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Neck Circumference as a Novel Measure of Central Obesity in Young Adults: Correlation with other Anthropometric Indices

Nida Nowreen[1], Manmeet Kour[2]

[1]Lecture, Department of Physiology, [2]Lecture, Department of Anatomy, G.M.C. Srinagar, J&K, India

Abstract

Background: Obesity is an important yet the most neglected public health problem that has assumed epidemic proportions even in developing countries. Many simple anthropometric indices, including the body mass index (BMI), waist circumference (WC) are being widely used as markers to reflect obesity. In recent years, there has been growing interest in the utility of neck circumference (NC) in identifying people with obesity. This new index of upper body adiposity is quite easy to determine, does not require much body exposure, and is believed to correlate with other obesity indices.

Objectives: This study was undertaken with the purpose to find out the relationship of neck circumference (NC) with other anthropometrical indices.

Materials and Method: This cross sectional study was carried out over a period of six months among 192 medical students. The participants were examined for various anthropometric parameters such as height, weight, and NC. BMI was calculated. The correlation between NC and other indices (BMI, weight WC) was assessed by calculating the Pearson's correlation coefficient (r) and $P > 0.05$ was taken as statistically significant.

Results: Neck circumference (NC) positively correlated with BMI, weight and WC. The correlation was statistically significant ($P < 0.001$).

Conclusion: Our study revealed a positive and significant correlation between neck circumference (NC)and other anthropometric indices like BMI, weight and waist circumference (WC) in young medical students, indicating an increase in BMI, weight and waist circumference (WC) with an increase in neck circumference (NC) or vice versa.

Keywords: *Neck circumference, Body Mass Index, Waist circumference, Obesity, Overweight.*

Introduction

Obesity is an important yet the most neglected public health problem that has assumed epidemic proportions even in developing countries. Earlier thought to be a problem of developed countries, it has now become an important worldwide contributor to morbidity and mortality among all ages and socioeconomic groups.[1,2] A high prevalence of overweight and obesity has been observed in adolescent students as well which is increasingly becoming one of the most prominent conditions affecting them. [3] Overweight and obesity are known risk factors for non-communicable diseases such as cardiovascular diseases, hypertension, diabetes, cancer (breast, colon, and endometrial), osteoarthritis, and fractures. [2] High levels of fat deposit is associated with increased levels of free fatty acids which forms one of the causes for the metabolic abnormalities observed in obesity. [4]Many simple anthropometric indices, including the body mass index (BMI), waist circumference (WC) are being widely used as markers to reflect obesity or central obesity and to predict metabolic syndrome or other cardiovascular risks. [5] It has been

Corresponding Author:
Dr Nida Nowreen
Lecture, Department of Physiology, G. M. C. Srinagar, J&K, India
e-mail: nowreen.n3@gmail.com

reported that upper body fat deposition is more harmful as compared to visceral fat deposition. [6] BMI is a useful measurement of overall obesity but for determining central obesity, WC, which demonstrates the existence of abdominal visceral fat more accurately, is applied. [5] The use of WC has some limitations. It requires convenience of proper temperature and removal of clothes which some people might not allow due to religious and cultural reasons. Also it may vary throughout the day based on whether the person has had meals. [7] In recent years, there has been growing interest in the utility of neck circumference (NC) in identifying people with obesity. This new index of upper body adiposity is quite easy to determine, does not require much body exposure, and is believed to correlate well with other obesity indices. [8-11] This study was undertaken with the purpose to find out the relationship of neck circumference (NC) with other anthropometrical indices in young adults.

Materials and Method

This cross sectional study was carried out over a period of six months (January 2018 to June 2018) in the department of physiology, SKIMS Medical College, Srinagar. The inclusion criteria was participants being medical students of first and second year willing to participate in the study. Students who were not willing to participate and those with history of thyroid disease, diabetes, Cushing's syndrome, lymphadenopathy, dyslipidemia, kyphoscoliosis or any other disease were excluded from the study. The objectives of the study were explained to the students. The study consisted of 192 medical students (96 males and 96 females) in the age group of 18-22 years. After obtaining consent from each, the participants were examined for various anthropometric parameters such as height, weight, waist circumference (WC) and neck circumference (NC). Weight was measured using digital scale to the nearest 0.1 kg with only light clothing and height was measured, without shoes, to the nearest 0.5 cm while the students were standing with their head in the Frankfort plane with the heel, buttock and occiput against the wall. BMI was calculated as weight (in kgs) divided by the square of height (in meters) and was categorized according to WHO classification. Neck circumference was measured mid-way between mid-cervical spine and mid anterior neck, horizontally (just below the laryngeal prominence), using non-stretchable plastic tape. [12] It was recorded in centimeters (cm) with the subject looking straight ahead, shoulders down and relaxed, but not hunched. WC was measured in centimeter (cm) to within 1 mm that was taken horizontally in using plastic tape measure at midpoint between the costal margin and iliac crest in the mid-axillary line, with the participant standing and at the end of a gentle expiration.. Data was analyzed using computer software MS Excel. Results were expressed in mean ± standard deviation. Data was entered in SPSS version 20.0 and correlation analysis was done using Karl Pearson's method and p >0.05 was taken as significant.

Results

Baseline characteristics of the study group are shown in table 1. All the characteristics are slightly higher in males except BMI which is slightly higher in females.

Table 1: Baseline Characteristics of the Study Group

S. No	Variable	Males (mean ±SD)	Females (mean ±SD)	Total (mean ±SD)
1	Age	19.95 ± 1.33	19.24 ± 1.50	19.61 ± 1.47
2	Weight (kg)	60.69 ± 7.66	56.15 ± 7.34	58.43 ± 7.82
3	Height (m)	1.68 ± 0.07	1.59 ± 0.08	1.64 ± 0.08
4	BMI (kg/m^2)	21.53 ± 2.65	22.01 ± 2.59	21.77 ± 2.62
5	NC (cm)	35.36 ± 2.16	33.12 ± 1.99	34.24 ± 2.36
6	WC (cm)	74.21 ± 8.56	73.52 ± 8.01	73.93 ± 8.34

BMI: Body mass index, NC: Neck circumference, WC: Waist circumference

Correlation analysis showed that neck circumference (NC) positively correlated with BMI, weight and WC, indicating an increase in BMI, weight and WC with an increase in NC or vice versa. The correlation was statistically significant ($P < 0.001$) (Table 2)

Table 2: Correlation of neck circumference with BMI, weight and WC

S. No.	Variable	Neck Circumference	
		r	p
1	BMI	0.369**	>0.001
2	Weight	0.684**	>0.001
3	WC	0.336**	>0.001

**Correlation is significant at the 0.01 level

Discussion

The findings of our study show a positive and significant correlation between neck circumference (NC) and other anthropometric indices like BMI, weight and

waist circumference (WC) in young medical students. Our findings are supported by a Turkish study conducted among young university students in the age group of 18-24 years. [10] The positive correlation between NC, BMI and WC has been established in elderly subjects (> 65 years) by Yan et al. [13] Studies conducted among diabetic subjects have also shown a positive association between NC and other anthropometric parameters. [14,15,16]

Upper body fat distribution has been considered as a risk factor of cardiovascular disease. [17] and NC has been used as an index for such an adverse risk profile. [18, 19]Although BMI, WC and W/H ratio are anthropometric indices commonly used in the diagnosis of obesity, there has recently been a gradual increase in the number of studies stating the use of neck circumference as a simple screening tool to identify overweight and obesity. BMI is a suboptimal marker for total body fat, and it cannot give precise information about body fat distribution. WC which is a better measure of visceral fat accumulation has a substantial association with NC as well as metabolic disorders and indices indicating visceral fat accumulation. [12, 16] Other procedures measuring body fat content and distribution such as ultrasound, computed tomography, magnetic resonance imaging, dual X-ray absorpsiometry, bioimpedance etc. are primarily used for research work and are quite costly. [8]The neck circumference is more accurate measure of central obesity (fat around the abdomen) than BMI because of the strong correlation between high neck circumference measurements and central adiposity. [12] Hence Neck circumference might serve as a useful screening instrument for obese/overweight individuals as it is easy to measure, inexpensive, non-invasive, and unlike waist circumference, does not vary throughout the day, is more practical and convenient during winter. [20] One limitation of our study is the lack of defined anatomical location for neck circumference measurement. Other limitations are cross-sectional nature of study with a small sample size.

Conclusion

Our study revealed a positive and significant correlation between neck circumference (NC) and other anthropometric indices like BMI, weight and waist circumference (WC) in young medical students, indicating an increase in BMI, weight and waist circumference (WC) with an increase in neck circumference (NC) or vice versa.

Ethical Clearance: The study was approved by the institutional ethics committee.

Source of Funding: Self

Conflict of Interest: Nil

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