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Original Article

Wrist Circumference as a Novel Predictor of Coronary Artery Disease and Metabolic Syndrome

Palash Mondal[1], Subrata Basu[2], Manish Saha[3], Krishanko Das[4]

[1]*Consultant Interventional Cardiologist, Kolkata, West Bengal, India*

[2]*Department of Cardiology, North Bengal Medical College, West Bengal, India*

[3]*Department of Cardiology, R.G. Kar Medical College and Hospital, Kolkata, West Bengal, India*

ABSTRACT

Introduction: Wrist circumference is a good predictor of obesity and insulin resistance. Wrist circumference may be considered as an indirect determinant of hyperinsulinemia and insulin resistance. The present study aimed to assess the wrist circumference as an alternative tool for differentiating patients with coronary artery disease and metabolic syndrome from those without coronary artery disease and metabolic syndrome.

Materials and Methods: The study had been conducted on patients ≥ 30 years undergoing coronary angiography following acute coronary syndrome or for evaluation of coronary artery disease.

Results: Diabetic, hypertensive, obese patients had more wrist circumference. High TG, low HDL level were associated with higher wrist circumference (p=0.005). Wrist circumference was positively correlated with waist hip ratio (p<0.001). Patients with Metabolic Syndrome have mean Wrist circumference 16.54 whereas patients without Metabolic Syndrome have mean wrist circumference 15.89(p<0.001). Coronary artery disease patients had higher mean wrist circumference than non- coronary artery disease patients (16.59 vs 15.9) (p<0.001). Triple-vessel-disease patients have higher wrist circumference than double-vessel-disease patients; Double-vessel-disease patients have higher wrist circumference than single-vessel-disease (p<0.001). Multivariate logistic model shows the main predictors for coronary artery disease are male sex, smoking, high BMI, low HDL and wrist circumference.

Conclusion: Measurement of Wrist circumference can serve as an easy anthropometric marker to identify individuals at risk of cardio-metabolic disorder, also to predict the severity of Coronary Artery Disease and can be used in large epidemiological studies.

Keywords: Cardiovascular disease; Cardiometabolic disorder; Coronary Artery Disease; Metabolic Syndrome; Wrist Circumference

Correspondence:

Dr. Krishanko Das, Post-Doctoral Resident,
Department of Cardiology
R.G. Kar Medical College and Hospital, Kolkata, West Bengal, India
ORCID ID:
Email: kri07@rediffmail.com

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INTRODUCTION

Cardiovascular diseases (CVDs) are major causes of morbidity and mortality worldwide.[1,2] Scarcity of preventive programs have made CVDs more prevalent in developing countries in recent years.[3,4] There are numerous anthropometric and metabolic indicators, with some causal and synergistic effects, for predicting cardiovascular disease including Metabolic Syndrome(MetS).[5] Obesity has a role to develop insulin resistance, diabetes, and MetS.[6] Cluster of anthropometric parameters are proposed as obesity-equivalent for diagnosing individuals with higher risk for CVDs. Previously body weight and body mass index (BMI) were main indicators for obesity; but those indices could neither distinguish fat from muscle mass, nor represent the distribution pattern of one's body fat.[7,8] Therefore, some other anthropometric parameters such as increased waist circumference and waist to hip ratio have been proposed and demonstrated to be closely associated with higher cardiovascular risk.[8,9] The values of these parameters, however, are affected by various environmental and hereditary factors, making their specificity lowered for cardiovascular risk estimation.[10] In a few studies, increased neck or wrist circumference (WrC) could delineate high-risk groups with morbid obesity, diabetes mellitus, dyslipidemia, or MetS.[11,12] From a pathophysiologic point of view, increased bone mass has been proved to be associated with hyperinsulinemia[13]; and the insulin receptor signaling pathway has been demonstrated to communicate the bone remodeling process with the body metabolic control.[14] In a study conducted by Tatar et al they showed that wrist circumference is a good predictor to qualify obesity and insulin resistance. Therefore, WrC in this context may be considered as an indirect determinant of hyperinsulinemia and insulin resistance. Assuming there is less comprehensive data in the literature focusing on the eligibility of WrC as a potential risk indicator for CVD, the present study aimed to assess the WrC as an alternative tool for differentiating patients with CAD and MetS from those without CAD and MetS.

MATERIALS AND METHODS

It is a hospital-based observational cross-sectional study. The study had been conducted on 200 patients aged 30 years or more who underwent coronary angiography following acute coronary syndrome or for evaluation of coronary artery disease meeting the inclusion and exclusion criteria in the Department of Cardiology, R. G. Kar Medical College, Kolkata from March 2017 to August 2018. Patients with previous history of coronary artery disease, history of diagnostic or therapeutic coronary intervention, acquired (traumatic) or inherited skeletal deformity involving wrist, endocrinal disorder like hypothyroidism, acromegaly etc., known malignancy, patients with edematous wrist due to local or systemic cause were excluded from this study.

RESULTS

Among 200 patients, 37.5% patients were female, 62.5% were male. Majority were between 40-70 years of age, with maximum 32.5% patients were between 41-50 years of age. 30% had family h/o CAD, and 25% were smokers. 35% had either history of diabetes or newly diagnosed Diabetes, and 65% patients were hypertensive. 47.5% of patients were either obese or pre-obese with BMI >25 Kg/m^2. 62.5% of patients had TG level>150 mg/dl. 42.5 % of patients had HDL levels <40 mg/dl in males and <50 mg/dl in females. 75% of patients had increased waist circumference according to race and sex. 70% of patients had increased waist-to-hip ratio. 65% of patients were having metabolic syndrome according to IDF (International Diabetes Federation) criteria. 60% of patients were diagnosed to have coronary artery disease by coronary angiography. Among the patients with coronary artery disease (CAD), 41.7% had single-vessel-disease (SVD), 33.3% had double-vessel-disease (DVD) and 25% had triple-vessel-disease (TVD). CAD was mainly prevalent in the age group of 41-70 years and in males. CAD was more associated with diabetes mellitus (DM) (p=0.005), more prevalent in patients with HTN (0.034), and in patients with BMI>25 kg/m^2 (p<0.001). CAD patients had more association with high TG levels (p=0.136) and low HDL levels (p=0.009). CAD patients had more waist circumference (p=0.096), and more waist-hip ratio than non-CAD patients (p=0.059). Male patients had more wrist circumference than female patients but it was not clinically significant (p=0.468). Diabetic patients had more wrist circumference than non-Diabetic patients (p<0.001). Hypertensive patients had more wrist circumference than normotensive patients (p<0.001). Higher BMI is associated with more wrist circumference in a statistically significant fashion (p=0.001). A higher TG level is associated with higher wrist circumference (p=0.005). A lower level of HDL was associated with higher wrist circumference (p<0.001). Wrist circumference is positively correlated with waist circumference (p<0.001) (Figure 1). In this study, it was observed that wrist circumference is positively correlated with waist-hip ratio (p<0.001) (Figure 2).

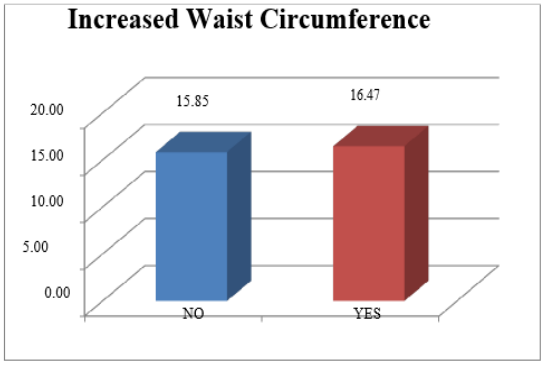

Figure 1: Correlation between Wrist Circumference and Increased Waist Circumference (p<0.001)

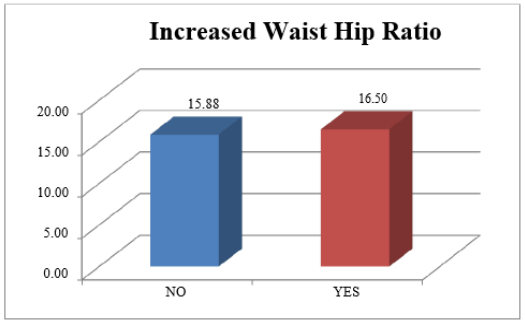

Figure 2: Correlation between Wrist Circumference and Increased Waist Hip Ratio (p<0.001).

Patients with Metabolic syndrome had a mean Wrist circumference of 16.54 whereas patients without metabolic syndrome had a mean wrist circumference of 15.89. It was positively correlated and clinically significant (p<0.001) (Figure 3). CAD patients had higher mean wrist circumference than non-CAD patients (16.59 vs 15.9) (p<0.001) (Figure 4). TVD patients had a higher wrist circumference than DVD patients; DVD patients had a higher wrist circumference than SVD patients (p<0.001) (Figure 5). A multivariate logistic model shows the main predictors for CAD are Male sex, Smoking, High BMI, Low HDL, Wrist circumference. (Table 1)

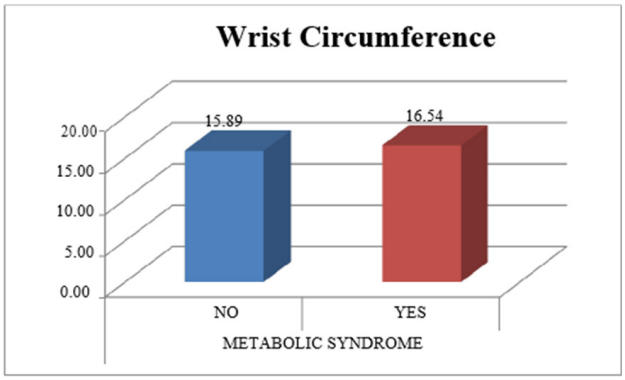

Figure 3: Correlation between Wrist Circumference and Metabolic Syndrome (p<0.001).

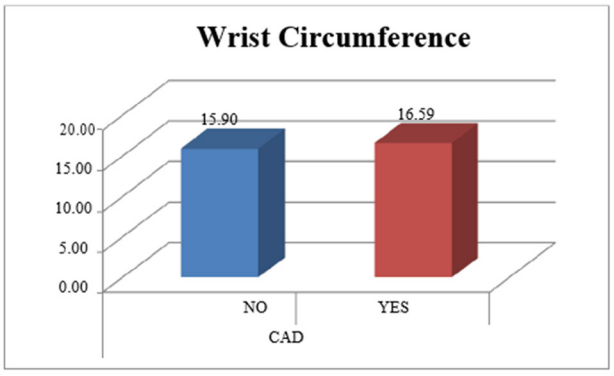

Figure 4: Correlation between Wrist Circumference and CAD(p<0.001).

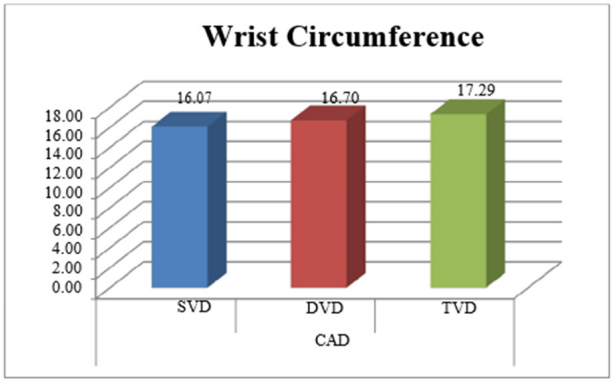

Figure 5: Correlation between Wrist Circumference and Number of Coronary Artery involvement (p<0.001).

Table 1: Multivariate Logistic analysis of predictors of CAD among the study population

	B	S.E.	Wald	df	p-Value	OR	95% C.I.for OR	
							Lower	Upper
Age	0.079	0.024	10.942	1	0.001	1.082	1.033	1.134
Sex	1.824	0.515	12.549	1	<0.001	6.197	2.259	17.002
F/H/CAD	-0.629	0.557	1.277	1	0.258	0.533	0.179	1.587
Smoking	-1.726	0.654	6.974	1	0.008	0.178	0.049	0.641
DM	0.053	0.607	0.008	1	0.931	1.054	0.321	3.463
HTN	-0.272	0.724	0.142	1	0.707	0.762	0.184	3.146
HIGH BMI	1.832	0.797	5.278	1	0.022	6.247	1.309	29.819
HIGH TG	-0.214	0.777	0.076	1	0.782	0.807	0.176	3.697
LOW HDL	1.661	0.681	5.947	1	0.015	5.265	1.385	20.008
INCREASED WC	-1.400	0.860	2.649	1	0.104	0.246	0.046	1.331
INCREASED WHR	1.689	1.137	2.207	1	0.137	5.413	0.583	50.255
WrC Circumference	0.700	0.214	10.673	1	0.001	2.013	1.323	3.063
MET	-1.445	1.130	1.635	1	0.201	0.236	0.026	2.159
Constant	-16.088	3.553	20.507	1	<0.001	0.000		

DISCUSSION

Other than BMI, waist circumference, waist to hip ratio, some recent evidences have been focused on the usefulness of measuring WrC for predicting risk of CVDs. Association has also been found between WrC and metabolic risk subgroups such as obesity, insulin resistance, and MetS.

In this study, CAD is associated significantly with male sex (p=0.003), increased age (p<0.001), Diabetes (p=0.015), Hypertension (p=0.034), increased BMI (>25kg/m^2) (p<0.001), Low HDL (p=0.009). Other risk factor also had some weak positive correlation like family history of CAD (p=0.208), high TG level (p=0.136), increased Waist circumference (p=0.096), increased Waist Hip ratio (p=0.059). In multivariate model, age, Sex, High BMI and Low HDL were shown to be associated with CAD.

In this study that WrC is positively associated with the risk factors of CAD like Diabetes (p<0.001), Hypertension (p<0.001), high TG level (p =0.005) and low LDL level (p<0.001). Other anthropometric parameters are also significantly associated with WrC like BMI (p=0.001), Waist Circumference (p<0.001), waist Hip ratio (p<0.001).

Shokoufeh Hajsadeghi et al showed that WrC had a weak positive correlation with triglyceride (r = 0.172, P = 0.011) and cholesterol (r = 0.141, P = 0.038) level and a weak negative association with high-density lipoprotein level (r = - 0.279, P < 0.001) which is similar like this study.[15] Tatar BT also demonstrated that WrC is positively correlated with the level of insulin resistance, weight, and BMI (p=0.002), as well as neck, waist circumference (p<0.001), hip circumferences (p=0.001), and waist to hip ratio (p=0.023); but negatively correlated with HDL-C level. [16] Similar associations have also been indicated among Iranian CAD patients in a study by Amini et al.[17] Reza Mohebi et al. found significant correlation between waist circumference and WrC in risk prediction of hypertension and CVD(*P*<.001).[18] Capizzi et al also found a close relationship between WrC, its bone component, and insulin resistance among overweight/obese children and adolescents.[19] Karki BB et al study showed that wrist circumference had positive correlation with Waist circumference, Waist Hip ratio and BMI, all having p value<0.001.[20] All these studies proved the association between Wrist circumference and cardiometabolic risk factors which is also seen in this study. Shokoufeh Hajsadeghi et al also showed WrC was significantly higher in CAD compared to non-CAD patients (17.85±1.29 mm vs 17.43±1.29 mm, P=0.017).[15] The overall prevalence of MetS was significantly different between the CAD and non-CAD subjects (74.3% vs 58.8%, P =0.016). Although there was a tendency for association, no statistically significant association between the mean of the WrC and the severity of CAD was found (P = 0.065). Maybe some racial variation is the reason for this weak correalation.[15] Reza Mohebi et al also concluded that Wrist circumference is a novel predictor of CAD especially in non-centrally obese women.[18]

This study also showed the association between WrC and CAD and MetS. Patients with MetS had mean WrC 16.54±1.09, and those without MetS had mean Wrc 15.89±1.05 which is statistically significant (p<0.001). Patient with CAD have mean Wrc 16.59±1.09 whereas in those without CAD it is 15.90±1.03 (p<0.001). Also WrC is positively correlated with the severity of CAD. Patients with TVD, DVD and SVD had mean WrC of 17.29±0.76, 16.70±1.06 and 16.07±1.03 respectively that is also statistically significant. With multivariate logistic model, the association between Wrist circumference and CAD has been proven to be clinically significant (p=0.001).

CONCLUSIONS

Wrist Circumference has a significant positive correlation with cardio metabolic risk factors like Diabetes, Hypertension, Triglyceride level and strong negative correlation with HDL level. It has weak positive correlation with male sex. Among the anthropometric indices BMI, Waist Circumference and Waist Hip ratio, all are positively associated with WrC. CAD and Metabolic syndrome are significantly associated with WrC. Severity of CAD also has a positive correlation with mean WrC. Measurement of Wrist circumference can serve as an easy-to-detect anthropometric marker to identify individuals at risk of cardio-metabolic disorder, also to predict the severity of Coronary Artery Disease and can be used in large epidemiological studies.

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