Index is obtained by using Valdez formula which involves dividing a person's waist circumference in meters by 0.109 of the square-root of weight in kg over the height in meters (Valdez, 1991). The actual range of CI is between 1.00-1.73 (Flora *et al.*, 2009; Shenoy and Jagadamba, 2017). Conicity Index could estimate the risk of diabetes, hypertension and dyslipidemia by correlating it with biochemical and clinical indices (Mirelli *et al.*, 2016). Therefore, this study was aimed at finding if there could be an association between Conicity, Biochemical and Clinical indices in predicting disease conditions.

2.0 Materials and Methods

This study was carried out on 87 undergraduates of Edo State University, Uzariue between 20th January, 2022 and 20th March, 2022, with 44 of them being males and 43 of them being females. Ethical approval for this study was obtained from the Ethical Review Committee, Faculty of Basic Medical Sciences/College of Medical Sciences, Edo State University Uzairue, Edo State, Nigeria on 22nd December, 2021. Ethical approval number is (**ERC/FBM/007/2021**). Written consent was obtained from the respondents after the study aims and objectives were discussed with them. Pre-test, structured questionnaires were used for data collection. The parameters measured were weight, height, waist circumference, blood pressure, pulse rate, pulse pressure, oxygen saturation, blood glucose and total cholesterol which required the use of the following materials; an automatic weighing scale, a measuring tape, a stadiometer, oximeter, glucometer (acu check), cholesterol analyser and sphygmomanometer.

2.1 Determination of Socio-demographic data: The participants' Socio-demographic data were collected using a structured questionnaire.

2.2 Determination of Weight, Height and Waist circumference: The body weight was measured using an automatic weighing scale in Kg with the participant removing any heavy materials on them and their shoes looking forward (Heyward and Stolarczyk, 2000). The height was measured in meters using a stadiometer (Linagjin 7.5M/25FT scale) with the participant standing barefoot facing forward. Waist circumference was measured in meters at normal end-expiration at the midpoint between the last floating rib and the iliac crest, with the subject standing and wearing light clothing, using a flexible non-stretch tape rule (Heyward and Stolarczyk, 2000).

2.3 Calcualtion of Conicity Index: Conicity index was calculated by the measured body weight, height and waist circumference. The Conicity index was then calculated using valdez formula:

$$\text{Conicity index} = \frac{\text{waist circumference (m)}}{0.109\sqrt{\dfrac{\text{weight (kg)}}{\text{height (m)}}}}$$

(Quitéria, 2017)

2.4 Determination of Body composition: The body composition of the participants including the fat, muscle, visceral fat, bone mass, lean body mass, water and obesity was taken using an automatic weighing scale which uses a phone application known as OKOK to show the participant body composition data.

2.5 Determination of Blood Glucose level: Blood Glucose level was determined using blood glucose oxidase method (Janet and Dianne, 2014). A Glucose monitor, Accu Check glucometer (Roche Diagnostics, GmbH, Mannheim, Germany) was used to measure the glucose level, a test strips that had not been exposed to the air, an alcohol swab (ethanol and cotton wool), single-use safety lancets, gloves, and cotton wool.

2.6 Determination of Cholesterol level: The determination of cholesterol level was done using a cholesterol analyzer, test strips, alcohol swap (ethanol and cotton wool), gloves and single-use safety lancets.

***2.7 Determination of Blood pressure and pulse pressure*:** The blood pressure was measured using a digital sphygmomanometer. Digital blood pressure monitors were placed on the upper arm and are activated simply by pressing a button. The machine read the blood pressure automatically based on variations in the volume of blood in the arteries (Kasper *et al.*, 2015).

***2.8 Determination of Pulse rate and Oxygen Saturation*:** Pulse rate and SPO_2 was determined by Pulse Oximeter. Pulse oximeter measures in percentage, the amount of oxygen being carried in the blood. The measurement was taken using any of the fingers by a Pulse Oximeter. The normal range of SPO_2 is 94% and above any value less than 94% is hypoxia.

***2.9 Data Analysis*:** The data were analysed using Statistical Package for Social Science (SPSS 20.0). Student's t-test was used to compare quantitative variables as Mean ± S.D. Person's correlation coefficient was used to determine the association between Conicity Index of the respondents and other variables of the respondents. Data were considered statistically significant at $^*p < 0.05$ and more significant at $^{**}p< 0.01$. The frequencies and percentages of respondents' socio-demographic data were determined.

3.0 Results

Fig. 1, shows the frequency of the respondents' gender, Fig. 2, shows the frequency of the respondent age ranges, Fig. 3, shows the frequency of the respondent faculties. Table 1, shows the significant differences between the male and female anthropometric measurements, body composition, clinical indices and biochemical indices at $^*p <0.05$. Table 2, shows the significant difference and correlation of Conicity Index of the respondents with the body composition, clinical and biochemical indices of the respondents at $^*p <0.05$ and $^{**}p <0.01$.

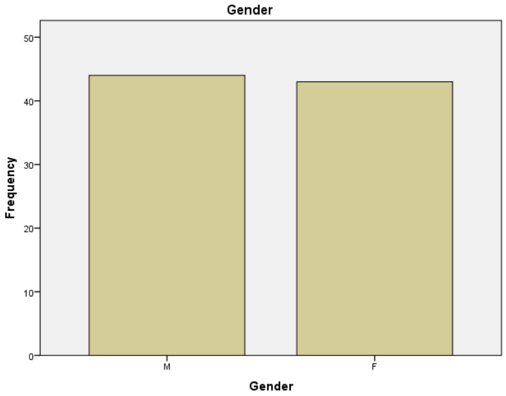

Figure. 1: The frequency of the gender

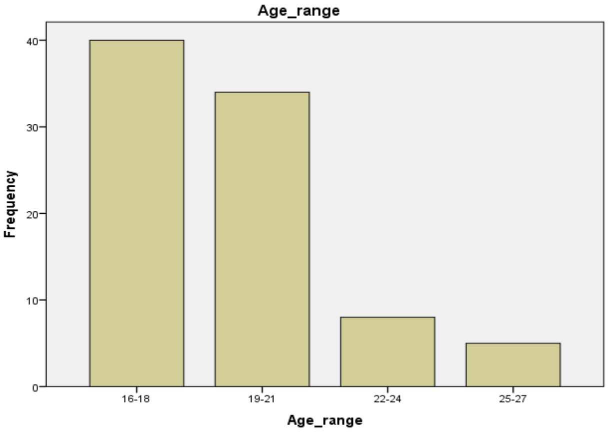

Figure. **2** :The age range of the respondents

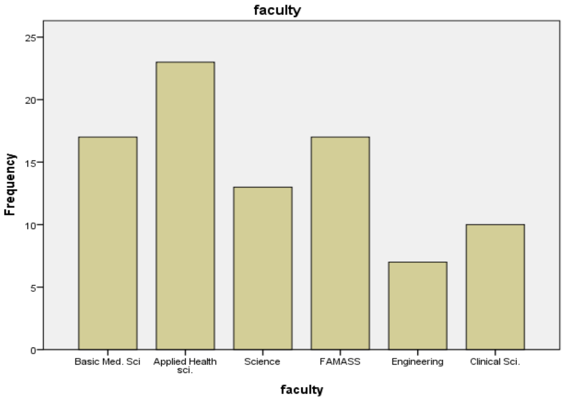

Figure 3: The faculty of the respondents

Table 1: Comparisons of Anthropometric, Body Composition, Clinical and Biochemical Indices in Male and Female Participant

Variable	**Male (n=44)**	**Female (n=43)**	**t**	**p**
Anthropometric Indices	**Mean value ± S.D**	**Mean value ± S.D**		
Weight (kg)	72.21 ± 9.47^{a}	60.19 ± 12.00^{b}	5.192	0.000*
Height (m)	1.76 ± 0.09^{a}	1.65 ± 0.07 ^{b}	6.474	0.000*
Body mass index	23.40 ± 2.97^{a}	22.15 ± 4.18^{a}	1.614	0.110
Waist circumference	0.78 ± 0.08^{a}	0.71 ± 0.10 ^{b}	3.232	0.002*
Hip circumference	0.94 ± 0.08^{a}	0.91 ± 0.10^{a}	1.262	0.210
Middle upper arm circumference	0.28 ± 0.03^{a}	0.26 ± 0.03 ^{b}	3.855	0.000*
Conicity Index	1.12 ± 0.09^{a}	1.09 ± 0.07^{a}	1.707	0.092
Body Composition	**Mean value ± S.D**	**Mean value ± S.D**	**t**	**p**
Fat (%)	20.55 ± 10.38 ^{b}	25.97 ± 8.05^{a}	-2.712	0.008*
Muscle (kg)	62.92 ± 11.85^{a}	45.36 ± 12.02 ^{b}	6.864	0.000*
Water (%)	55.63 ± 2.62^{a}	51.02 ± 4.30 ^{b}	5.509	0.000*
Visceral fat	6.07 ± 3.54^{a}	3.30 ± 3.14 ^{b}	3.432	0.001*
Obesity	8.50 ± 12.43^{a}	5.03 ± 18.79 ^{b}	1.018	0.312
Bone	2.37 ± 2.62^{a}	2.35 ± 0.88^{a}	0.031	0.975
Lean body mass	76.18 ± 120.57^{a}	43.43 ± 5.74^{a}	1.779	0.079
Clinical Indices	**Mean value ± S.D**	**Mean value ± S.D**	**t**	**p**
Pulse rate	81.14 ± 12.42^{a}	82.80 ± 20.11^{a}	-0.466	0.642
Systolic Blood pressure	139.66 ± 151.85^{a}	106.14 ± 10.38^{a}	1.444	0.152
Diastolic blood pressure	77.16 ± 9.64^{a}	74.23 ±10.84^{a}	1.331	0.187
Saturated oxygen pressure	96.04 ± 2.07^{a}	96.70 ±2.94^{a}	-1.199	0.234
Pulse pressure	80.30 ± 11.84^{a}	83.77 ± 13.46^{a}	-1.278	0.205
Biochemical Indices	**Mean value ± S.D**	**Mean value ± S.D**	**t**	**p**
Glucose	106.84 ± 19.79^{a}	117.66 ± 42.20^{a}	-1.393	0.168
Cholesterol	260.11 ± 27.90^{a}	267.80 ± 34.62^{a}	-0.524	0.606

*Values are mean ± SD, *Significant at p<0.05. Same alphabet indicates not significantly different; different alphabets indicate significant difference.*

Table 2: Correlations of Conicity Index with Body Composition, Clinical and Biochemical Indices

Index	**Variables**	**r**	**p**
CONICITY INDEX	**Body Composition**		
	Fat (%)	-0.029	0.793
	Muscle (kg)	0.323	0.002**
	Water (%)	-0.040	0.741
	Visceral fat	0.294	0.013*
	Obesity	0.287	0.007**
	Bone	0.121	0.264
	Lean body mass	0.037	0.735
	Clinical Indices	**r**	**p**
	Pulse rate	0.020	0.854
	Systolic Blood pressure	0.214	0.046*
	Diastolic blood pressure	0.284	0.008**
	Saturated oxygen pressure	0.075	0.490
	Pulse pressure	-0.143	0.188
	Biochemical Indices	**r**	**p**
	Glucose	0.038	0.759
	Cholesterol	0.016	0.942

r =Pearson correlation coefficient. *Significant at p <0.05. **Significant at p <0.01 NB: The correlation value is between ± 0.00 -1

4.0 Discussion

Conicity index is an anthropometric measurement established in 1991 by Valdez that analyzes central obesity and body fat distribution (Valdez, 1991). In this study (Table 1), the body weight was significantly higher in males than in females. This is in agreement with other studies (Lawan *et al.*, 2013; Akram *et al.*, 2019). This is because men have more muscle and heavier bones than women. Healthy men usually weigh more than healthy women of the same height (Akram *et al.*, 2019)**.** Height was significantly higher in males than in female. This is in agreement with other studies (Lawan *et al.*, 2013; Tang *et al.*, 2019). Male growth spurt comes at the end of puberty, not the beginning. This delay gives boys the advantage of an extra two years of normal childhood growth before their final growth spurt. Another reason for their height is that boys grow faster than girls at their peak rate because they have higher levels of testosterone in their bloodstream than girls. During puberty an average boy's production of testosterone will increase (Tang *et al.*, 2019). In this study**,** the waist circumference (WC) was found to be significantly higher in males than in females. Studies have shown similar report (Stevens *et al.*, 2010; Lawan *et al.*, 2013; Akram *et al.*, 2019). This is due to the high accumulation of abdominal fat in male than in females (Stevens *et al.*, 2010). In this study, fat was found significantly higher in female than in male; this is also in agreement with other studies (Blaak, 2001; Betty and Anthony, 2011). There are indications that basal fat oxidation (adjusted for fat-free mass) is lower in females as compared to males, thereby contributing to higher fat storage in women (Blaak, 2001). It is possible that ovarian hormones, particularly oestrogen, may also account for these observations by promoting postprandial conversion of dietary energy into fat, especially during natural hyper-oestrogenic states such as pregnancy. (Betty and Anthony, 2011). Visceral fat was significantly higher in males than females in this study. This was seen in other studies done by (Blaak, 2001; Nauli and Matin, 2019). Men have a higher tendency to accumulate abdominal visceral fat compared to pre-menopausal women (women that have not reached menopause) (Blaak, 2001). The accumulation of abdominal visceral fat in men is because the chylomicrons in men are generally bigger in size and more in quantity than those in women. This is due to the high dietary fat that is absorbed by the enterocytes and transported to the circulation in the forms of chylomicrons and Very Low Density Lipoproteins (VLDLs) in men than in women (Nauli and Matin, 2019**).** In this study, conicity index (CI) was seen to have statistically significance with blood pressure (Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP)) but a higher significance with DBP than SBP, it also showed a positive correlation and direct relationship with the blood pressure this implies that the higher or lower the blood pressure, the higher or lower the conicity index values. This was also shown in a study done by Sousa *et al.,* (2020). The study found that the greater the CI values, the higher the SBP and DBP values, making the CI an essential element in the diagnosis of hypertension and a possible indication of cardiovascular disease (Sousa *et al.*, 2020). The CI showed a weak positive and negligible correlation with pulse rate in this study (Table 2). This is seen also in studies done by Godfrey *et al.*, 2021 and Mbelege *et al.*, 2021. In (Table 2), CI had a negative correlation with pulse pressure which was not significant. CI showed a significantly positive correlation with obesity at $*p < 0.05$ this implies that the values of CI is directly related to obesity as shown in a study by Mbelege *et al.*, 2021. This also implies that CI could be used as a predictor of obesity. In this study, CI showed some correlation with random blood glucose level and total cholesterol; this could imply that CI may be a predictor of diabetes mellitus, hypercholesterolemia and dyslipidemia (Mirelli *et al.*, 2016).

5.0 Conclusion

It can be concluded that conicity index had a correlation with clinical and biochemical indices. This makes it a factor for predicting cardiovascular disease, hypertension, and central obesity and may be a predicting factor for diabetes mellitus and dyslipidaemia.

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