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Original Research Article

Association of Waist-Hip Ratio and Waist-Height Ratio as Independent Factors of Coronary Artery Disease

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Abstract:
Background: Coronary artery disease (CAD) is a major cause of morbidity and mortality worldwide. Abdominal obesity, measured by waist-hip ratio (WHR) and waist-height ratio (WHtR), has been shown to be a better predictor of CAD than body mass index (BMI). This study aimed to investigate the association of WHR and WHtR as independent factors of CAD in an Indian population.
Methods: A prospective observational study was conducted on 110 patients (aged 18-80 years) suspected of having CAD based on non-invasive methods. Anthropometric measurements, including BMI, WHR, and WHtR, were obtained. The association between these indices and CAD was analyzed using odds ratios (OR) and 95% confidence intervals (CI).
Results: The prevalence of CAD was 88% (n=97). WHtR > 0.52 (OR=2.1, 95% CI: 0.65-6.77), WHR > 0.81 in females (Relative Risk [RR]=1.05), and WHR > 0.88 in males (OR=2.0, 95% CI: 0.61-6.47) were strongly associated with CAD. WHtR was a better independent factor of CAD compared to WHR (p<0.00001, 95% CI: -0.4889 to -0.4072) and BMI (p<0.00001, 95% CI: -25.6647 to -24.1011).
Conclusions: WHtR is a better independent factor of CAD compared to WHR and BMI in an Indian population. The strong association of WHtR with CAD, along with its simplicity and ease of measurement, makes it a valuable tool for the early identification of individuals at risk for CAD in resource-limited settings.
Keywords: Coronary artery disease, Waist-hip ratio, Waist-height ratio, Body mass index, Abdominal obesity.

Introduction

Coronary artery disease (CAD) is a major global health concern, leading to significant morbidity and mortality worldwide [1]. In 2016, CAD accounted for approximately 31% of all deaths globally [2]. The burden of CAD is particularly high in developing countries like India, where the prevalence and mortality rates have been increasing rapidly over the past two decades [3]. This rise in CAD prevalence is primarily attributed to the increasing prevalence of risk factors such as diabetes, hypertension, dyslipidemia, smoking, physical inactivity, and central obesity [4].

Obesity is a well-established risk factor for CAD [5]. While body mass index (BMI) is commonly used to assess obesity, it does not account for the distribution of body fat [6]. Measures of abdominal obesity, including waist circumference (WC), waist-hip ratio (WHR), and waist-height ratio (WHtR), have been shown to be better predictors of obesity-related health outcomes, such as cardiovascular diseases [7,8]. However, there is a lack of consensus regarding which anthropometric measurement is the most important independent factor for the risk of CAD [9]. Therefore, this study aims to assess whether WHR or WHtR correlates better with the risk of CAD in an Indian population.

Aims and Objectives

The primary objective of this study is to investigate the association of WHR and WHtR as independent factors of CAD in patients suspected of having the disease based on non-invasive methods.

Methods Study Design and Population

This observational prospective study was conducted at the Department of General Medicine, Rajiv Gandhi Medical College, Kalwa, Thane, Maharashtra, India, over a period of 6 months from February 2023 to July 2023. The study included 110 patients aged between 18 and 80 years, who were suspected of having CAD based on non-invasive methods such as symptoms, electrocardiogram (ECG), cardiac markers, or clinical assessment. The study was approved by the Institutional Ethics and Scientific Committees of Rajiv Gandhi Medical College.

Patients with a previous history of CAD, those consuming anti-platelets, statins, or anticoagulant drugs for any other reason, and those who participated in weight reduction programs or received weight-reducing medications were excluded from the study. Additionally, pregnant patients, those with endocrinopathies (except diabetes), any vascular disease (except CAD), intra-abdominal tumors or masses, ascites, or a history of gastric surgery, and those unwilling to participate were also excluded.

Data Collection After obtaining written informed consent, demographic details, medical history (including comorbidities and family history), and anthropometric measurements were recorded for each participant. Anthropometric measurements included height, weight, WC, and hip circumference (HC). Height was measured manually in centimeters using a stadiometer, while weight was measured in kilograms using a digital weighing scale. WC was measured using a flexible measuring tape at the midpoint between the lower costal margin and the iliac crest, and HC was measured at the level of the greater trochanter. All measurements were taken with the participants wearing light clothing and without shoes.

Derived Anthropometric Indices

1. Body Mass Index (BMI): Calculated as weight in kilograms divided by height in meters squared (kg/m²). The cut-off value was taken as 23 kg/m² irrespective of gender [10].
2. Waist-Hip Ratio (WHR): Calculated as WC divided by HC. The cut-off values were taken as 0.89 for men and 0.81 for women [10].
3. Waist-Height Ratio (WHtR): Calculated as WC divided by height. The cut-off value was taken as 0.52, irrespective of gender [11].

Statistical Analysis

Data were analyzed using SPSS software version 20 (IBM Corporation). Categorical variables were presented as frequencies and percentages, while continuous variables were presented as mean ± standard deviation or median (minimum-maximum). The normality of distribution was assessed using the Shapiro-Wilk test. Fisher's exact test was used to assess the statistical significance of differences in categorical variables. Odds ratios (OR) with 95% confidence intervals (CI) were used to determine the association between various parameters and CAD. The independent samples t-test was used to compare the means of continuous variables between groups. A p-value < 0.05 was considered statistically significant.

Results

Demographic and Anthropometric Characteristics The mean age of the participants was 56.1 ± 12.41 years, with a nearly equal distribution between males (77%) and females (23%). The mean weight, height, WC, and HC were 67.54 ± 10.59 kg, 163.05 ± 10.49 cm, 83.12 ± 23.77 cm, and 84.43 ± 24.58 cm, respectively. The demographic and anthropometric characteristics of the study population are summarized in Table 1.

Table 1: Demographic and anthropometric characteristics of the study population

Characteristic	Mean ± SD or Frequency (%)
Age (years)	56.1 ± 12.41
Gender	
- Male	85 (77%)
- Female	25 (23%)
Weight (kg)	67.54 ± 10.59
Height (cm)	163.05 ± 10.49
Waist Circumference (cm)	83.12 ± 23.77
Hip Circumference (cm)	84.43 ± 24.58
BMI (kg/m²)	25.47 ± 3.86
WHR	
- Male	0.93 ± 0.06
- Female	0.88 ± 0.07
WHtR	0.51 ± 0.14

SD: Standard Deviation; BMI: Body Mass Index; WHR: Waist-Hip Ratio; WHtR: Waist-Height Ratio

Prevalence of CAD and Associated Factors Out of 110 participants, 88% (n=97) had CAD, while 12% (n=13) did not. No significant association was found between CAD and gender (p=0.29). However, family history (OR=1.11, 95% CI: 0.33-3.64) and the presence of comorbidities (OR=3.02, 95% CI: 0.93-9.81) were strongly associated with CAD (Table 2).

Table 2: Association of CAD with gender, family history, and comorbidities

Factor	CAD Present (n=97)	CAD Absent (n=13)	OR (95% CI)	p-value
Gender				
- Male	73 (86%)	12 (14%)	0.30 (0.04-2.44)	0.29
- Female	24 (96%)	1 (4%)		
Family History				
- Present	62 (89%)	8 (11%)	1.11 (0.33-3.64)	1.00
- Absent	35 (88%)	5 (12%)		
Comorbidities				
- Present	70 (92%)	6 (8%)	3.02 (0.93-9.81)	0.07
- Absent	27 (79%)	7 (21%)		

OR: Odds Ratio; CI: Confidence Interval

Association of CAD with Anthropometric Indices WHR > 0.81 in females (Relative Risk [RR]=1.05) and WHR > 0.88 in males (OR=2.0, 95% CI: 0.61-6.47) were strongly associated with CAD. WHtR > 0.52 was also strongly associated with CAD (OR=2.1, 95% CI: 0.65-6.77). The association of CAD with various anthropometric indices is presented in Table 3.

Table 3: Association of CAD with anthropometric indices

Anthropometric Index	CAD Present (n=97)	CAD Absent (n=13)	OR (95% CI)	p-value
BMI (kg/m²)				
- ≥23	73 (88%)	10 (12%)	0.91 (0.25-3.36)	1.00
- <23	24 (89%)	3 (11%)		
WHR (Females)				
- >0.81	22 (96%)	1 (4%)	RR=1.05	0.08
- ≤0.81	2 (100%)	0 (0%)		
WHR (Males)				
- >0.88	62 (89%)	8 (11%)	2.00 (0.61-6.47)	0.34
- ≤0.88	11 (73%)	4 (27%)		
WHtR				
- >0.52	70 (91%)	7 (9%)	2.10 (0.65-6.77)	0.31
- ≤0.52	27 (82%)	6 (18%)		

OR: Odds Ratio; CI: Confidence Interval; RR: Relative Risk; BMI: Body Mass Index; WHR: Waist-Hip Ratio; WHtR: Waist-Height Ratio Comparison of Anthropometric Indices WHtR was found to be a better independent factor of CAD compared to WHR (p<0.00001, 95% CI: -0.4889 to -0.4072) and BMI (p<0.00001, 95% CI: -25.6647 to -24.1011). WHR was also a better independent factor of CAD compared to BMI (p<0.00001, 95% CI: -25.2159 to -23.6538) (Table 4).

Table 4: Comparison of anthropometric indices as independent factors of CAD

Comparison	Mean Difference (95% CI)	p-value
WHtR vs. WHR	-0.4480 (-0.4889 to -0.4072)	<0.00001
WHtR vs. BMI	-24.8829 (-25.6647 to -24.1011)	<0.00001
WHR vs. BMI	-24.4348 (-25.2159 to -23.6538)	<0.00001

CI: Confidence Interval; WHtR: Waist-Height Ratio; WHR: Waist-Hip Ratio; BMI: Body Mass Index

Discussion

This study aimed to investigate the association of WHR and WHtR as independent factors of CAD in an Indian population. The findings demonstrate that WHtR is a better independent factor of CAD compared to WHR and BMI. These results are consistent with previous studies that have shown WHtR to be a superior anthropometric measure for predicting cardiovascular risk [12,13].

The strong association between CAD and family history, as well as the presence of comorbidities, is well-established [14,15]. Our study further confirms these associations, highlighting the importance of considering these factors in the assessment of CAD risk. The higher prevalence of CAD in individuals with a family history and comorbidities underscores the need for early screening and intervention in these high-risk groups.

The stronger association of WHR with CAD in females compared to males is in line with previous findings [16]. This may be attributed to the differences in body fat distribution between genders, with females having a higher propensity for abdominal obesity [17]. The gender-specific cut-off values for WHR used in this study also account for these differences in body fat distribution.

The superiority of WHtR over BMI in predicting CAD risk can be explained by the fact that BMI does not account for the distribution of body fat [18]. In contrast, WHtR considers both central adiposity and overall body size, making it a more comprehensive measure of obesity-related health risks [19]. Additionally, WHtR has the advantage of being a simple and easily interpretable measure, with a single cut-off value applicable to both genders and across different age groups [20].

Limitations of this study include the relatively small sample size and the single-center design, which may limit the generalizability of the findings. Furthermore, the use of non-invasive methods for the initial suspicion of CAD may have introduced some selection bias. Future research should focus on validating these findings in larger, multi-center cohorts with more definitive diagnostic criteria for CAD.

Conclusions

In conclusion, this study demonstrates that WHtR is a better independent factor of CAD compared to WHR and BMI in an Indian population. The strong association of WHtR with CAD, along with its simplicity and ease of measurement, makes it a valuable tool for the early identification of individuals at risk for CAD in resource-limited settings. Healthcare professionals can use WHtR to recommend lifestyle modifications, such as healthy dietary habits and regular exercise, to reduce the risk of developing CAD. The findings of this study highlight the importance of incorporating WHtR in the routine assessment of cardiovascular risk and support its potential as a screening tool for the primordial prevention of CAD and its risk factors. Future research should focus on validating these findings in larger, more diverse populations and exploring the cost-effectiveness of using WHtR as a screening tool in various healthcare settings.

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