

Prediction of Waist Circumference from Neck Circumference: Implications for Tailors Working in Muslim Conservative Environment

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Abstract

There has been an old adage commonly by women that if one can wrap the width of the waist of his pants around the neck, then the pants will fit. The aim of this study was to scientifically evaluate whether there is relationship between neck circumference (NC) and waist circumference (WC) and also to formulate a simple regression equation for estimation of waist circumference from neck circumference. Apparently, healthy students from Bayero University Kano were selected for this cross-sectional study with a total of 385 subjects males (192) and females (193) participants aged between 16-35 years. Neck and waist circumferences were measured using a non-stretchable plastic measuring tape according to International Standards for Anthropometric Assessment. The result of this study shows positive correlation between neck circumference and waist circumference in both males ($r = 0.64$, $P < 0.001$) and females ($r = 0.66$, $P < 0.001$). Neck and waist circumference were higher in males than in females ($P < 0.001$). The regression equation derived for males is $[WC (cm) = 2.139 \times NC (cm) - 1.449; r^2 = 0.404]$ and that for females is $[WC (cm) = 2.578 \times NC (cm) - 8.007; r^2 = 0.432]$, $p < 0.001$. The ratio factor of waist to neck circumference was not exactly 2 as held in the Hausa adage.

This study shows that neck circumference correlates positively with waist circumference and that neck circumference could be used as a reliable measurement to estimate waist circumference.

Keywords: Waist Circumference, Neck Circumference, Correlation, Tailor.

INTRODUCTION

Since prehistoric times, a quite number of people had tried to learn the proportions of the human body. Then, scientists used the "golden ratio" (approximately 1.618), which is believed to be the equation that determines what is aesthetically attractive (reference). For example, *Leonardo da Vinci* applied the golden ratio in many of his works (Lester, 2011). The ancient Greeks too used the golden ratio to determine certain specific proportions of the "ideal" male. One of these proportions is the link between waist and neck circumference. In which case, waist circumference would be about twice neck circumference. Anthropometry has wide application in forensics, clinical medicine, and

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design of prosthetics as well as in clothing industry as it tends to give predictive correlation between various bodies parts essential for design.

There has been an old adage commonly by women that if one can wrap the width of the waist of one's pants around the neck, then the pants will fit. On the other hand, if the ends of the waistline do not meet at the back of one's neck, the pants may be tight and if the waistline overlaps, the pants may be saggy. Given the fact that our bodies grow proportionally, this should work no matter what size one's neck is; an exception is the obese individuals (Cindy, 2013).

This assumption has been a practice in most rural areas and as well in urban settings of northern Nigeria when the actual measurement of the body is not possible due to either religious beliefs, absence of measuring tools or even inadequate time in market place. Appropriate measurements of body parts are significant part of sewing in the fashion industry. Many body measurements with respect to the fashion industry include neck, waist and hip measurements among others (Oghenemavwe and Asuai, 2016). Deliberate and intentional understanding of the correlations of these body parts is also essential in tailoring especially in a conservative cultural, religious and traditional society. The aim of this study was to evaluate the relationship between neck circumference and waist circumference as well as to formulate a simple regression equation for estimation of waist circumference from neck circumference.

METHODOLOGY

Apparently, healthy students from College of Health Sciences, Bayero University Kano were selected for this cross-sectional study with a total of 385 subjects males (192) and females (193) participants aged between 16-35 years. We included students that gave their consent to participate in the study and excluded those with physical deformity or abnormality in their waist and neck region that could hinder accurate measurement or females students who are Pregnant.

Anthropometric Measurements

A non-stretchable plastic measuring tape (HT TEX model, china) was used in measuring girths (to the nearest 0.1 centimeters). Neck and waist circumferences were measured using a non-stretchable plastic measuring tape according to International Standards for Anthropometric Assessment.

Neck circumference

The participants were asked to look straight ahead with the head oriented in the Frankfort horizontal plane, and with shoulders down, but not hunched. Neck circumference was measured to the nearest 0.1cm using a non-stretchable plastic measuring tape placed in a horizontal plane, at the level of the inferior border of the thyroid cartilage or just below the laryngeal prominence (Adam's apple) in men, and perpendicular to the vertical axis of the neck (Hall *et al.*, 2007).

Waist circumference

The participants were asked to stand with the arms at the sides, feet positioned close together, and weight evenly distributed across the feet. Waist circumference was measured to the nearest 0.1cm at the approximate midpoint between the lower margin of the last palpable rib and the upper margin of the iliac crest at the end of normal expiration, using a non-stretchable plastic measuring tape snug around the body (WHO, 2011). Measurements were taken in light clothing.

Statistical Analysis

The data were summarized using frequencies and percentages for qualitative variables, and means and standard deviations for quantitative variables and analyzed using IBM SPSS (Statistical Package for Social Sciences) version 24.0. Pearson's correlation was used to assess the relationship between neck circumference and waist circumference while independent t-test was used to determine sexual dimorphism in the variables. A linear regression analysis was performed to establish linear regression equation in which waist circumference can be estimated from neck circumference. A *p* value of <0.05 was considered to be significant.

RESULTS AND DISCUSSION

Table 1, shows the socio-demographic characteristics of the study population. The mean age of all participants was 21 ± 3 years. The mean waist and neck circumferences were 72.47 ± 7.35 cm and 32.93 ± 2.99 cm respectively. Descriptive statistics of the studied population was shown in Table 2.

Table 3 shows the correlation of waist circumference with neck circumference as well as the ratio factor of waist to neck circumference. Waist circumference correlates positively with neck circumference in both male and female participants ($P < 0.001$). The ratio factor of waist to neck circumference was 2.1 for males and 2.3 for females.

Table 4 shows sexual dimorphism in waist circumference and neck circumference. There was statistically significant ($P < 0.001$) sexual dimorphism in both neck circumference and waist circumference with males having higher values of neck and waist circumferences when compared with their female counterparts.

Table 5 shows simple linear regression equations for estimation of waist circumference from neck circumference. The equation is statistically significant in both sexes. The equation is more accurate in females than in males. The values of the Pearson's coefficients of determination (R^2) signified that neck circumference significantly predicts waist circumference in both sexes.

Table 1: Socio-demographic Characteristics of the Study Population

Variables	Frequency (n)	Percentage (%)
Age group (years)		
16-20	182	47
21-25	159	42
26-35	44	11
Sex		
Male	192	49
Female	193	51
Ethnicity		
Hausa/Fulani	337	87
Yoruba	30	8
Igbo	16	4
Others	2	1

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Table 2: Descriptive Statistics of the Study Population and Measured Variables

Variables	All (n=385)	Min - Max	Male (n= 192)	Min - Max	Female (n= 193)	Min - Max
	Mean ± SD		Mean ± SD		Mean ± SD	
Age (years)	21.20 ± 2.77	16-35	22.13 ± 3.19	17-35	20.28 ± 1.89	16-27
Neck circumference (cm)	32.93 ± 2.99	25.00-41.00	35.17 ± 2.04	30.50-41.00	30.72 ± 1.94	25.00-40.00
Waist circumference (cm)	72.47 ± 7.35	50.00-116.00	73.79 ± 6.86	60.00-116.00	71.17 ± 7.61	50.00-109.00

Min: Minimum, Max: Maximum, SD: Standard Deviation

Table 3: Pearson's Correlation of Waist Circumference with Neck Circumference

Sex	Ratio Factor WC to NC	Pearson's Correlation Coefficients (r)	P
Male	2.10	0.64	<0.001*
Female	2.32	0.66	<0.001*

WC = waist circumference, NC = neck circumference. *Statistically significant

Table 4: Sexual Dimorphism in Neck Circumference and Waist Circumference

Variables	Male (n = 192)	Female (n = 193)	T	P
	Mean ± SD	Mean ± SD		
Neck circumference (cm)	35.17 ± 2.04	30.72 ± 1.94	21.94	<0.001*
Waist circumference (cm)	73.77 ± 6.86	71.17 ± 7.61	3.517	<0.001*

SD: Standard deviation, *: Statistically significant

Table 5: Linear Regression Equations for Estimation of Waist Circumference from Neck Circumference

Sex	Regression Equation	R	R ²	SEE	P
Male	WC = (2.139 ×NC) + (-1.449)	0.636	0.404	5.751	<0.001*
Female	WC = (2.578 ×NC) + (-8.007)	0.657	0.432	5.307	<0.001*

NC: Neck circumference, WC: Waist circumference, *: Statistically significant

DISCUSSION

The results of the present study indicated that there is a positive correlation between neck circumference and waist circumference. This is in agreement with other studies conducted elsewhere which a positive correlation was found between neck circumference and waist circumference in both males and females (Ben-Noun and Loar, 2003, 2006; Arnold *et al.*, 2013; Aswathappa *et al.*, 2014; Karki *et al.*, 2014; Saka *et al.*, 2014; Joshipura *et al.*, 2016; Moazezi *et al.*, 2016; Verma *et al.*, 2017; Patil *et al.*, 2018; Pei *et al.*, 2018; Sharma *et al.*, 2018).

Similarly, the study of Hingorjo *et al.* (2012) found strong positive correlation between neck and waist circumferences in males but moderately positive among their females counterparts. Equally, the study conducted by Özkaya and Tunçkale (2016) in which the correlation was found to be moderately positive in males and weak in females.

Some studies in Nigeria found weak positive correlation between neck and waist circumferences in both males and females (Adamu *et al.*, 2013; Ese and Nneka, 2016). The disparity with the present study could be explained by the fact that Adamu *et al.* (2013) used much smaller sample size compared to the present study predisposing their study to Type I error. Ese and Nneka (2016), on the other hand, found weak correlation between neck circumference and a waist circumference measure taken at the upper border of iliac crest; the present study used a different method of measuring waist circumference accounting for the disparity in the findings.

Our result also shows that there was difference based on sex in neck circumference and waist circumference, showing that the population exhibits sexual dimorphism with the males having significantly higher values of neck circumference and waist circumferences than females. This also agrees with the reports of other studies (Adamu *et al.*, 2013; Aswathappa *et al.*, 2014; Özkaya and Tunçkale, 2016; Sharma *et al.*, 2018).

The regression coefficients of 2.139 in males and 2.578 in females were found from the results of linear regression equation. Pearson's coefficients of determination (R^2) were 0.404 in males and 0.432 in females. This shows that neck circumference could be used to estimate waist circumference even though not as exactly as it was assumed (i.e twice). Ucheya *et al.* (2009) in Nigeria found a regression coefficient of 0.198 ($R^2 = 0.21$) in males, however, their study used a hybrid method of measuring neck circumference; one using the point below the laryngeal prominence and another using midway of the neck. Another study in Nigeria reported a regression coefficient of 1.277 ($R^2 = 0.23$) in males and 0.941 ($R^2 = 0.12$) in females (Ese and Nneke, 2016). As mentioned earlier, the disparity with the present study might be explained by methodological differences in measuring waist circumference. Hingorjo *et al.* (2012), in their study among dental students, reported a regression coefficient of 0.184 ($R^2 = 0.735$) in males and 0.134 ($R^2 = 0.387$) in females; the disparity with the present study can be explained by racial differences in anthropometrics between the subjects of the two studies.

The ratio factor of waist to neck circumference was not exactly 2.0 in either sex though it is closer to this value for males. This is in agreement with what Ese and Nneka (2016) found in a study among members of a university community in Nigeria.

CONCLUSION

This study shows that neck circumference correlates positively with waist circumference and that neck circumference could be used as a reliable measurement to estimate waist circumference in such conservative environment. The ratio factor of waist to neck circumference was not exactly twice as held in the Hausa adage.

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