CORRELATION OF NECK AND WRIST CIRCUMFERENCE WITH VARIOUS ANTHROPOMETRY INDICES AMONG STUDENT OF AFE BABALOLA UNIVERSITY, ADO-EKITI (ABUAD)

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Abstract

Aim of study: The aim of this study is to determine the prevalence of obesity among students at Afe Babalola University in Ado Ekiti and its connection to anthropometry indices. **Patients and methods:** Type of study is cross sectional study. Afe Babalola University was the site of the study, with samples drawn at random from students at the several colleges. The age considered was between 18-25 years old of both male and female. Using the formula BMI=weight in Kg/height in meter squared, we assessed height using a tape measure and weight using a weighing scale. **Result:** Out of the 113 male students, 59.3%, 9.7%, 18.6%, and 12.4% were normal weight, underweight, overweight, and obese, whereas out of the 161 female students, 52.2%, 8.7%, 27.3%, and 11.8% were normal weight, underweight, overweight, and obese respectively. A significant positive correlation is found between neck circumference and the BMI, waist circumference, in female normal weight. A significant positive correlation is found between neck circumference and the waist circumference, in female overweight and obese group respectively. A significant positive correlation is found between wrist circumference and the waist circumference, hip circumference in male normal, while a positive significant correlation was observed between wrist circumference and height, BMI, waist circumference and weight in female normal. A significant positive correlation is found between wrist circumference and the height, weight in male overweight group, while a positive significant correlation was observed between wrist circumference and hip circumference, weight in female overweight. In the obese group a significant positive correlation was observed between the wrist

circumference with the height and waist to hip ratio in male while waist to hip ratio in female. **Conclusion:** Neck and wrist circumference had significant positive correlation with waist circumference and BMI in the female than male subject at normal, overweight and obese.

Keywords: BMI, Neck circumference, Waist circumference, Height, obese.

INTRODUCTION

Obesity is increasing at an alarming rate in both industrialized and developing nations [1]. This has been associated with the metabolic syndrome, which raises the risk of type 2 diabetes and cardiovascular illnesses through factors like insulin resistance, hypertension, and dyslipidemia. [2, 3].

As a result of its simplicity to do on a broad scale, BMI has been utilized by health professionals for the majority of time to quantify and classify obesity. However, this does not accurately reflect the body's actual makeup. Measurement of the waist circumference is a more accurate indicator of visceral obesity, which is directly related to circulating cholesterol levels and associated with coronary artery disease [4]. For the diagnosis of metabolic syndrome, waist circumference is regarded as a key factor [5], however, it can be challenging to obtain an accurate waist measurement for a variety of reasons, including poor body exposure, particularly in the winter, busy primary care practices, the location of the measurement, and others.. So alternative to this measurement for a practical point of view is needed.

The distribution of upper body fat according to neck circumference has been reported to be an indicator of obesity in patients [6- 10], and also found to be related to cardiovascular risk factors in severely obese men and women [6]. With age, weight, waist-to-hip ratio, waist-to-hip circumference, and BMI for both sexes, measurements of neck circumference have recently been used to detect overweight and obesity [11].

The aim of this study was to correlate wrist and neck circumference with waist circumference in various BMI groups as alternatives for measuring obesity.

Material and Methods

The present study comprised of 274 (113 males; 161 females) individuals, between 16- 30 years of ages, studying in Afe Babalola University Ado Ekiti, Ekiti State, Nigeria. Out of the 113 male students, 59.3%, 9.7% 18.6% and 12.4% were normal, underweight, overweight and obese respectively while out of the 161 female students, 52.2%, 8.7%, 27.3% and 11.8% were normal, underweight, overweight and obese respectively

To minimize subjective errors all the measurements were taken twice and then mean was taken. The data thus obtained was subjected to statistical calculations using Correlation coefficient which was prepared on the basis of collected data. Graph Pad Prism 5 (Version 5.03, Graph pad Inc.) was the statistical package used for data analysis.

Materials Used for the Research

Improvised Standimeter (for measuring stature),

Cardboard Paper, Long Transparent Ruler,

Writing Materials, Flexible Tape and Sliding

Caliper

Method of Data Collection

Sampling

A sample of Two hundred and seventy four (274) students comprising of forty one percent (41) males and fifty nine percent females (59), were randomly selected from the students of Afe Babalola University Ado Ekiti. All participant were healthy students in the age range of sixteen to thirty (16-30) and it was ensured that none has skeletal deformity.

Stature Measurement

The stature is measured as vertical distance from the vertex to the floor with the subject bare footed standing erect on horizontal plane using the standimeter calibrated in (cm). An improvised standimeter constructed as a straight rule starting on a base. The subjects were asked to stand erect with their feet flat on the floor with their heels together and the weight evenly distributed between both feet. The subjects stood erect with the Frankfort plane (line passing horizontally from the ear canal to the lowest point of the eye orbit) of his head parallel to the floor. Measurement was taken with an anthropometer from the ground to the highest point on the subject's head while firmly contacting the scalp. The measurement was recorded in centimeters [12].

Weight Measurement

Waist and Neck Measurement

Statistical Analysis

Correlation coefficient was prepared on the basis of collected data and their distributions, central tendencies and standard deviations (S.D.) were calculated. Gender differences for the parameters were determined using one way Anova.

Pearson's correlation coefficient (r) was used to examine the relationship between four anthropometric parameters and standing height (stature).

Graph Pad Prism 5 (Version 5.03, Graph pad Inc.) was the statistical package used for data analysis. Significant difference was set at $p < 0.05$.

RESULTS

Table 1: Shows the Gender and Weight Differences of Anthropometric Parameters

		Normal	Underweight	Overweight	Obese
Height (cm)	Female	166.2 ± 6.115	168.3 ± 5.788	165.7 ± 6.852	164.9 ± 6.059
	Male	164.2 ± 29.76	175.4 ± 6.626	180.9 ± 7.719 $^{\alpha\ \beta}$	178.7 ± 4.950 $^{\beta}$
Weight (Kg)	Female	60.50 ± 6.887	49.14 ± 3.820 $^{\beta}$	74.41 ± 5.974 $^{\beta\delta}$	93.11 ±13.25 $^{\beta\ \delta\yen}$
	Male	88.52 ± 42.09 $^{\alpha}$	54.00 ± 3.550 $^{\beta}$	88.29 ± 7.274 $^{\alpha\ \beta\delta}$	110.1 ± 25.09 $^{\alpha\ \beta\delta\yen}$
BMI (kg/m^2)	Female	21.86 ± 1.727	17.35 ± 0.8781 $^{\beta}$	27.09 ± 1.434 $^{\beta\delta}$	34.17 ± 3.835 $^{\beta\delta\yen}$
	Male	21.97 ± 1.599	17.56 ± 0.8879 $^{\beta}$	26.97 ± 1.550 $^{\beta\delta}$	34.30 ± 6.291 $^{\beta\delta\yen}$
Waist Circumference	Female	74.36 ± 5.347	66.93 ± 3.892 $^{\beta}$	82.53 ± 5.705 $^{\beta\delta}$	96.63 ± 7.261 $^{\beta\delta\yen}$
	Male	77.99 ± 5.487$^{\alpha}$	70.00 ± 4.290 $^{\beta}$	91.21 ± 6.758$^{\alpha\ \beta\delta}$	105.4 ± 11.67$^{\alpha\ \beta\delta\yen}$
Neck Circumference	Female	33.63 ± 2.024	33.11 ± 2.322	34.53 ± 1.831	36.58 ± 2.063
	Male	39.05 ± 6.499 $^{\alpha}$	35.77 ± 1.723$^{\beta}$	41.02 ± 1.735$^{\alpha\ \beta\delta}$	41.86 ± 2.107 $^{\alpha\ \beta\delta}$
Hip Circumference	Female	96.12 ± 10.90	89.21 ± 3.766 $^{\beta}$	108.5 ± 5.768 $^{\beta\delta}$	119.0 ± 9.371 $^{\beta\delta\yen}$
	Male	95.97 ± 9.649	88.05 ± 4.698 $^{\beta}$	106.9 ± 8.759 $^{\beta\delta}$	117.8 ± 4.419 $^{\beta\delta\yen}$
Waist to hip ratio	Female	0.8367 ± 0.654	0.7514 ± 0.03880	0.7620 ± 0.04811	0.8137 ± 0.0519
	Male	0.8234 ± 0.141	0.7964 ± 0.03613	0.8600 ± 0.1053	0.8929 ± 0.0783
Wrist Circumference	Female	16.14 ± 1.482	15.57 ± 0.9169	17.14 ± 0.8784 $^{\beta\delta}$	18.18 ± 1.169 $^{\beta\delta\yen}$
	Male	17.82 ± 1.144$^{\alpha}$	16.36 ± 0.8970 $^{\beta}$	18.62 ± 0.8501$^{\alpha\ \beta\delta}$	19.71 ± 0.7263$^{\alpha\ \beta\delta\yen}$

$^{\alpha}$ = significant different between Male and Female.

$^{\beta}$ = significant different between (Underweight, Overweight, Obese) and Normal.

$^{\delta}$ = significant different between (Overweight, Obese) and Underweight.

$^{\yen}$ = significant different between Obese and Overweight.

Table 2: Shows the Correlation between neck circumference with BMI and waist circumference of Normal and Underweight students

	Normal				Underweight			
	Male		Female		Male		Female	
Variables	Pearson Coefficient (r)	P Value	Pearson Coefficient (r)	P value	Pearson Coefficient (r)	P value	Pearson Coefficient (r)	P value
BMI	0.0007	0.99	0.37	0.0005	-0.43	0.19	0.10	0.7
Waist Circumference	-0.09	0.47	0.44	0.00003	0.45	0.17	0.22	0.4

In this study a significant positive correlation is found between neck circumference and the BMI (0.37), waist circumference (0.44), in females with normal weight (Table 2)

Table 3: Shows the Correlation between neck circumference with BMI and waist circumference of Overweight and Obese students

	Overweight				Obese			
	Male		Female		Male		Female	
Variables	Pearson Coefficient (r)	P value	Pearson Coefficient (r)	P Value	Pearson Coefficient (r)	P value	Pearson Coefficient (r)	P value
BMI	-0.16	0.50	0.10	0.50	0.43	0.12	0.31	0.2
Waist Circumference	-0.03	0.91	0.53	0.0002	0.46	0.10	0.44	0.05

A significant positive correlation is found between neck circumference and the waist circumference (0.53, 0.44), in overweight and obese females respectively (Table 3)

Table 4: Shows the Correlation between Wrist Circumference with some Anthropometric Indices of Normal and Underweight students

Variables	Normal				Underweight			
	Male		Female		Male		Female	
	Pearson Coefficient (r)	P Value	Pearson Coefficient (r)	P value	Pearson Coefficient (r)	P value	Pearson Coefficient (r)	P value
Height (cm)	0.21	0.09	0.27	0.009	0.09	0.79	0.26	0.36
BMI	0.22	0.07	0.28	0.01	0.19	0.57	0.25	0.38
Waist circumference	0.36	0.003	0.27	0.007	0.38	0.25	0.01	0.97
Hip circumference	0.34	0.005	0.02	0.83	0.03	0.94	0.26	0.36
Waist to hip ratio	-0.10	0.4	0.08	0.49	0.51	0.11	-0.22	0.45
Weight (kg)	-0.07	0.6	0.37	0.0005	0.25	0.46	0.40	0.15

A significant positive correlation is found between wrist circumference and the waist circumference (0.36), hip circumference (0.34) in normal males, while a positive significant correlation was observed between wrist circumference and height (0.27), BMI (0.28), waist circumference (0.27) and weight (0.37) in normal females. (Table 4)

Table 5: Shows the Correlation between Wrist Circumference with some Anthropometric Indices of Overweight and Obese students

Variables	Overweight				Obese			
	Male		Female		Male		Female	
	Pearson Coefficient (r)	P value	Pearson Coefficient (r)	P value	Pearson Coefficient (r)	P value	Pearson Coefficient (r)	P value
Height (cm)	0.54	0.01	0.07	0.06	0.54	0.05	0.20	0.42
BMI	0.14	0.56	0.29	0.66	0.19	0.53	0.12	0.62
Waist circumference	0.37	0.10	0.27	0.07	0.49	0.07	0.33	0.16
Hip circumference	0.13	0.57	0.32	0.04	0.09	0.76	-0.14	0.58
Waist to hip ratio	0.16	0.49	0.02	0.88	0.58	0.03	0.58	0.009
Weight (kg)	0.65	0.001	0.33	0.03	0.28	0.33	0.20	0.40

A significant positive correlation is found between wrist circumference and the height (0.54), weight (0.65) in overweight male group, while a positive significant correlation was observed between wrist circumference and hip circumference (0.32), weight (0.33) in overweight female. In the obese group a significant positive correlation was observed between the wrist circumference with the height (0.54) and waist to hip ratio (0.58) in male while waist to hip ratio (0.58) in females (Table 5).

DISCUSSION

This study, which was conducted on some male and female students of Afe Babalola University Ado Ekiti, focuses on the correlation between neck and wrist circumference and several anthropometry indices. The waist circumference of both overweight and obese female students as well as female subjects/students with normal body weight

showed a significantly positive connection with the neck circumference and the BMI. One of the most accurate anthropometrical indices of abdominal fat has been found to be waist circumference [13]. It also has a high correlation with waist to hip ratio. In evaluating obesity and associated health risks, newer metrics like the neck and wrist circumference have proven to be even more conclusive and precise. According to a Brazilian study, males with necks longer than 15 inches may be more susceptible to heart disease [14]. This is a definite sign that neck circumference is an important anthropometric measurement that can be used instead of waist circumference given the challenges with using waist circumference to diagnose obesity and metabolic syndrome. According to the study's findings, there was no significant positive correlation between the male subject's neck circumference, BMI, and waist circumference across all categories. A study that contradicted ours revealed a tenuous correlation between neck circumference and body mass index (BMI) [14]. The results of this investigation also revealed a moderate correlation between neck and waist circumference. A weak to moderate correlation between the neck circumference and adult males' body mass index was discovered in a Chinese study, which is consistent with ours. Studies conducted in India by Aswathappa *et al* [14] was in correlation with the study carried out by Ukoha et al [15] as it showed moderate correlation between the neck circumference of the males males. Our investigation was refuted by its findings, which indicated a tenuous correlation between female body mass index and neck circumference. This recommends that the assessment of waist circumference and BMI using the neck circumference as an alternate index should be done on female participants rather than male individuals. A significant positive correlation is found between wrist circumference and the waist circumference, hip circumference in male normal, also with height, BMI, waist circumference and weight in female normal. This is an indication of a dimorphism in the gender. This connotes that wrist circumference measurement may be used as an alternative to waist circumference in the determination of obesity and metabolic syndrome in male and female subjects. It can also be used to predict height, weight and BMI in the female while hip circumference in male subjects with normal weight. This was in correlation with them study carried out by Karki *et al* [16] which showed a positive correlation with waist and wrist circumference in females and a positive correlation between wrist circumference and the weight of both sexes. Studies by Vasily *et al* [17] showed moderate positive correlation between wrist circumference and BMI which is sparingly in correlation to our study.

In the overweight group, a significant positive correlation is found between wrist circumference and the height, weight in male subjects, and also with hip circumference, weight in female subjects. This also suggests the efficacy of wrist circumference measurement in determining the weight of overweight male and female subjects, height of overweight male subject and the hip circumference of overweight female subject. Wrist circumference on the other can be used to get the body frame size and measure the ideal body weight of a person [18]. This is because wrist circumference has a significant correlation with height. Also in the obese group a significant positive correlation was observed between the wrist circumference with the height and waist to hip ratio in male

while waist to hip ratio in female. This suggests the effectiveness of wrist circumference measurement as an alternative index to determine waist to hip ratio of an obese subjects.

We conclude that based on the strong correlation evident among the attributes considered and studied, neck circumference can be a simple, fast and cheap method for early prediction of cardiovascular risk factors and diseases as it shows a significant correlation with waist circumference, waist to hip ratio and body mass index (BMI). Also, wrist circumference may be a substitute or supplement parameter in accessing obesity especially when other measures of obesity like body mass index (BMI) or waist circumference measurement are difficult, or inaccessible or not feasible. This is because wrist circumference showed a significantly positive correlation with waist circumference, body mass index (BMI), hip circumference and waist to hip ratio. All these therefore make neck and wrist circumference viable parameters for accessing obesity and other health risks associated with this phenomenon.

Acknowledgments

Conflict of interest

The authors have no conflict of interest to declare

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