Neck Circumference as an Independent Predictor of Metabolic Syndrome- A Cross Sectional Study in a Tertiary Care Hospital

Jithendra Chaitanya Gubbala[1], Thanuj Reddy K. V.[2], Prabhakar K.[3]

[1]Postgraduate, Department of General Medicine, Sri Devaraj Urs Academy of Higher Education and Research, Kolar, Karnataka. [2]Assistant Professor, Department of General Medicine, Sri Devaraj Urs Academy of Higher Education and Research, Kolar, Karnataka. [3]Professor, Department of General Medicine, Sri Devaraj Urs Academy of Higher Education and Research, Kolar, Karnataka.

ABSTRACT

BACKGROUND
Various studies indicate that neck circumference may be an independent correlate of metabolic risk factors beyond BMI and waist circumference. Besides, NC is considered to be an index of upper body obesity and correlates positively with changes in systolic and diastolic blood pressure and other components of the metabolic syndrome. This study was conducted to evaluate the association between neck circumference and metabolic syndrome.

METHODS
This is a cross sectional study conducted in the department of general medicine of R. L. Jalappa Hospital, Tamaka, and Kolar. IDF Criteria were used for diagnosis of metabolic syndrome among subjects.

RESULTS
161 subjects were included in the study. In our study 58 out of 161 subjects were female and 103 out of 161 subjects were male with a male to female ratio of approximately 2:1. Mean age of the study subjects was 55.76 ± 13.1 yrs. Out of 161 subjects 86 (53%) subjects had metabolic syndrome and 75 (46.6%) did not have metabolic syndrome. Mean age of the study subjects was 55.76 ± 13.1 yrs. Overall, the mean neck circumference with Metabolic Syndrome is 37.11 cms with an SD of 1.66 cms. Mean neck circumference without Metabolic Syndrome is 34.62 with an of SD 2.29 cms. There was a statistically significant difference between mean neck circumference and metabolic syndrome.

CONCLUSIONS
Neck Circumference may be used as a simple, cost effective and time-saving screening measure to identify cardio metabolic risk factors in patients. Patients with abnormal neck circumference should be screened for cardiovascular risk factors and followed up at regular intervals to detect abnormality at the earliest for the prevention of cardiovascular disease.

KEYWORDS
Metabolic Syndrome, Neck Circumference

BACKGROUND

A global transition in disease patterns has been observed, where the relative impact of infectious diseases is decreasing while that of chronic diseases like cardiovascular disease (CVD) and diabetes is increasing. Epidemiologists in India and international agencies such as the World Health Organization (WHO) have been sounding an alarm on the rapidly rising burden of CVD for the past 15 years. 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 is approximately doubled compared with an absence of the syndrome. Metabolic syndrome is defined as a set of risk factors that includes insulin resistance, dyslipidaemia, 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 up to 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 or neck circumference (NC) has been used as its index.[7,8,9] Upper body subcutaneous fat, as estimated by Neck Circumference (NC) confer risk above and beyond visceral abdominal fat. Various studies indicated that neck circumference may be independent correlate of metabolic risk factors beyond BMI and waist circumference.[10] 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.[11]

METHODS

Study was conducted to establish an association between neck circumference and metabolic syndrome. The study was conducted in department of general medicine of R L Jalappa Hospital, Tamaka, and Kolar. IDF Criteria was used for diagnosis of metabolic syndrome among subjects.

IDF Criteria
The presence of central adiposity defined as waist circumference of ≥90 cm in males and ≥80 cm in females in the South East Asian population. Along with central adiposity two of the following four factors should be present to define metabolic syndrome:
1. Fasting triglycerides ≥150 mg/dl or specific medication.
2. HDL cholesterol < 40 mg/dl and < 50 mg/dl for men and women, respectively or specific medication.
3. Blood pressure ≥ 130 mmHg systolic or ≥85 mmHg diastolic or previous diagnosis or specific medication.
4. Fasting plasma glucose ≥ 100 mg/dl or previously diagnosed Type 2 diabetes

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. 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. Normal value: In males <37 cms 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.

Statistical Analysis
Data was entered into Microsoft excel data sheet and was analysed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square test or Fischer's exact test (for 2 x 2 tables only) was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation. Independent t test was used as test of significance to identify the mean difference between two quantitative variables. Neck circumference were further analysed using the receiver operating characteristic (ROC) and optimal cut-off points were chosen for the calculation of sensitivity, specificity. A test that predicts an outcome no better than chance has an area under the ROC curve of 0.5. An area under the ROC curve above 0.8 indicated fairly good prediction. P value (probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests. Statistical software: - MS Excel, SPSS version 22 (IBM SPSS Statistics, Somers NY, USA) was used to analyse data.

RESULTS

A cross sectional study was conducted in department of general medicine of R. L. Jalappa Hospital, Tamaka, and Kolar. Total 161 subjects were included in the study. In our study 58 out of 161 subjects were female and 103 out of 161 subjects were male. 36% were female and 64 were male. Male female ratio was approximately 2:1. Mean age of the study subjects was 55.76 ± 13.1 yrs. Out of 161 subjects 86(53%) subjects had metabolic syndrome and 75 (46.6%) did not had metabolic syndrome. Mean age of the study subjects was 55.76 ± 13.1 yrs.

Metabolic syndrome was significantly associated with Neck Circumference. Metabolic syndrome was not
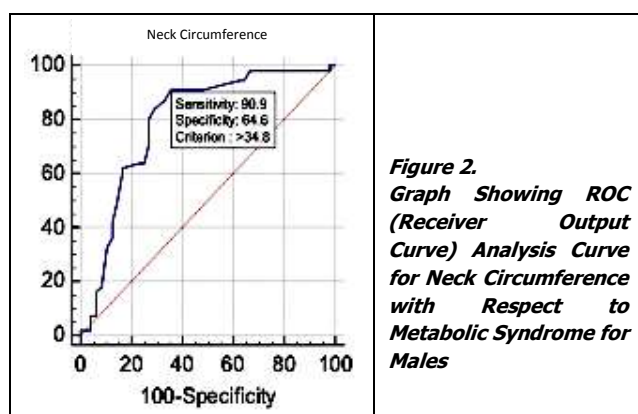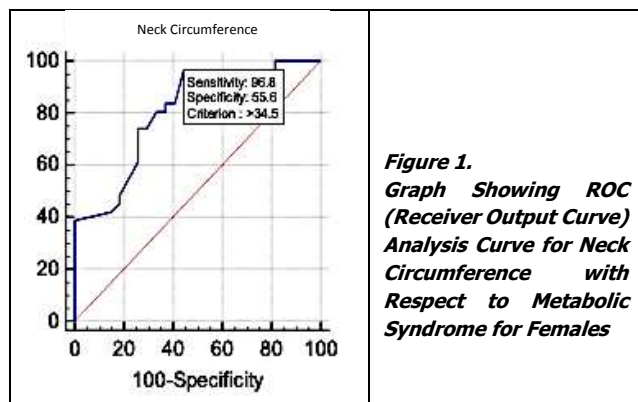
significantly associated with age, gender, and Hypertension and waist circumference**.**

		Metabolic Syndrome				
		Absent		Present		p
		Count	N (%)	Count	N (%)	
Age group	21-30 yrs.	4	5.3%	4	4.7%	0.770
	31-40 yrs.	5	6.7%	5	5.8%	
	41-50 yrs.	19	25.3%	17	19.8%	
	51-60 yrs.	20	26.7%	32	37.2%	
	>60 yrs.	27	36.0%	28	32.6%	
Gender	Female	27	36.0%	31	36.0%	0.995
	Male	48	64.0%	55	64.0%	
Hypertension	No	31	41.3%	44	51.2%	0.268
	Yes	44	58.7%	42	48.8%	
Waist circumference	Normal	15	20.0%	24	27.9%	0.272
	Abnormal	60	80.0%	62	72.1%	
Neck Circumference	Normal	46	61.3%	21	24.4%	<0.001
	Abnormal	29	38.7%	65	75.6%	

Table 1. Association of Metabolic Syndrome with Neck Circumference and Other Factors

		Metabolic Syndrome				
		Absent		Present		p
Neck Circumference		Mean	SD	Mean	SD	
	Female	34.59	2.21	36.97	1.44	<0.001
	Male	34.64	2.36	37.19	1.78	<0.001
	Overall	34.62	2.29	37.11	1.66	<0.001

Table 2. Association of Neck Circumference with Metabolic Syndrome

Figure 1.
Graph Showing ROC (Receiver Output Curve) Analysis Curve for Neck Circumference with Respect to Metabolic Syndrome for Females

Figure 2.
Graph Showing ROC (Receiver Output Curve) Analysis Curve for Neck Circumference with Respect to Metabolic Syndrome for Males

In females Mean neck circumference with Metabolic Syndrome is 36.97 cms with SD 1.44 cms. Mean neck circumference without Metabolic Syndrome is 34.59 with SD 2.21 cms. There was a statistically significant difference found between mean Neck circumference and metabolic syndrome. In males Mean neck circumference with Metabolic Syndrome is 37.19 cms with SD 1.78 cms. Mean neck circumference without Metabolic Syndrome is 34.64 with SD 2.36 cms. There was a statistically significant

difference found between mean Neck circumference and metabolic syndrome. Overall Mean neck circumference with Metabolic Syndrome is 37.11 cms with SD 1.66 cms. Mean neck circumference without Metabolic Syndrome is 34.62 with SD 2.29 cms. There was a statistically significant difference found between mean Neck circumference and metabolic syndrome.

Area under the ROC curve for neck circumference was 0.811 with 95% CI (0.686-0.902). This was statistically significant with the P value <0.001. An area under the ROC curve above 0.8 indicated fairly good prediction which mean Neck circumference can be a good predictor of metabolic syndrome.For mean neck circumference more than 34.5 cms sensitivity is 96.8% and specificity is 55.6% in females. (Figure 1) Area under the ROC curve for neck circumference was 0.803 with 95% CI (0.732-0.897). This was statistically significant with the P value <0.001. An area under the ROC curve above 0.8 indicated fairly good prediction which mean Neck circumference can be a good predictor of metabolic syndrome.For mean neck circumference more than 34.8 cms sensitivity is 90.9% and specificity is 64.6% in males. (Figure 2).

DISCUSSION

A cross sectional study was conducted in department of general medicine of R. L. Jalappa Hospital, Tamaka, and Kolar. Total 161 subjects were included in the study. In our study 58 out of 161 subjects were female and 103 out of 161 subjects were male. 36% were female and 64 were male. Male female ratio was approximately 2:1. Similarly, to study done by Sunil Kumar, Apurva Gupta, Shraddha Jain[12] at Wardha Hospital, total study population 203 patients, of which 120 are male and 83 were female. In our study Mean age of the study subjects was 55.76 ± 13.1 yrs. Out of 161 subjects 86(53%) subjects had metabolic syndrome and 75 (46.6%) did not had metabolic syndrome. Mean age of the study subjects was 55.76 ± 13.1 yrs.

Similar study done by Bochaliya RK, et al[13] 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. Overall Mean neck circumference with Metabolic Syndrome is 37.11 cms with SD 1.66 cms. Mean neck circumference without Metabolic Syndrome is 34.62 with SD 2.29 cms. There was a statistically significant difference found between mean Neck circumference and metabolic syndrome Similarly, to our study Kumar NV et al[14] Mean NC among patients with cardio metabolic risk factor was 36.44 cms, whereas those without cardio metabolic risk factor was 34.08 cms it was statistically significant. In the present study, significant association was found between neck circumference and metabolic syndrome (p<0.001).

Kumar S ET al had hypothesized that neck circumference could be a predictor of obesity and overweight in rural Indian population. Ben-Noun L et al[15-16] have also indicated that neck circumference may be an independent correlate of metabolic risk factors above and

beyond BMI and waist circumference. 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.

In our study Area under the ROC curve for neck circumference was 0.803 with 95% CI (0.732-0.897). This was statistically significant with the P value <0.001.An area under the ROC curve above 0.8 indicated fairly good prediction which mean Neck circumference can be a good predictor of metabolic syndrome. Similarly, study done by Kumar NV et al[14] ROC Curve signifies NC with cardio metabolic syndrome with area under the curve is 70%. Mean neck circumference 36.5 cms, sensitivity is 50% and specificity is 76%.

CONCLUSIONS

Upper-body fat distribution has long been recognized as related to increased cardiovascular disease risk. Neck circumference can be used as a sensitive marker for metabolic syndrome although not specific. Females with a neck circumference of more than 34.5 cms and males with a neck circumference of more than 34.8 cms are more prone for metabolic syndrome. Neck Circumference may be used as a simple, cost effective and time-saving screening measure to identify cardiometabolic risk factors in patients. 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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