



CORRELATION OF NECK CIRCUMFERENCE WITH WAIST CIRCUMFERENCE AND BODY-MASS-INDEX IN ISCHEMIC HEART DISEASE: A PROSPECTIVE STUDY

Cardiology

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ABSTRACT

Waist circumference (WC) and Body Mass Index (BMI) are established anthropometric measures for assessing over weight and obesity, which correlate with increased risk of ischemic heart disease (IHD). Neck circumference is a novel and simple anthropometric marker for assessment of upper body obesity.

OBJECTIVES: This study was conducted to evaluate correlation of neck circumference with waist circumference and body mass index in patients with IHD undergoing coronary angiogram (CAG), in a referral institute.

MATERIAL & METHODS: Consecutive patients of IHD, undergoing CAG in our institute were included prospectively in the study. This included total of 41 patients- males 28, females 14, and mean age 55 (range 33-85) years. Apart from standard contra-indications for invasive CAG study, those patients having established thyroid disease or enlargement, neck abnormalities, pregnant women and critically ill subjects were excluded. Their demographic profile and anthropometric measurements were documented. Neck circumference was measured with the superior border of the tape placed below the laryngeal prominence, midway between base of the neck and the upper part of the sternum to within 1mm. Waist circumference was measured at midpoint between the lower margin of the last palpable rib and top of iliac crest, in standing position after normal expiration. Body mass index (BMI) was calculated as weight in kilograms divided by the square of standing height in meters.

RESULTS: Pearson's correlation coefficients indicated a statistically significant correlation between changes in NC and changes in waist circumference (Corr.coeff= .42, $p=0.007$) and body mass index (Corr.coeff= .31, p value 0.048).

DISCUSSION AND CONCLUSION: Neck circumference, a novel anthropometric index is an excellent method for assessment of upper body obesity in ischemic heart disease patients. It is simple, reliable, socially acceptable, time saving and less cumbersome measure of obesity.

KEYWORDS

neck circumference, waist circumference, body-mass-index, ischemic heart disease, coronary angiogram, obesity.

INTRODUCTION

Ischemic heart disease is a major cause of mortality and morbidity. Several studies have established relation between obesity and the development of cardiovascular disease^{1,4}. Obesity results in metabolic abnormalities, and especially, central obesity is strongly associated with glucose intolerance, hyperinsulinemia, diabetes, hypertriglyceridemia and gout, increasing mortality and morbidity of IHD patients⁵. While BMI is used to assess overall obesity, a better measure of cardiovascular risk is considered to be central obesity, which can be assessed by different methods, such as waist circumference (WC), hip circumference (HC) and waist-hip ratio (WHR). Mid upper-arm circumference and neck circumference (NC) are considered measures of upper-body obesity. It has been suggested that subcutaneous fat in the neck may be more similar to visceral fat, which is more strongly related with cardiometabolic risks^{1,4}. An upper body distribution of fat, especially with increased visceral adipose tissue, is considered predictive of cardiometabolic conditions. This study was undertaken as not many Indian studies are available of NC correlation with cardiometabolic risk factors in established IHD patients.

MATERIAL(SUBJECTS)AND METHODS

This was a prospective, cross-sectional study carried out in 41 consecutive IHD patients undergoing coronary angiography in cardiology department of our institute, after obtaining the approval of the institutional ethics committee. Study period was 8 months, from May 2021 to December 2021. Inclusion criteria are stable cardiac patients aged 18-85 years. We excluded patients with standard contra-indications to invasive catheterization study, known contrast allergy, renal insufficiency, pregnancy, bleeding diathesis, acute stroke, thyroid disease, neck tumours or with history of neck surgery.

After informed consent baseline data like name, age, gender, demographic, life style and comorbidities were collected using standard questionnaire.

Anthropometric Indices: Following parameters were assessed with patient wearing a light clothing without shoes and measured using inelastic tape with one millimetre precision.

A) Neck circumference (NC) was measured with the superior border of the tape placed below the laryngeal prominence, midway between base of the neck and the upper part of the sternum to within 1mm. Normal: Males <37 cm, Females <34 cm².

B) Waist circumference (WC) measured at midpoint between the lower margin of the last palpable rib and top of iliac crest, in standing position after normal expiration. Normal value in Indian male < 85 cm, Indian female <80 cm^{6,7}.

C) Weight (in Kg) and Height (in meters).

F) Body mass index (BMI) was calculated as weight in kilograms divided by the square of standing height in meters. Patients are categorized as underweight (<18.5 kg/m²), normal (18.5–22.9 kg/m²), overweight (23.0–24.9 kg/m²) and obese (≥25 kg/m²) based on the revised consensus guidelines for India⁷.

Data Statistical Analysis: Data was analyzed through multiple logistic regression using statistical package for social sciences (SPSS) software. Mean and standard deviation for each continuous variable was calculated. Correlation of neck circumference with metabolic risk factors was tested by Karl Pearson's correlation coefficient method.

RESULTS

There were 41 patients, who underwent CAG for evaluation of IHD, including 29 males and 12 females, with mean age of 55 (33-85) years. Their mean WC was 95 (69-125) cm, mean WHR was 1.01 (0.85-1.91), mean BMI 25.4 (17.8-35.3) Kg/m² and mean NC was 38.3 (33-46). (Table 1).

Table – 1 Anthropometric Statistics

Variable	N	Min	Max	Mean	Std.Dev
NCcms	41	33.0	46.0	38.3	3.17
BMI kg/m ²	41	17.8	35.3	25.4	4.05
WCcms	41	69.0	125.0	95.3	11.4

NC-Neck Circumference, WC-Waist Circumference

While NC was not elevated in 5 patients, WC was normal in 8 patients and BMI was normal in 9 patients.

On Pearson's correlation coefficient statistical testing of continuous variables, there was a weak positive correlation between NC and BMI (Pearson's R value 0.311, significance $p=0.048$) and strong correlation between NC and WC, with Pearson's R value 0.416 and significance p value 0.007. (Table 2).

Table – 2 Correlation Of Neck Circumference With Bmi And Waist Circumference

Variable	Pearson's R Value	Significance 'p'
NC with BMI	.311	.048
NC with WC	.416	.007

NC-Neck Circumference, WC-Waist Circumference, BMI- Body Mass Index

DISCUSSION

Our study found that in high-risk Indian population of ischemic heart disease, there was a positive correlation between neck circumference and established cardiometabolic risk factors. NC had strong correlation with WC which is a similar visceral fat measure and weak correlation with index of overall obesity as BMI.

Body mass index, although recommended presently by World Health Organization to evaluate overweight and obesity in general population, does not give any idea of central adiposity or visceral fat, which has been implicated in cardiovascular risk⁸. So, other methods like waist circumference and waist to hip ratios are used to identify central obesity. But waist circumference measurement varies with respiration and with post prandial distension of abdomen. It appears that upper body subcutaneous fat has similar pathophysiological characteristics as abdominal visceral fat¹. A study by Li et al done in Chinese adults inferred that the neck circumference has significant correlation with the visceral adipose tissue as documented by CT scans⁹.

Waist circumference, WHR and BMI are traditional indicators for obesity diagnosis, which have been confirmed by numerous studies to be related to cardiovascular events. Neck circumference is a relatively novel indicator of body fat distribution. It is a reliable and simpler parameter to measure than WC, especially in the screening process¹⁻⁴. NC can be measured in a sitting position without interference from breathing and also is socially more acceptable than other measures of central adiposity, such as, WC and HC.

Various methods like Computed tomography (CT), Magnetic resonance and Dual Energy X-ray Absorption (DEXA) are used for evaluation of adiposity¹⁰. CT can differentiate the subcutaneous fat and intraabdominal visceral fat, accumulation of which has been associated with morbidities. Cost constraints, resource limitations make these radiological imaging modalities impractical for a widespread use for clinical practice. Hence, NC is a reliable parameter of central adiposity as a screening parameter for epidemiological and clinical purpose.

Cut-off points for NC have been variable in various studies, and it is recommended to use local values. While most Indian studies used NC cut-off value >37cm in males and >34cm in females, Brazilian study to predict metabolic syndrome in the population used NC values of 39.6 cm for men and 36.1 cm for women and another Chinese study used 38 cm for men and 35 cm for women³.

NC is an important indicator of distribution of subcutaneous fat in the upper body. Subcutaneous fat in the upper body has shown to be an important source of free fatty acid release in the circulatory system, especially in obese people⁵. This can lead to increased release of inflammatory factors, which can result in insulin resistance and vascular endothelial damage. Furthermore, NC has good predictive value for the risk of obstructive sleep apnea syndrome, which is also closely related to a variety of cardiovascular diseases. NC is positively

correlated with other metabolic parameters too, such as, glucose and insulin resistance, systolic and diastolic blood pressure, free-fatty acids, the production of very low-density lipoprotein cholesterol and triglycerides, while there is an inverse association with HDL cholesterol¹³.

Majority of our study patients had abnormal anthropometric parameters, underscoring the importance of unhealthy life style and obesity as causative factors of serious cardiovascular disease, even in a semi-urban based peripheral referral centre for cardiac patients.

Strengths and Limitations of our study: Our study is unique in evaluating neck circumference in a high-risk group of undergoing coronary angiogram for evaluation of established ischemic heart disease. It adds to the current literature by showing that neck circumference is a good correlate of waist circumference and BMI for obesity assessment in this subset of patients. Limitations are that this was a single centre experience, in a small number of focussed-group patients undergoing CAG for IHD.

CONCLUSIONS

In patients with ischemic heart disease, neck circumference has good correlation with other parameters of obesity such as waist circumference and body-mass-index. It is a reliable, simple, inexpensive, socially more acceptable index for assessment of central obesity.

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