ORIGINAL ARTICLE

Neck Circumference as A Sampling Tool to Identify Overweight and Obesity

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ABSTRACT

Objectives: To assess the practicality of neck circumference in categorizing individuals into obese and non-obese categories and identifying its appropriate cutoff points in young adults.

Methods: A cross-sectional study was performed from 2018 January to 2018 April and comprised of students between 18 to 35 years of age. Anthropometric measurements of study participants were recorded such as; weight, height, waist circumference (WC), neck circumference (NC), and BMI by following standard protocols using tape measure and calculator. Obesity and overweight levels were also categorized according to WHO values.

Results: The mean BMI was lower in females in contrast to males. Mean WC and NC was also higher in males as compared to females. In both gender, neck circumference had a significant association with relevant indicators. Cut-off points for obesity in males and females were 39.38cm and 33.28cm respectively.

Conclusion: This study indicates that neck circumference strongly correlates with other signs/symptoms of obesity in both women and men and is therefore a valid tool for identification of obese individuals. It is a simple and inexpensive tool which can be used at any work place.

Keywords: Neck circumference, Body mass index, Overweight, Obesity.

INTRODUCTION

One of the biggest challenge to the healthy body is being overweight. Severe overweight or obesity is a key risk factor in the development of many chronic disease such as heart and respiratory diseases, Type 2 diabetes mellitus, hypertension as well as early death. Obesity and overweight are serious problems that pose a huge and growing financial burden on national resources. However, the conditions are largely preventable through sensible lifestyle changes.

Obesity is defined as, an excessive fat accumulation in adipose or fat tissues of the human body leading to health issues. The underlying cause is a positive energy balance leading to weight gain i.e. when the calories consumed exceed the calories expended.

To determine obesity, various methods are being used by doctors and health professionals. The most widely used tool to determine weight is Body Mass Index (BMI). Despite being a simple tool for assessing obesity, BMI is not very effective in illustrating central obesity which is the chief predictor for obesity related disorders. Alternative methods have been proposed by researchers such as waist to hip ratio (WHR) and waist circumference (WC) but each has certain drawbacks. For example, hip and waist circumference is time consuming and is also not accepted culturally in many parts of the world. Also, the waist circumference is influenced by eating leading to abdominal distension.

One of the new methods with promising effectiveness is using neck circumference (NC) as an assessing tool. Measurement of NC is easy, less time consuming and culturally acceptable method. The aim of our research was to compare NC with other commonly used anthropometric indices of obesity such as WC and BMI. We also intended to define the NC cutoff values for our study population.

METHODS

This cross-sectional study was conducted from 2018 January to 2018 April. The subjects were all students with ages ranging between 18 to 35 years. This study was approved by Research and Ethics Committee of Jinnah Medical and Dental College and written informed consent was obtained from each study participant. Total 3624 subjects from various colleges and universities of Karachi were selected for the study. Subjects who were chair bound, had thyroid nodules or neck injuries were refused to participate and excluded from the study. The data was collected by 9 medical students under the guidance of a professor.

During routine clinical assessment the subjects were weighed using standard home weighing scale with an accuracy of 0.1 kg. Weight of study participants was measured without shoes. Height of subjects were also measured by removing shoes by using a wall fixed height ruler having an accuracy of 0.1cm. Obesity was expressed through the body mass index (BMI)(kg/m^2). The neck circumference was measured by simply wrapping the measuring tape around the neck. We used a flexible measuring tape and took the measurement while the subject was standing and looking straight ahead with their shoulders relaxed and fallen. Waist circumference was measured while the individual was upright with normal breathing rate and at the level of the umbilicus.

Subjects were specified into male and female genders and their BMI values were calculated using the standard formula. Data was analyzed using SPSS-21 software.

RESULTS

There were 1833 (50.6%) males and 1791 (49.4%) were females. Table 1 shows the anthropometric measurements of the study participants. No significant difference in the mean BMI between the two genders (22.53 kg/m^2 in males; 21.37 kg/m^2 in females) was found, whereas, the mean waist circumference and neck circumference were considerably higher in males (84.52±8.47 cm, and 37.04±3.17 cm) than females (77.18±9.70 cm, and 32.79±2.95 cm) respectively.

The participants were categorized into four groups; normal weight, underweight, obese and overweight using BMI as reference following the WHO criteria specified for the Asian population (Table-2). The highest percentages (42.38%) of subjects were found to be in the normal weight category. The second highest percentage (23.34%) of participants fell in the overweight category followed by underweight (22.27%) and obese (12.00%). The mean BMIs were found to be 17.04±1.25 for underweight, 20.63±1.20 for normal weight, 24.78±1.10 for overweight and 30.33±3.25 for obese with 95% confidence intervals.

Comparison between Neck Circumference and Commonly Used Anthropometric Indices of Obesity was done by Pearson's-

Correlation Coefficient (Table-3). In both the genders, NC was significantly related with body mass index (in female's r = 0.484, p<.001 and in male's r = 0.157, p<.001); and also with waist circumference (in male's r = 0.378, p<.001 and in female's r = 0.336, p<.001).

ROC analysis indicated that at 95% confidence interval the area under the curve (AUC) for neck circumference for males was 0.805±0.016) and for females 0.724±0.019). The cut off data obtained for NC were 39.38 cm in males (sensitivity 60.5%, specificity 9.8%) and 33.28 in females (sensitivity 68.8%, specificity 29.8%).

Table 1: Descriptive Data of Study Participants, N = 3624

	Mean (SD)	[95% CI]	Range
Age, years	22.64 (4.17)	[22.51-22.78]	16 – 35
Weight, kg	61.55 (13.78)	[61.10-62.00]	25 – 129
Height, m	1.68 (0.11)	[167.54-168.2]	121.92 – 204.22
*BMI, kg/m^2	21.96 (4.35)	[21.82-22.10]	9.57 – 41.70
**WC, cm	81.06 (10.83)	[80.70-81.41]	33.02 – 142.00
***NC, cm	35.04(4.33)	[34.90-35.18]	21.90 – 91.44
*BMI, body mass index; **WC, waist circumference; ***NC, neck circumference			

Table 2: BMI Categorization According to International Standards

BMI*groups	N (%)	BMI (kg/m^2)**	[95% CI]***	Reference Range
Under-weight	807 (22.27%)	17.04 ± 1.25	[16.95, 17.12]	9.57 – 18.50
Normal-weight	1536 (42.38%)	20.63 ± 1.20	[20.57, 20.69]	18.53 – 22.98
Over-weight	846 (23.34%)	24.78 ± 1.10	[24.70, 24.85]	23.00 – 26.90
Obese	435 (12.00%)	30.33 ± 3.25	[30.02, 30.63]	27.00 – 41.70
*BMI:body mass index,**Values expressed as mean ± SD, ***CI:confidence interval				

Table 3: Comparison between Neck Circumference and Commonly Used Anthropometric Indices of Obesity by Pearson's-Correlation Coefficient (r)

	All		Males		Females	
	R	p-value	r	p-value	r	p-value
BMI*	.409	< .001	.157	< .001	.484	< .001
WC**	.371	< .001	.378	< .001	.336	< .001
*body mass index, **waist circumference						
p < .05, significant,p < .01, very significant and p < .001, extremely significant						

DISCUSSION

This study revealed that Neck circumference (NC) can be used a marker for over-weight and obesity, but not use extensively due to inadequate knowledge and research. Main objective of this study is to determine neck circumference as a pointer for obesity by measuring body mass index (BMI) and waist circumference (WC) and then estimating the optimal NC values accordingly in young adults.

BMI and WC both used for measuring general and visceral obesity, worldwide [1], and considered akey step in evaluating the distribution and level of obesity [2].Neck circumference is a measurement of upper body adipose tissue (mainly composed of fat cells) distribution. It is generally regarded as reliable, quick and simple protocol for determining obesity and over-weight [3,4].

In present study, a significant correlation between BMI and WC with neck circumference is determined. Various other studies also reported the similar findings [5,6]. Literature also highlighted that NC is positively associated with insulin resistance and other metabolic syndromes [7, 8, 9]. It also proves an additional factor for cardiovascular disorders both in severely obese women and men [10].

Studies from the same geographical areas show similar trends of NC measurements along with the other anthropometric markers of obesity and display variance when compared to different topographical regions. Likewise, the average BMI found in this study is analogous to another study conducted in Karachi on both males and females which consolidates this supposition [11]. Waist circumference and neck circumference for both the genders in both the studies conducted in same region also showed resemblance. These findings of BMI, WC and NC were inconstant from studies performed in other parts of the world with average BMI as high as 28.5 kg/m^2 for females and 27.1 kg/m^2 for males in a study conducted by Liubov et al in southern Israel [12].

In this study, the cutoff-values of neck circumference for obesity menwas39.38cm and 33.29cm for women, which was lower as compared with other studies. This change could be the result of difference between reference values used in present and past studies. This study used WHO reference values of BMI and WC specifically for Asian population.

Various other studies also highlighted the association of obesity with neck circumference [13,14,15]. Another study described a strong correlation of neck circumference with BMI [13]. Results of Chinese study reveal that, WC, BMI and metabolic disorders all can be positively interrelate with type 2 diabetes[14].

Neck circumference is an effective pointer for identifying obesity that can also correlate with all other anthropometric measurements. Up to the present, various study already conducted to determine the relation of neck circumference with other health indicators such as; cardiovascular disorders[16–18], hypertension[19], and respiratory disorders [20]. On the contrary, a very limited number of scientific data is available for the classification of overweight/obesity on the basis of neck circumference measurement.

Even though neck circumference indicates a positive association with obesity, it is still not reliable to consider it as a screening test. Men with NC <35 cm and women with NC <33 cm does not require further evaluation. Patients above these levels require a more comprehensive assessment of their overweight or obesity status.

There were a few limitations met in the study. Although the sample size used in study is vast compared to the studies previously conducted in the region, the study consisted of only young healthy adults of college and university going age groups, therefore this data and its results cannot be implied to the general population of Karachi. To determine the right cutoff points, the study needs to be expanded to a larger scale containing sample population from variable age groups and especially including subjects with obesity-induced health problems and co-morbid.

CONCLUSION

Result of this study revealed vital implications and suggestions for preventing obesity and over-weight in young adults as it indicates the practical procedure of an easier substitute for obesity measurement. Furthermore, NC has been revealed to be independently contributing in the prediction of overweight and obesity in individuals and therefore can be used as a preliminary screening mean for this purpose. It is a straightforward, simple and inexpensive tool that can be performed at any workplace or in the

field situation and for emergency clinical diagnosis with a tape measure.

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