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Risk of Coronary Artery Disease and Thigh Circumference

Ishwah Akram[1], Muhammad Zubair[1], Syeda Kinza Bukhari[1], Fahad Ahmad Khan[1], Aima Maheen[2], Bareera Aslam[1]

[1]Department of Medicine, Combined Military Hospital (CMH), Multan, Punjab, Pakistan.
[2]Bakhtawar Amin Medical and Dental College, Multan, Punjab, Pakistan.

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Corresponding Author: Ishwah Akram, Department of Medicine, Combined Military Hospital (CMH), Multan, Punjab, Pakistan.
Email: ishwahakram07@gmail.com

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ABSTRACT

Objectives: To determine the association between thigh circumference and risk of coronary artery disease. **Study Design:** Case-control study: Place and duration of study: Department of Medicine, CMH Hospital Multan, Pakistan from November 2023 to February 2024. **Methods:** A total of 150 patients reporting at the outpatient department and diagnosed as having coronary artery disease were enrolled in this study and included in Study group through consecutive sampling. Another 150 patients reporting at the outpatient department and not suffering from coronary artery disease were included in the Control group. Diagnosis of coronary artery disease was performed on the basis of electrocardiogram, levels of creatine kinase and further confirmed on coronary angiogram. All the demographic details and relevant clinical history and anthropometric measurements were performed including the thigh circumference. The primary outcome was set as the significance of difference between thigh circumferences of patients in the Study group compared with patients in Control group. **Results:** The Mean±SD of age of study participants was 55.23±8.12 years with age ranging from 42 to 68 years. Male gender was 56% while female gender was 44%. The results of this study showed that thigh circumference in Study group was significantly smaller than that in Control group (51.30±3.41 cm Vs 52.55±3.80 cm, p=0.003). Moreover the number of patients with thigh circumference≤50 cm were significantly higher in the Study group compared to Control group (58 Vs 40, p=0.026). **Conclusion:** An association was found between smaller thigh circumference and incidence of coronary artery disease, it is therefore an important anthropometric parameter for measuring the risk of coronary artery disease.

INTRODUCTION

Cardiovascular disease (CVD) has emerged as a common condition, affecting the heart and arteries, and accounts for about 31% of mortality around the globe. Hypertension (HTN), coronary artery disease (CAD), cardiomyopathies, heart failure (HF), acute coronary syndrome (ACS) and stroke are among the frequently reported CVDs which contributes to the largely reported data of morbidity, mortality and cost high heath budgets.[1,2] The developing countries going rapidly through the process of urbanization are facing this challenge more seriously. In case of South Asia, ethnicity also contribute to this challenge, as a data extracted from the UK Biobank shows a significantly higher risk of CVD in South Asians compared to Europeans.[3,4] It was also observed that the atherosclerotic CVD was prevalent at earlier ages in South Asians people than other ethnic communities.[4,5,6]

The worldwide incidence of obesity has reached at an epidemic level during past few decade. The data has found relation between the buildups of body fat in the abdomen to the metabolic syndrome, responsible for the incidences of HTN, CAD, HF and strokes and linked to the highly reported morbidity and mortality in the obese.[7,8]

In view of the above mentioned data, the risk assessment for CVD has been the topic of research since many years. Anthropometric parameters are suggested to be useful in this regard including waist circumference (WC), hip circumference (HC), waist/Hip ratio (W/H), waist/ height ratio (W/H) and body mass index (BMI).[9] As per the recent understanding, visceral adipose tissues are given more attention for calculating the risk of adverse outcomes as compared to previously considered biometric criteria of body mass index (BMI).[10,11]

There is an important finding in this risk assessment criteria that contrary to the visceral fat, peripheral fat located in the lower parts of body is beneficial and provide a good assessment of CV risk including BP,

diabetes, CAD and stroke.[12] A large amount of body mass is made up of skeletal muscle, which is also the main area of insulin-stimulated absorption of glucose.

Researchers working on anthropometric parameters have found a contrasting association between the thigh mass and the metabolic diseases risk. Small thigh circumference (TC), an easily measured anthropometric parameter, has been linked to higher heart disease morbidity and mortality risk in the general population. Furthermore, TC has been shown in prior research to have an inverse relationship with cardio metabolic disorders, such as dyslipidemia, peripheral artery disease and type 2 diabetes. Dementia is an increasingly common condition with greater death rates, and it is also linked to small TC.[13]

Despite of being easier and needing no extra costs, this association is, however, under- investigated in global as well as our local medical literature. It is also important to mention that these measurements indicating this risk are found to be specific for the lifestyles, geographical areas and ethinicity.[14]

This study was therefore planned to find the association between TC and the risk of developing CAD in our local population. The results of this study will help cardiologists, physicians and general practitioners to determine the risk of CAD in patients and design their treatment strategy accordingly.

METHODOLOGY

This case control study was conducted at the department of Medicine, CMH Hospital Multan, Pakistan from November 2023 to February 2024 over a period of 4 months.

Sample size was estimated with OpenEpi sample size calculator taking,

Power= 80% and α=5% (two-sided) m1=47.2, m2=45.36 sd1=±5.77, sd2=±5.31.[14]

n2/n1= 1, sample size n1=143, n2=143

A total of 150 patients reporting at the outpatient department of the unit and diagnosed as having CAD were enrolled in this study and included in study group through consecutive sampling. Another 150 patients reporting at the outpatient department and not having CAD were included in the controlled group.

Patients under the age of 18 years, pregnant females and patients not willing to participate, were excluded.

Diagnosis of CAD was made on the basis of electrocardiogram (ECG), levels of creatine kinase and further confirmed on coronary angiogram.

All the demographic details and relevant clinical history, risk factors and concomitant diseases were recorded. Anthropometric measurements were performed including the TC. Measurement of TC was done on the right thigh using a measuring tape directly below the gluteal fold. The measurement of hip circumference was taken at the area over the buttocks that yielded the largest circumference, and the waist circumference was measured halfway between the iliac crest and lower rib edge.

The primary outcome was set as the significance of difference between TC of patients in the study group compared with patients in control group.

Participants were informed about the objectives and a written consent was taken before adding them in the study. Approval of conducting the study was taken from the ethical committee of the hospital.

Data was analyzed using SPSS version 25. Quantitative variables were presented in form of Mean±SD while qualitative variables were calculated in form of frequency and percentage. Anthropometric parameters including TC were compared between the 2 groups by applying Chi-square test and independent t-test, where $p \leq 0.05$ was taken as statistically significant.

RESULTS

The Mean±SD of age of study participants was 55.23±8.12 years with an age range of 42-68 years. Male gender was 56% while female gender was 44%. The group wise details of demographics, risk factors and concomitant diseases are shared in Table-I.

Table I

Demographics and clinical history. (n=300)

Demographics and clinical history		Study Group n=150	Control group n=150
Age (Mean±SD) years		55.6±8.05	54.86±8.21
Gender	Male n (%)	85 (56.67)	83 (55.33)
	Female n (%)	65 (43.33)	67 (44.66)
Smoking n (%)		38 (25.33)	36 (24)
History of CAD n (%)		32 (21.33)	19 (12.66)
Hypertension n (%)		59 (39.33)	48 (32)
Diabetes n (%)		50 (33.33)	39 (26)
Dyslipidemia n (%)		34 (22.66)	35 (23.33)

The comparison of anthropometric assessments of the study participants shows that TC had significant association with the incidence of CAD. Moreover the number of patients with TC≤50 cm were significantly higher in the Study group compared to Control group, as shown in Table- II:

Table II

Comparison of anthropometric assessments (n=300)

Anthropometric parameters	Study Group n=150	Control group n=150	Chi-square/ t test values	P-value
BMI (Mean±SD) Kg/m^2	29.74±4.12	29.02±4.35	1.47	0.142
W/H ratio (Mean±SD)	0.880±0.050	0.878±0.049	0.35	0.727
TC (Mean±SD) cm	51.30±3.41	52.55±3.80	2.999	0.003
Number of participants with TC≤50 cm n (%)	58 (38.66)	40 (26.66)	4.91	0.027

DISCUSSION

The association between TC and risk of CVD has been mentioned in medical literature but the data provided in this regard is sparse. This is even more valid for

association specifically between TC and the risk of CAD.

Heitmann BL and Frederiksen P planned a prospective cohort study to explore any link between TC and risk of CVD. The results of this study established an independent association between low TC and increased incidences of CAD, overall CV morbidity and total mortality. This association was independent of BMI or WC and present irrespective of gender and established that smaller TC is a disadvantage for CV health and overall survival. Stratification with type of obesity, fat distribution, hypertension and dyslipidemia suggested the same. This advantage was however found up to a threshold value of 60 cm for TC.[15]

Latheef SAA studied the association between anthropometric parameters and the risk of CAD in adult males. The study confirmed that 18 parameters were useful for assessing the CAD risk. Out of these abdomen, thigh, calf and foot circumferences, W/H ration, lean body mass and skin fold thickness were most useful and were able to account for 73% of the risk variation.[14]

Laghari ZA et al performed a study with Pakistani population to determine the utility of anthropometric indicators for the assessment of CVD risk. The parameters used for this assessment were TC, BMI, WC and W/H ratio. While the parameters like WC, W/H ratio, BMI and circumference of mid upper arm were linked to overall CVD risk, TC was positively related to high density lipoprotein levels and increase in TC was shown to decrease the cardiac disease risk. TC was therefore mentioned as useful cardio-protective indicator.[16]

Chen CL worked on the link of TC with important CV end points like CV, cerebrovascular and all-cause mortality. An important finding of this large scale cohort study was a 4% decrease in all-cause mortality and 6% decrease in CV mortality with just 1 cm increase in TC. The study shared the conclusion that a low TC is indicator of high risk of CV as well as total mortality.[17] Arbero worked on the correlation between thigh, calf and arm circumference and the incidence of CV and total mortality. An association was established in this study for increased risk of CAD and kidney disease with decreased TC. The results reported an association correlation between TC and calf circumference with CV and total mortality risk, this risk was not found for arm circumference. The study established that there is statistically significant link between increased TC and lowered risk of mortality. The study investigators mentioned TC and calf circumference as a tool for providing a valuable prognostic information for both CV and total mortality.[18]

The Mean±SD of age of in our study was 55.23±8.12 years with an age range of 42-68 years. Male gender was 56% while female gender was 44%. The results of the study show that thigh circumference in study group was significantly smaller than that in control group (51.30±3.41 cm Vs 52.55±3.80 cm, p=0.003). Moreover the number of patients with TC≤50 cm were significantly higher in the study group compared to control group (58 Vs 40, p=0.026). These results are in line with the finding shared previously by different researches working on this topic and establish an association between TC and risk of CAD.[14,15,16,17,18]

The major limitation of our study is small sample size. Moreover we took limited number of parameters into considerations that can be assessed with ease of use without any additional requirements of health budgets. Future studies with a larger sample size and adding more variety of parameters will add up to this use full data for risk assessment of CAD.

CONCLUSION

An association was found between smaller TC and incidence of CAD, establishing TC as an important anthropometric parameter for measuring the risk of CAD. Measuring TC is a simple procedure, not consuming extra time and budgets, hence its use as a focal point may assist the clinicians in identifying patients who are more susceptible to CVD especially CAD. It can also be assumed that this risk can be minimized with increase in TC.

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