

Neck Circumference and Cardio-Metabolic Syndrome

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ABSTRACT

Background: Only few studies about neck circumference (NC) as a measure of cardio metabolic syndrome available from India. Study was conducted to establish an association between neck circumference and cardio metabolic syndrome.

Material and Methods: Cross-sectional study was conducted in a tertiary care hospital in South India. NCEP: ATP III 2001 guideline was used for diagnosis of Cardio-metabolic syndrome among subjects. Neck circumference was measured and it was correlated with Cardio-metabolic syndrome.

Results: Mean neck circumference was found to be 36.5 cms. Cardio-metabolic syndrome was present in 272 participants, of which 100 were females and 172 males. Among females

82(82%) had neck circumference >34cms, 18(18%) had <34cms and among males 117(68%) had NC >37cms and 55(32%) had NC<37cms. All individual parameter of cardio metabolic risk factor, i.e., BMI, waist circumference, hip circumference, systolic blood pressure, diastolic blood pressure, FBS, HDL & TG except waist/hip ratio were correlating with abnormal neck circumference when compared with those with normal neck circumference.

Conclusion: Neck circumference with metabolic syndrome correlated better among females than males. Men with NC >37 cm and women with NC >34 cm are more prone for cardio metabolic syndrome and require additional evaluation. Measurement of NC is a simple, time saving, and least invasive measurement tool.

Keywords: BMI, Metabolic syndrome, Waist-hip ratio

INTRODUCTION

Alarming raise of cardiovascular disease (CVD) over the past 15 yrs has been reported by epidemiologists and international agencies such as world health organization (WHO). It is estimated that by 2020, CVD will be the largest cause of disability and death in India, with 2.6 million Indians predicted to die due to CVD. The risk of CVD accompanying the metabolic syndrome (MetS) is approximately doubled compared with an absence of the syndrome. Term "globesity" is becoming more popular worldwide to describe the epidemic trend towards increased body weight [1].

The Criteria for the metabolic syndrome according to National Cholesterol Education Program, Adult Treatment Panel III

Three or more of the following:

- **Elevated waist circumference:** Men — greater than 40 inches (102 cm).
- **Women** — greater than 35 inches (88 cm).
- **Elevated triglycerides:** Equal to or greater than 150 mg/dL/ specific medication.
- **Reduced HDL ("good") cholesterol:** Men — Less than 40 mg/dL and Women — Less than 50 mg/dL.
- **Elevated blood pressure:** Equal to or greater than 130/85 mm Hg or use of medication for hypertension.
- **Elevated fasting glucose:** Equal to or greater than 100 mg/dL (5.6 mmol/L) or use of medication for hyperglycemia.

Obesity is a state of excess adipose tissue mass. Although not a direct measure of adiposity, the most widely used method to gauge obesity is the body mass index (BMI), which is equal to weight in kg / height in meter [2]. Other approaches to quantifying obesity include anthropometry (skinfold thickness), densitometry (underwater weighing), Computerized Tomography (CT) or MRI, and electrical impedance upper body subcutaneous fat, as estimated by NC confer risk above and beyond visceral abdominal fat. Various studies indicated that NC may be independent correlate of metabolic risk factors beyond BMI and waist circumference [2]. Besides, NC is considered an index of upper body obesity and

correlates positively with changes in systolic and diastolic blood pressure and other components of the metabolic syndrome [3]. The purpose of our study is to determine the reliability of NC as a measure of cardiometabolic risk factors.

MATERIALS AND METHODS

This Cross sectional study was carried out in patients who attended medicine clinic in a tertiary care KMC hospital of Mangalore Southern India during September 2010 to August 2012. Total 431 patients chosen randomly in which 250 males and 181 females, fulfilling criteria of Males > 35 year and females > 40 year were included. Pregnant females, patients with thyroid disorders, history of previous neck surgery and type I diabetes mellitus were excluded. Detailed history followed by complete physical examination of patients done. All anthropometric measurement were performed among all patients according to WHO guide lines and biochemical parameters to suggest cardio-metabolic risk factors were carried out among all participants after obtaining informed consent. Ethics committee approval from the institutional ethics committee was obtained prior to the study. Statistical analysis done by using Chi-square test and Karl pearson correlation coefficient.

Neck circumference is measured the superior border of the tape measure was placed just below the laryngeal prominence and applied perpendicular to the long axis of the neck [4]. Normal value: In males < 37cms and in females < 34 cms. Waist circumference (WC) is perimeter measured at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest, in standing position after normal expiration. Normal value for Indian male is 85 cms and for Indian female 80 cms. Hip circumference is the perimeter at the level of the greatest posterior protuberance of the gluteals and was measured widest portion of buttocks [5].

Waist to hip ratio calculated and its normal value is 0.88 for male, 0.81 for female [5]. BMI measured as weight in kg / (height in meter) [2]; normal 18 -24.9kg/m² [5]. Fasting Lipid profile: Lowdensitylipoprotein, Highdensitylipoprotein, Totalcholesterol, Triglycerides and Fasting blood glucose level were obtained.

RESULTS

Total of 431 patients were studied, of which 250 males and 181 females. 46% of them were belonging to 41-50 year age group, 24% were 51-60 and remaining 30% above 60 years. Among 431 patients, 272 patients had Metabolic syndrome (MetS) according to NCEP, ATP III guidelines [6]. Out of 272 participants with Met S, 172 (58%) patient were males and 100 (42%) were females [Table/ Fig-1].

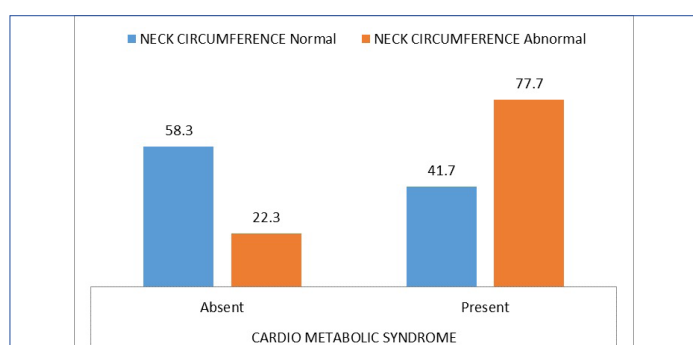
Cardio Metabolic Syndrome	n	Minimum	Maximum	Mean SD	Media	t-value	p-value
Absent	159	25	41	34.08±3.960	34.00	7.453	<0.000
Present	272	29	42	36.44±2.605	37.00		HS
Total	431	25	42	35.57±3.367	36.00		

[Table/Fig-1]: Neck circumference in cardio-metabolic syndrome

Mean NC among patients with cardio metabolic risk factor was 36.44 cms, whereas those without cardio metabolic risk factor was 34.08 cms. This correlation is statically highly significant [p-value = <0.001], [Table/Fig-2].

Sex	Neck Circumference	Cardio Metabolic Syndrome	Cardio Metabolic Syndrome		Total
			Absent	Present	
F	< 34	49 73.1% 60.5%	18 26.9% 18.0%	67 100.0% 37.0%	
			>= 34	32 28.1% 39.5%	82 100.0% 63.0%
	Total	81 44.8% 100.0%	100 55.2% 100.0%	181 100.0% 100.0%	
M	< 37	53 49.1% 67.9%	55 50.9% 32.0%	108 100.0% 43.2%	
			>= 37	25 17.6% 32.1%	117 100.0% 56.8%
	Total	78 31.2% 100.0%	172 68.8% 100.0%	250 100.0% 100.0%	

[Table/Fig-2]: Sex distribution v/s cardio-metabolic syndrome v/s neck circumference



[Table/Fig-3]: Neck circumference in metabolic syndrome

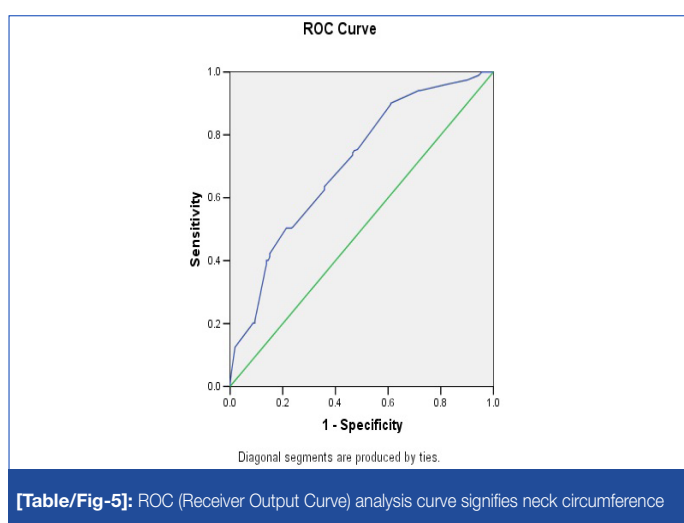
Among females with NC is <34cms, 26.9% had MetS, whereas among females with NC ≥34 cms, 71.9% had MetS. Among males with NC<37cms, 50.9% had MetS, whereas among NC≥ 37cms

In patient with MetS, 77.7% had increased NC,whereas in those patient without MetS only 22% had abnormal NC. Again this correlation was highly significant [Table/Fig-3].

All individual parameter of cardiometabolic riskfactor i.e. BMI,waist circumference, hip circumference, systolic blood pressure, diastolic blood pressure, FBS, HDL & TG except waist/hip ratio highly significant in patient with abnormal NC when compared with those with normal NC.

		Karl pearson correlation coefficient r-value	p-value
Neck circumference	BMI	.492(**)	<0.001
	WAIST	.453(**)	<0.001
	HIP	.458(**)	<0.001
	W/H RATIO	-.005	.912
	SBP	.243(**)	<0.001
	DBP	.107(*)	.027
	FBS	.166(**)	<0.001
	TC	.266(**)	<.0001
	LDL	.344(**)	<0.001
	HDL	-.173(**)	<0.001
	Triglyceride	.280(**)	<0.001
	Age	.029	.544

[Table/Fig-4]: Neck circumference correlation with cardio-metabolic risk factor



[Table/Fig-5]: ROC (Receiver Output Curve) analysis curve signifies neck circumference

Individual parameter of cardio-metabolic risk factor statically correlates with NC except for waist hip ratio [Table/Fig-4].

ROC Curve signifies NC with cardio metabolic syndrome with area under the curve is 70% [Table/Fig-5]. In our study for mean neck circumference 36.5cms, sensitivity is 50% and specificity is 76%.

DISCUSSION

We hypothesized that NC could be a predictor MetS in Indian population. In this study, we looked into the association between neck circumference and cardio-metabolic risk factor, whether neck circumference independently contribute to cardio-metabolic risk and that higher values of NC has any association with higher prevalence of cardiovascular risk factors. We also observed neck circumference was more strongly associated with adverse risk factor levels in women compared with men.

In our study we have taken NC, waist circumference, hip circumference, W/H ratio, BMI by calculating height and weight and blood pressure, laboratory value including fasting lipid profile (TG, HDL, LDL, TC) and FBS. In study done by Sunil Kumar et al., [7], all anthropometric measurements (weight, height, and NC) and blood pressure were performed and laboratory value FBS, lipid profile not performed due to in all patient. In the Framingham Heart Study [8] with arthropometric (weight, height, and NC, WC,HC, W/H ratio, BMI) and laboratory parameter HDL,LDL,TG,FBS,insulin, proinsulin and homeostasis model assessment of insulin resistance (HOMA-IR), imaging multi detected computerised tomography used in measuring visceral adipose tissue.

	Our study	Sarah Rosner Preis et al., study[8]	S Kumar, A Gupta, S Jainstudy [7]
Study population	431	3307	203
Sex distribution	M:58%, F:42%	M:52%, F:48%	M:60%, F:40%
Mean Neck circumference	36.5cm	37.3cm	33.3cm
BMI	25.4kg/m ²	27.8kg/m ²	24.2kg/m ²
Lab parameter included in study	HDL,TG, LDL, total cholesterol, FBS	HDL, TG, LDL, FBS, insulin, proinsulin HOMA	FBS
Radiological parameter	Nil	Multi detected computerized tomography for visceral adipose tissue measurement	Nil
Positive correlation of NC	Significant correlation with all anthropometric measurement and lab parameter except for W:H ratio	significant correlation with all anthropometric measurement, lab parameter and VAT	significant correlation with all anthropometric measurement

[Table/Fig-6]: Comparison of our study with previously conducted studies

In our study MetS present in 272 participant according to criteria of NCEP: ATP111 2001 [6]. In which female were 100, 82 of them had NC more than 34cm, only 18 of them had NC less than 34 cm. In male 172 had MetS of which 117 i.e. 68% had NC more than 37cm and 55 i.e. 32% had NC less than 37cm. So NC with MetS was more correlating with female than with male.

NC is also related to cardiovascular risk factors in severely obese men and women. In our study NC, positively correlates with BMI and mean BMI for our study with metabolic syndrome is 25.4 kg/m², mean NC is 36.44cm, p-value is <0.001 with NC this value are statistically significant [Table/Fig-1].

In a first cross sectional study by Ben-Noun et al., [9-12] which was done to identify overweight or obese patients solely by measuring the circumference of the neck, observed that NC >37cm for men and >34cm for women were the best cutoff levels for determining the subjects with BMI >25.0 kg/m² using the receiver output curve analysis. In our study we also observed same characteristics as NC 37 cm for men and 34 cm for women identified subjects with BMI >25.0 kg/m² with 75% to 86% sensitivity for men and 63% to 93% for women, 80% to 90% specificity for men and 80% to 100% for women.

We found that neck circumference have positive correlation with systolic and diastolic blood pressure, t-value for systolic and diastolic blood pressure are 8.256 and 5.247, both p-value < 0.000. Ben Noun et al.,[9-12] observed relationship between changes in neck circumference and changes in blood pressure. They found that changes in systolic BP and diastolic BP correlated positively with changes in NC and other components of the metabolic syndrome.

Neck circumference were correlated with various metabolic parameter like LDL, HDL, TC, TG and FBS, t-value were 6.898, 8.472, 6.025, 9.071 & 5.160. P-value <0.001 of all these were statically significant correlations. For all risk factors, women exhibited a larger effect size in risk factor levels per SD increment in neck

circumference than men. This finding can be explained by differences in bodily structures between men and women especially in India. It seems, therefore, that with an increase in NC, the likelihood of risk factors for cardiovascular disease also increases.

Our observations indicate that NC as an index of upper body fat distribution can be used to identify cardio-metabolic syndrome. In India study about neck circumference as a measure of cardio-metabolic syndrome has not been done. In contrast measurement of NC is a simple, time saving, and least invasive measurement tool. Comparison of our study with previously conducted studies [Table/Fig-6].

LIMITATIONS

Since our study was a hospital based study, results may overestimate the true correlation between NC and cardio metabolic syndrome. Neck circumference is a proxy for upper-body fat; we did not have radiographic measures to directly quantify this fat deposition. Other variables such as heart variability, plasma insulin, leptin, interleukin-6, C-reactive protein, and urinary excretion of cortisol and catecholamines metabolites, which can be increased in the metabolic syndrome, were not examined in the present study. Rare endocrine disorders like Cushing's and other obesity associated syndrome evaluation also remains a limitation of our study. However, further studies are needed to examine the relationship between neck circumference and cardio metabolic risk factor in form measurement of visceral fat tissue.

CONCLUSION

Patients with NC >37cm for men and >34cm for women are more prone for cardio metabolic syndrome and require additional evaluation. Men with NC <37cm and women with NC <34cm are not to be considered less prone for cardio metabolic syndrome. NC may be used as a simple, cost effective and time-saving screening measure to identify cardio metabolic risk factors in patients.

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