

## SHORT ARTICLE

## Role of neck circumference in measuring obesity in healthy adults

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<a href="#">Abstract</a>	<a href="#">Introduction</a>	<a href="#">Methodology</a>	<a href="#">Results</a>	<a href="#">Conclusion</a>	<a href="#">References</a>	<a href="#">Citation</a>	<a href="#">Tables / Figures</a>
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### Article Cycle

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### Abstract

**Background:** Visceral fat or intra-abdominal fat is the adipose tissue surrounding mesenteries and omentum. This has been linked to lifestyle diseases like heart diseases, arthritis, stroke and even cancer. At present we have three tools to measure visceral fat area (VFA) – Bio impedance analysis, Magnetic resonance analyser and DEXA scan. Neck circumference measurement is a simple, easy to do and a quantifiable method of measuring visceral fat. **Aim & Objective:** This study aims to find correlation of visceral body fat with Neck Circumference (NC) and Body Mass Index. **Methodology:** A cross sectional study was carried out in a medical college of western Maharashtra, wherein 290 healthy males (>18 years) were selected by simple random sampling over a period of 7 months from (February 2018 – August 2018). Data was analyzed using SPSS version 20.0. Visceral body fat was measured using Body Space 720 and neck circumference using measuring tape. **Results:** We found a significant association between neck circumference and VFA. There is a strong association between NC of >35cm and VFA >100cm<sup>2</sup>. NC can be useful in field settings as it can be used easily by health care workers in predicting risk of lifestyle diseases.

### Keywords

Neck Circumference; Obesity; Visceral Fat Area; Body Fat Percentage

### Introduction

Obesity due to its high prevalence has become a world-wide major public health problem (1). According to WHO data more than 1.9 billion adults are overweight. Prevalence of obesity in India is ever increasing. In the urban set up the prevalence is a staggering 50% and in rural set up 38.2% adults are suffering from obesity.(2) Obesity is heralded by two forms of adipose tissue namely the subcutaneous and the intra-abdominal fat and is a known risk factor for many metabolic syndromes. A human body is composed of body fat and a fat free mass

composed of muscles, bones and organs. Generally, in a healthy human the fat free mass exceeds the body fat by a factor of 4-5 (60- 75%). Fat can be retroperitoneal or intraperitoneal and is called as Visceral Fat (VF) surrounding mesenteries and omentum. Even in thin individuals whose weight is in normal limits, VF can be on the higher side resulting in a condition known as metabolic obesity.(3) Higher VF causes metabolic syndromes, cardiovascular diseases, Diabetes, secondary insulin resistance, Stroke, cancer, Hypertension, Alzheimer's disease and arthritis. The underlying mechanism stems from

the increased release of adipocyte derived biologically active substances (adipokines) including free fatty acids, adiponectin, interleukin-6, tumour necrosis factor alpha and plasminogen activator inhibitor 1. These factors are responsible for insulin resistance and associated cardio metabolic risk factors.(4) Body Mass Index(BMI), Waist Circumference (WC) and Waist Hip Ratio (WHR) are the contemporary screening tools for obesity, but all of these parameters have racial, ethnic and gender based variations.5Anthropometric measurements at the waist are too subject to observer errors and vary with respiratory movements and varying breathing patterns (Abdomino-thoracic vs Thoraco-abdominal). BMI too is not a reliable indicator of VF. A study by Despres' et al showed varying visceral fat areas (VFA) on the CT scans of subjects despite having similar BMIs.( 4)

For VF, one requires expensive instruments like the Bio Impedance Analyser (BIA), Magnetic Resonance Analyser and Dual Energy X- Ray Absorptiometry (DEXA) scanner. To make measurement of VF easy, convenient and inexpensive, an alternate method of measurement is desirable. Neck circumference (NC) is an index of measurement of upper body subcutaneous fat distribution. (5,6) NC is a simpler screening method with a low error probability than any other contemporary method. Recent studies suggest its positive correlation to metabolic syndromes.(7) Neck circumference has low intra- and inter observer variability and can be applied to larger population and mass screenings.(8) This study aims to assess visceral body fat and its correlation with Neck Circumference (NC) and Body Mass Index (BMI) among healthy adults.

### Aims & Objectives

To estimate visceral body fat and neck circumference and determine correlation between the two variables in healthy adults

### Material & Methods

This is a descriptive cross-sectional study conducted on 290 healthy males aged >18 years working in a medical college of western Maharashtra over a period of 07 months from February to August 2018. Individual sample sizes were calculated based on mean and standard deviation for the parameters under study viz. the Body fat % and Visceral Fat Area (VFA) (cm<sup>2</sup>%) from previous studies and the sample size for the highest parameter was taken i.e.290. Subjects with any chronic illness, existing metabolic

disorders, and hypertension or with a history of being medicated were excluded from study. Those with bony deformities of head, neck and face and chest were also excluded from study. Written informed consent was obtained from all participants. Visceral Fat Area (VFA)(cm<sup>2</sup>%), body mass composition and fitness score (out of 100) were recorded using the Bio Impedance Analyser (BIA) using Biospace 720. Measurements were taken after 20 minutes of rest prior to study. Prerequisites before the measurements included subjects being empty stomach for 12hrs, afebrile, with empty bladder and not under any physical stress. Subjects were asked to remove metallic objects and be bare foot with minimal clothing. Each participant was asked to stand on the machine such that both heel and the ball of feet would touch the foot electrode. The participant was instructed to take the hand electrode in their hand and stand still for 2 to 3 min. Anthropometric parameters of the subjects were measured by authors. For neck circumference, measurement was done in standing position with the subject looking horizontally with the shoulders relaxed. Measurement was done perpendicular to the long axis of neck, just below the larynx at the level of cricoid cartilage. Data was analyzed using SPSS 20. Pearson's correlation coefficient was used.

### Results

Data was analysed for 290 adult males with mean age of 25.01 + 9.59 years and mean weight of 71.5 + 9.5 Kg ([Table 1](#)). Positive correlation was found between NC and BMI and NC and VFA ([Table 2](#)). On performing linear regression analysis using unstandardized and standardised coefficients using VFA as a dependent variable significance was obtained with fat percentage and NC. ([Table 3](#)). ROC curves for neck circumference cut off 35 cm with visceral fat area and body fat% are given in figures 1 and 2 respectively.

### Discussion

WHO recommends an early assessment of overweight and obese individuals as it is associated with a host of lifestyle diseases, increased morbidity and mortality.(9) As central obesity is related to metabolic syndromes directly, various studies have tried to conceptualize anthropological methods for early screening and diagnosis. Previous studies have shown NC to be an innovative and alternative approach to indicate metabolic syndrome.(10) In the present study too, we tried to assess the VFA and its

correlation with NC and BMI, as it provides an inexpensive yet invaluable screening tool in the community itself to identify individuals at risk. Our results are quite similar to study done by Qureshi NK et al in Bangladesh. (11) Findings of present study show very strong correlation between VFA and NC. Quantitatively the association is most significant between NC >35 cm and VFA >100cm<sup>2</sup>. Hence, cut off point or upper acceptable limit for NC is proposed to be 35 cm. Kroll et al in a systemic review and meta-analysis concluded that NC is an accurate tool for assessing overweight and obesity among males and females of different age groups. Because of its easy and low cost approach it can be used in screening in routine medical examination and epidemiological studies. (12) Various studies have shown similar correlation between NC and body fat. (13,14,15) Individuals found to have high NC in community can be counselled and encouraged for lifestyle modification in order to prevent health risks and metabolic syndromes. In developing countries like India, NC being an inexpensive tool could be quite a boon at community level. It can be easily used at peripheral level by health care workers to predict risk of developing lifestyle diseases and intervening at early stages. NC can be component as screening tool under the NPCDCS (National programme for prevention and control of cancer, diabetes, cardiovascular disease and stroke).

### Conclusion

NC can be used as a surrogate marker to estimate visceral fat area in healthy individuals. It can be labeled as an appropriate technology as its early recognition of risk factors combined with counseling and lifestyle modification can help in controlling the alarming rate of overweight population at community level.

### Recommendation

Neck circumference can be used as in community settings to estimate obesity

### Limitation of the study

Participants of the study are from one institute/setting.

### Relevance of the study

Neck circumference can be used as an anthropometric tool in the community as it is cheap, reliable and easier to use as compared to waist and hip measurements in assessment of obesity in adults.

### Authors Contribution

SS: Collection of data, drafting of manuscript; KS: Collection of data, analysis of data; VB: Analysis of data, drafting of manuscript; PD: Study concept and design, analysis of data, drafting of manuscript

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**Tables**

**TABLE 1 ANTHROPOLOGICAL VARIABLE OF STUDY SUBJECTS**

Variable	Mean	SD
VFA (%)	65.88	32.80
Fat (%)	14.44	6.14
BMI (Kg/m2)	23.49	3.13
NC (cms)	36.02	2.56

**TABLE 2 CORRELATION COEFFICIENT BETWEEN VARIOUS VARIABLES**

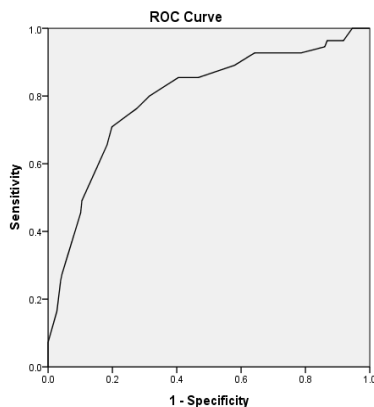
	NC	BMI	FAT %	VFA
NC	1	0.664	0.593	0.710
BMI	0.664	1	0.716	0.677
FAT %	0.593	0.716	1	0.831
VFA	0.710	0.677	0.831	1

**TABLE 3 REGRESSION ANALYSIS WITH VISCERAL FAT AREA AS DEPENDENT VARIABLE**

	Unstd coeffB	Std error	Std coefficient	t	sig
CONSTANT	-129.82	12.23		-10.61	.000
BMI	0.40	0.44	0.39	0.90	0.369
Fat %	3.26	0.20	0.62	15.99	0.000
NC	3.85	0.41	0.33	9.40	0.000

**Figures**

**FIGURE 1 ROC CURVE BETWEEN NECK CIRCUMFERENCE AND VISCERAL FAT AREA (AUC: 0.905)**



**FIGURE 2 ROC CURVE BETWEEN NECK CIRCUMFERENCE AND BODY FAT % (AUC: 0.795)**

