

ORIGINAL ARTICLE

To Evaluate the Association of Neck Circumference with Metabolic Syndrome and Cardiovascular Risk Factors

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Abstract

Background: It is accepted that metabolic syndrome increases the relative risk of cardiovascular disease and visceral adiposity lies at root of the cardio-metabolic risk. Upper body fat distribution has long been recognized as associated with metabolic syndrome and increased cardiovascular risk; hence the present study was conducted with the objective to evaluate the association of neck circumference with metabolic syndrome and cardiovascular risk factors.

Material and Methods: The present study was a hospital based observational, Descriptive and comparative analysis, conducted at Department of General Medicine at a tertiary care centre of west India after Ethical clearance from the institute's ethical committee and written informed consent. A total of 405 subjects aged 18 – 60 years were selected consecutively after inclusion and exclusion criteria. Subjects were evaluated for metabolic syndrome components and cardiovascular risk factors. Neck circumference of ≥ 37 cm in males and ≥ 34 cm in females was considered abnormal.

Results: Metabolic syndrome was seen in 189 (46.7%) subjects. Raised triglyceride level was the most common (52.8%) component. Neck circumference was found to be statistically significant associated with metabolic syndrome ($p < 0.001$) as well as cardiovascular risk factors like BMI, Waist circumference, Hypertension, Fasting blood sugar, TG and HDL were also found to be statistically significant associated with neck circumference.

Conclusion: Neck Circumference can be used as a sensitive tool for metabolic syndrome and cardiovascular risk factors. Patients with abnormal Neck circumference should be screened for cardiovascular risk factors to detect abnormality for early and appropriate intervention.

Introduction

Metabolic syndrome is defined as a set of risk factors that includes insulin resistance, dyslipidemia, abdominal obesity and high blood pressure, increases the risk of cardiovascular diseases and diabetes.^{1,2} Globally, the prevalence of metabolic syndrome may range from 8 to 13% in men and 2 to 18% in women depending on the population and definitions used.³⁻⁵ In India, studies have reported prevalence varying upto 24.9% in northern India and 41% in Southern India using different definitions.⁶

Upper body obesity have been found to be more strongly associated with glucose intolerance, hyperinsulinemia, diabetes, hypertriglyceridemia and

has long been recognized as related to increased cardiovascular disease risk, and neck skin fold⁽⁷⁾ or neck circumference (NC) has been used as its index.^{8,9}

NC has been reported to be a simple and time-saving screening measure to identify high risk overweight and obese individuals. It has been shown that men with a NC < 37 cm and women with a NC < 34 cm probably have a less chance of developing metabolic syndrome.¹⁰

Evidence regarding clinical significance of Neck Circumference in

cardio-metabolic syndrome is limited and needs to be further clarified hence present study aimed to investigate the independent contribution of NC to cardio-metabolic risks. This study could present a novel approach for screening cardio-metabolic risks.

Material and Methods

The present study was a hospital based observational, Descriptive and comparative analysis, conducted at Department of General Medicine at a tertiary care centre of west India after Ethical clearance from the institute's ethical committee and written informed consent. A total of 405 subjects aged 18 – 60 years were selected consecutively after inclusion and exclusion criteria, from patients attending Medicine Out Patient Department. Sample size was calculated at α -error 0.05 and study power 80% and was adequate to assess an expected proportion of neck circumference abnormality among metabolic syndrome and normal patients to be 60% and 38.6% respectively.¹¹

Subjects taking antihypertensive, antilipid, anti diabetic drugs, weight reduction drugs and those who had undergone neck or abdominal surgery and those with h/o malignancy or thyroid disease were excluded from study. Detailed medical history, General and physical examination, Anthropometric indices, Neck Circumference, Waist Circumference, FBS and Lipid profile were measured as per standard methods. NC was measured with plastic tap calibrated to one millimeter with head positioned in horizontal plane and superior border of plastic tap placed just below the laryngeal prominence and applied

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Table 1: Components of metabolic syndrome among study subjects

Metabolic syndrome components	No. of patients	Percentage
Abnormal waist circumference (males >90 cm and females >80 cm)	206	50.86%
Raised SBP (≥130 mmHg)	106	26.17%
Raised DBP (≥85 mmHg)	71	17.53%
Raised FBS (>7 mmol/l)	108	26.66%
Low HDL (men <40 mg/dl and female <50 mg/dl)	90	22.22%
Raised LDL (>100 mg/dl)	138	34.07%
Raised TG (>150 mg/dl)	214	52.83%
Raised TC (>200 mg/dl)	98	24.19%

perpendicular to the long axis of the neck. Neck circumference of ≥ 37 cm in males and ≥ 34 cm in females was considered abnormal.

Statistical analysis

Qualitative data was presented as number and proportions and associated between qualitative variables was analyzed using Chi square test or Fischer exact test as applicable. Quantitative data was presented as mean and standard deviation. A p value less than 0.05 were taken as statistically significant.

Results

The mean age of study subjects was 44.7 ± 18.3 years. There were 211 (52.1%) female and 194 (47.9%) males in the study population. The mean BMI of the study population was 27.51 ± 4.53 Kg/m². Based on the IDF criteria, 189 (46.7%) subjects were found to have metabolic syndrome. Metabolic syndrome was seen in 189 (46.7%) subjects. Raised triglyceride level was the most common (52.8%) individual component of metabolic syndrome followed by abnormal waist circumference seen in 50.86% (Table 1 and Figure 1). Overall, the mean neck circumference was 39.08 ± 2.315 cm. Among the males the mean neck circumference was 38.91 ± 1.956 cm and in females it was 39.23 ± 2.597 cm.

Neck circumference was found to be significantly associated with metabolic syndrome (p<0.001). Individual components like BMI, waist

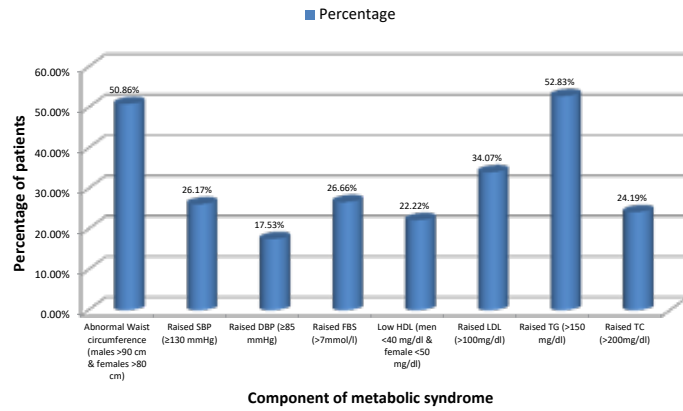


Fig. 1: Components of metabolic syndrome among study subjects

Table 2: Association of neck circumference with metabolic syndrome and its individual components

Component	Subgroup	Neck circumferences		P value
		Normal	Abnormal	
Metabolic syndrome	No	30 (28.5%)	186 (71.5%)	<0.001
	Yes	0	189 (100%)	
BMI (Kg/m ²)	<18.5	1 (14.28%)	6 (85.71%)	<0.001
	18.5-24.99	27 (21.42%)	99 (78.57%)	
	25-29.99	2 (1.21%)	162 (98.8%)	
	>30	0 (0%)	108 (100%)	
Waist circumference	Normal	30 (15.1%)	169 (84.9%)	<0.001
	Abnormal	0	206 (100%)	
Hypertension	No	29 (10.6%)	245 (89.4%)	<0.001
	Yes	1 (0.8%)	130 (99.2%)	
Blood Sugar	Normal	29 (9.8%)	268 (90.2%)	0.005
	Raised	1 (0.9%)	107 (99.1%)	
TG	Normal	29 (15.2%)	162 (84.8%)	<0.001
	Raised	1 (0.5%)	213 (99.5%)	
HDL	Normal	26 (10%)	234 (90%)	0.014
	Low	4 (2.8%)	141 (97.2%)	

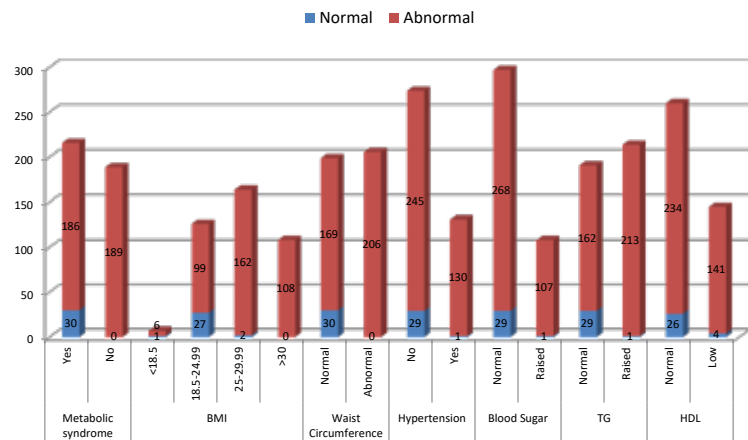


Fig. 2: Association of Neck circumference with metabolic syndrome and its individual components

circumference, Hypertension, Fasting blood sugar TG and HDL were also found to be significantly associated with neck circumference (Table 2 and Figure 2).

Discussion

Present study was undertaken to evaluate the relationship of NC with metabolic syndrome and cardiovascular risk factors. Studies like that by Ravikiran M et al¹² have

showed that metabolic syndrome and cardiovascular risk in Asian Indians/South Asians are increased by their relative increase in body fat mass, truncal subcutaneous fat mass, intra-abdominal fat mass, and also by ectopic fat deposition like neck region.

In the present study, significant association was found between neck circumference and metabolic syndrome ($P < 0.001$) and its individual components. All subjects with metabolic syndrome had abnormal neck circumference using age specific criteria. Kumar S et al¹³ had hypothesized that NC could be a predictor of obesity and overweight in rural Indian population and that higher tertile of neck circumference may be associated with higher prevalence of cardiovascular risk factors like hypertension and diabetes. Ben-Noun L et al¹⁴⁻¹⁶ have also indicated that neck circumference may be an independent correlate of metabolic risk factors above and beyond BMI and waist circumference.

In a study to identify overweight patients by measuring neck circumference Ben-Noun L et al¹⁶ in 2001, reported that Men with NC < 37 cm and women with NC < 34 cm may not to be considered overweight. It was found that NC > 37 cm for men and > 34 cm for women were the best cutoff levels for determining the subjects with higher BMI of > 25.0 kg/m².

The Fat Redistribution and Metabolic study had showed that increased levels of upper-body Subcutaneous fat were positively associated with LDL cholesterol and inversely associated with HDL cholesterol levels, after adjustment for demographic and lifestyle factors.¹⁷ Systemic free fatty acid concentrations are known to be primarily determined by upper-body subcutaneous fat, suggesting that this fat depot may play an important role in risk factor pathogenesis. Elevated free fatty acid concentrations have

been associated with insulin resistance, increased VLDL cholesterol production, and endothelial cell dysfunction.¹⁸

In present study, abnormal neck circumference was also found in many individuals without metabolic syndrome. These false positives results could be because abnormalities in components of metabolic syndrome were present in these patients but criteria were not fulfilled as a whole metabolic syndrome.

Another study done in Israel reported a strong correlation between NC, BMI and other upper-body obesity indexes (WC and waist-to-hip ratio). NC also strongly correlated with SBP, DBP, total cholesterol, LDL-cholesterol, triglycerides, fasting glucose, and uric acid levels.¹⁹ No significant correlation was found between NC and HDL-cholesterol levels, which were similar with present study results.

These novel findings presumably reflect NC is an indicator of central obesity and other cardio-metabolic risk factors and metabolic syndrome as a whole. Evaluation of NC based on single measurements might be considered a minor limitation.

Conclusion

Upper-body fat distribution has long been recognized as related to increased cardiovascular disease risk and Neck Circumference could be used as an index. NC can be use as a sensitive marker for metabolic syndrome although not specific. Patients with abnormal Neck circumference should be screened for cardiovascular risk factors and followed up at regular intervals to detect abnormality at earliest for prevention of cardiovascular disease.

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