

Correlation Between Body Mass Index and Severity of Coronary Artery Disease in Patients Undergoing Angiography at Tertiary Care Hospital Bahawalpur

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Abstract

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Background: Coronary artery disease (CAD) remains a leading cause of morbidity and mortality globally and is increasingly prevalent in South Asian populations. Obesity, as measured by body mass index (BMI), is a recognized cardiovascular risk factor; however, its direct association with the severity of CAD remains debated. Aim and Objective: This study aimed to assess the association between BMI and the severity of CAD among patients undergoing coronary angiography at a tertiary care hospital in Bahawalpur. Methodology: A hospital-based cross-sectional, correlational study was conducted among 179 patients who underwent coronary angiography. Data on demographic variables, comorbidities, and BMI were collected. CAD severity was classified as single-vessel disease (SVD), double-vessel disease (DVD), or triple-vessel disease (TVD). Descriptive statistics, cross-tabulation, chi-square tests, and Pearson correlation were applied to evaluate the relationship between BMI and CAD severity. Results: The majority of patients were overweight (44.1%) or obese (39.1%). CAD distribution showed 39.1% with SVD, 36.3% with DVD, and 24.6% with TVD. Obese individuals were more likely to present with multi-vessel disease. The chi-square test demonstrated a statistically significant association between BMI and CAD severity ($\chi^2 = 38.162$, $df = 4$, $p = 0.001$). Pearson correlation further indicated a weak but significant positive relationship ($r = 0.147$, $p = 0.050$). Conclusion: The study confirms that higher BMI is significantly associated with greater severity of CAD among angiography patients in Bahawalpur. These findings highlight the importance of weight management and lifestyle modification as part of early prevention strategies, particularly in high-risk South Asian populations.

INTRODUCTION

Background of the Study

Coronary artery disease (CAD) is one of the leading causes of morbidity and mortality worldwide, accounting for nearly 17.9 million deaths annually, with the majority of these deaths occurring in low- and middle-income countries (Yusuf, Reddy et al. 2001). In

South Asia, including Bangladesh and neighboring regions, CAD tends to manifest earlier, progress more rapidly, and present with greater angiographic severity compared to other populations (Hossain, Akanda et al. 2017). This epidemiological trend has created an urgent need to investigate risk factors and their associations with CAD within specific regional and ethnic contexts.

Obesity is a recognized contributor to cardiovascular disease, and body mass index (BMI) remains one of the most commonly used metrics for its assessment. BMI, calculated as weight in kilograms divided by height in meters squared (kg/m^2), classifies individuals as underweight, normal weight, overweight, or obese (Khanna, Peltzer et al. 2022, Chen, Huang et al. 2025). Other anthropometric measures such as waist circumference, waist-to-hip ratio, and visceral fat percentage are also valuable indicators of cardiometabolic risk (Khanna, Peltzer et al. 2022). Importantly, obesity is increasing at an alarming pace in Pakistan and poses a significant public health challenge as a risk factor for cardiovascular disease (Alzahrani, Ahmad et al. 2025).

Coronary angiography remains the gold standard for diagnosing and evaluating CAD severity, allowing direct visualization of coronary arteries and quantification of stenosis through scoring systems such as Gensini and SYNTAX (Terada, Forhan et al. 2017, Seddik and Hassan 2024). Several studies have attempted to explore the association between BMI and CAD severity, but results remain inconsistent. Gregory (2017) reported that overweight and obese individuals exhibited more extensive coronary involvement compared to those with normal BMI, whereas Nabati et al. (2020) found an inverse relationship. Such variations may be influenced by genetic predisposition, lifestyle factors, and the pattern of central obesity (Myers, McAuley et al. 2015). Furthermore,

paradoxical findings, such as obese individuals sometimes demonstrating less severe angiographic disease, have also been reported (Powell-Wiley, Poirier et al. 2021).

Pathophysiologically, obesity contributes to CAD through its frequent association with hypertension, dyslipidemia, insulin resistance, and systemic inflammation, all of which accelerate atherosclerosis (James and Krmnicek 2020). Atherosclerosis-induced narrowing or occlusion of coronary arteries reduces blood supply to the myocardium, leading to angina, myocardial infarction, or heart failure (Chong, Jayabaskaran et al. 2024). Despite these well-established mechanisms, the inconsistent relationship between BMI and CAD severity highlights the need for further exploration, particularly in high-burden countries such as Pakistan.

Problem Statement

Although CAD is a leading cause of mortality worldwide, its risk profile is not uniform across populations. The relationship between BMI and CAD severity remains controversial, with some studies suggesting a positive correlation, others reporting an inverse association, and some demonstrating paradoxical findings. In Pakistan, where obesity is increasing rapidly alongside a rising CAD burden, limited evidence exists on how BMI correlates with the severity of coronary involvement. Without region-specific data, clinicians may face challenges in early risk stratification and preventive care.

Rationale of the Study

Understanding the relationship between BMI and CAD severity in Pakistani patients can provide valuable insights for clinical practice. Since coronary angiography offers the most reliable assessment of CAD severity, combining angiographic data with BMI measurements may help in identifying high-risk groups more effectively. This study seeks to provide locally relevant evidence, thereby contributing to more accurate risk

prediction, better-informed treatment decisions, and improved public health strategies for reducing the cardiovascular disease burden.

Objectives

To assess the correlation between body mass index (BMI) and the severity of coronary artery disease (CAD) in patients undergoing angiography at a tertiary care hospital in Bahawalpur.

Significance of the Study

This study holds both clinical and public health importance. At the clinical level, it will provide cardiologists and healthcare providers with region-specific evidence to support early risk stratification and personalized patient management. At the public health level, the findings can inform awareness campaigns, preventive strategies, and policy interventions targeting obesity and CAD risk factors. Ultimately, the study will contribute to reducing the cardiovascular disease burden in Pakistan by enhancing evidence-based prevention and management approaches (Iserson and Moskop 2007, Horta, Rollins et al. 2023).

LITERATURE REVIEW

Global Burden of Coronary Artery Disease

Coronary artery disease (CAD) remains a major cause of morbidity and mortality worldwide and has shown an increasing trend in South Asian countries, including Pakistan (Labounty, Gomez et al. 2013). Obesity, most commonly assessed through body mass index (BMI), is a key modifiable risk factor for CAD owing to its close association with diabetes, hypertension, and dyslipidemia (Gregory 2017). Despite this, the direct link between BMI and the angiographic severity of CAD is debated. Some studies report

a weak or absent correlation, while others show a positive relationship, indicating that higher BMI corresponds to more severe angiographic disease(Stalls, Triplette et al. 2014).

The Role of Metabolic Health

An important consideration in this association is metabolic health. Distinctions such as metabolically healthy obesity and metabolically unhealthy normal weight are often overlooked, despite their moderating influence on the BMI–CAD relationship(Ng'iendo 2025). Evidence suggests that metabolic abnormalities—such as insulin resistance, dyslipidemia, and hyperglycemia—contribute to angiographic burden regardless of BMI class. This highlights the importance of considering metabolic profile alongside anthropometric measures for a more accurate estimation of CAD severity (Ng'iendo 2025).

Evidence from International Studies

Several international studies have attempted to clarify this relationship. LaBounty et al. (2013) demonstrated through coronary CT angiography that CAD prevalence and severity increased with every 5 kg/m² rise in BMI (Labounty, Gomez et al. 2013). Similarly, Gregory (2017) found greater coronary involvement among overweight and obese patients compared to those with normal BMI on conventional angiography(Gregory, Lester et al. 2017).Conversely, Farid (2019) found no significant correlation between BMI and angiographic severity. Likewise, Stalls et al. (2024) reported that after adjusting for confounding variables such as diabetes and hypertension, BMI did not independently predict CAD severity(Stalls, Triplette et al. 2014). These mixed findings suggest that the association may vary across populations, influenced by genetics, lifestyle, and fat distribution patterns(Myers, McAuley et al. 2015).

Evidence from Pakistan and Regional Context

In Pakistan, obesity is rapidly increasing and represents a major public health challenge, contributing significantly to cardiovascular disease risk (Alzahrani, Ahmad et al. 2025). However, the relationship between BMI and CAD severity has not been consistently studied in local populations. Evidence from regional studies remains limited, leaving uncertainty about whether BMI independently predicts angiographic severity in South Asian contexts. To aid early risk stratification and preventive interventions, region-specific evidence is crucial(Iserson and Moskop 2007).Recent findings from South Punjab further emphasize this gap, as inconsistent results continue to raise questions about the precise influence of BMI on the number of arteries involved, degree of stenosis, and lesion complexity in CAD patients(Sohaib, Farid et al. 2025).

Gaps in Literature

Collectively, the literature highlights two critical gaps. First, the role of BMI as an independent predictor of CAD severity remains inconclusive, with evidence varying across populations. Second, limited angiographic data from South Asian and particularly Pakistani populations restricts the generalizability of global findings to local contexts. Addressing these gaps through region-specific angiographic studies will provide a more nuanced understanding of the relationship between BMI and CAD, thereby informing clinical practice and guiding preventive strategies in Pakistan.

METHODOLOGY

This quantitative, cross-sectional study was conducted to determine the correlation between body mass index (BMI) and the severity of coronary artery disease (CAD) among patients undergoing angiography at a tertiary care hospital. The study population included adult patients who were admitted to the cardiology department

and met the inclusion criteria, such as being clinically indicated for coronary angiography. A purposive sampling technique was employed to recruit participants, ensuring that patients with incomplete medical records or co-morbid conditions that could confound BMI or CAD severity were excluded. A structured proforma was used to collect demographic details, BMI values, and angiographic findings. BMI was classified according to the World Health Organization (WHO) criteria, while CAD severity was categorized into single-vessel disease (SVD), double-vessel disease (DVD), triple-vessel disease (TVD), and multi-vessel disease (MVD) based on angiographic reports.

Data were entered and analyzed using Statistical Package for Social Sciences (SPSS). Descriptive statistics such as frequencies, percentages, means, and standard deviations were used to summarize demographic and clinical variables. Inferential statistics, including Chi-square tests for categorical variables and Pearson's correlation coefficient, were applied to assess the association between BMI categories and CAD severity. A p-value of less than 0.05 was considered statistically significant. Ethical approval was obtained from the institutional review board, and written informed consent was taken from each participant. Confidentiality and anonymity of participants were maintained throughout the research process.

RESULTS

Demographic and Clinical Characteristics

A total of 179 patients were analyzed, including 61 males (34.1%) and 118 females (65.9%). Hypertension was present in 70.9% of patients, diabetes mellitus in 76%, and 55.3% reported smoking. Regarding body mass index (BMI), 16.8% were classified as normal weight, 44.1% as overweight, and 39.1% as obese. Coronary angiography

revealed that 39.1% of participants had single-vessel disease (SVD), 36.3% had double-vessel disease (DVD), and 24.6% had triple-vessel disease (TVD).

Table 1: *Demographic and clinical Characteristics*

Variables	Characteristics	Frequency	Percentage (%)
Gender	Male	61	34.1
	Female	118	65.9
Hypertension	Yes	127	70.9
	No	52	29.1
Diabetes Mellitus	Yes	136	76
	No	43	24
Smoke	Yes	99	55.3
	No	80	44.7
Body Mass Index	Normal (<25)	30	16.8
	Over Weight (25-30)	79	44.1
	Obese (>30)	70	39.1
Coronary Artery Disease	Single Vessel Disease (SVD)	70	39.1
	Double Vessel Disease (DVD)	65	36.3
	Tripple Vessel Disease (TVD)	44	24.6

BMI Across Severity of CAD

The mean BMI increased progressively with the severity of CAD. Patients with SVD had a mean BMI of 28.36 ± 3.02 , those with DVD had a mean BMI of 28.95 ± 3.16 , while the highest mean BMI (29.61 ± 3.92) was observed among patients with TVD.

Table 2: Mean BMI Across CAD Severity Groups

Body Mass Index	Coronary Artery Disease	Mean	SD ±
	SVD	28.36	3.02
	DVD	28.95	3.16
	TVD	29.61	3.92

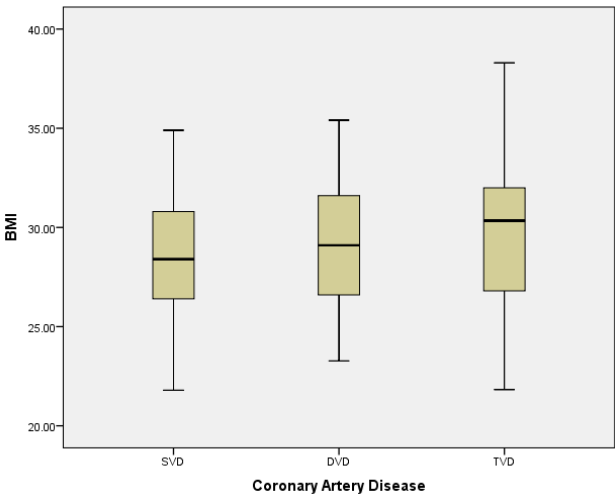


Figure 1: Mean BMI Across CAD Severity Groups

Cross-Tabulation of BMI and CAD

Cross-tabulation revealed distinct trends between BMI categories and CAD severity. Most normal-weight patients were found in the SVD group (21 out of 30), overweight patients were more often classified with DVD (37 out of 79), while the majority of obese patients had TVD (32 out of 70).

Table 3: Cross Tabulation of BMI Categories and CAD Severity

Coronary Artery Disease	Body Mass Index			Total
	Normal (<25)	Over Weight (25-30)	Obese (>30)	
SVD	21	33	16	70
DVD	6	37	22	65
TVD	3	9	32	44
Total	30	79	70	179

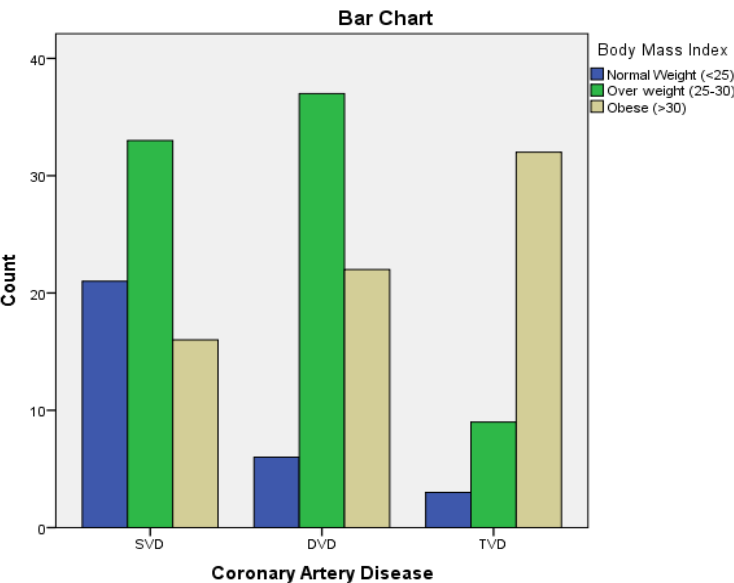


Figure 2: BMI Categories and CAD Severity

Statistical Association Between BMI and CAD Severity

Chi-square analysis confirmed a statistically significant relationship between BMI and CAD severity ($\chi^2 = 38.16$, $df = 4$, $p < 0.001$). Linear-by-linear association further suggested a positive trend: as BMI increased, the severity of vessel involvement also

rose. Symmetric measures supported a moderate strength of association (Phi = 0.462; Cramer’s V = 0.326; p < 0.001).

Table 4: Chi-Square Test Results

	Value	df	Significance
Pearson Chi-Square	38.162 ^a	4	.001
Likelihood Ratio	37.408	4	.001
Linear-by-Linear Association	28.106	1	.001
N of Valid Cases	179		

Correlation Analysis

Pearson’s correlation demonstrated a weak but statistically significant positive relationship between BMI and CAD severity (r = 0.147, p = 0.050). This indicates that higher BMI was modestly associated with greater severity of multi-vessel coronary artery disease.

Table 5: Pearson Correlation Between BMI and CAD Severity

Correlation		BMI	Coronary Artery Disease
Body Mass Index	Pearson Correlation	1	.147
	Sig. (2-tailed)		.050
	N	179	179
Coronary Artery Disease	Pearson Correlation	.147	1
	Sig. (2-tailed)	.050	
	N	179	179

DISCUSSION

The purpose of this study was to evaluate the relationship between body mass index (BMI) and the severity of coronary artery disease (CAD) in patients undergoing angiography at a tertiary care facility in Bahawalpur. CAD remains one of the leading causes of morbidity and mortality worldwide and is increasingly prevalent in South Asian countries, including Pakistan. While obesity, measured by BMI, is widely recognized as a risk factor for cardiovascular disease, the extent of its association with CAD severity continues to generate debate. By focusing on a local population, this study provides context-specific evidence to inform this ongoing discourse.

The findings revealed that a majority of participants were either overweight (44.1%) or obese (39.1%), reflecting Pakistan's rising trend in obesity. This aligns with prior research that has documented the growing prevalence of obesity and its association with cardiovascular risk in South Asia (Alzahrani et al., 2025). In terms of angiographic distribution, single-vessel disease (39.1%) was most common, followed by double-vessel disease (36.3%) and triple-vessel disease (24.6%). When stratified by BMI categories, obese patients were more likely to present with severe CAD than those with normal BMI. A statistically significant relationship between BMI and CAD severity was confirmed through chi-square testing ($p = 0.001$).

These findings are consistent with global and regional evidence. Gregory (2017) reported that overweight and obese individuals had greater coronary involvement compared to those with normal BMI, while LaBounty et al. (2013) demonstrated that CAD frequency and severity increased with every 5 kg/m² rise in BMI. Similarly, Myers et al. (2015) emphasized the role of central obesity and lifestyle factors in accelerating CAD progression. Collectively, these studies reinforce the view that obesity contributes to

atherosclerotic burden, particularly in South Asian populations who are predisposed to early and aggressive CAD.

Nevertheless, the literature also presents conflicting results. Nabati et al. (2020) and Stalls et al. (2014) found either weak or inverse associations between BMI and CAD severity after adjusting for comorbidities such as diabetes and hypertension. Farid (2019) also reported that BMI alone was not a reliable predictor of angiographic severity. These discrepancies suggest that BMI, though convenient, is a limited measure of cardiovascular risk. Other factors such as visceral fat distribution, systemic inflammation, insulin resistance, and overall metabolic health may have greater predictive value (Ng'iendo, 2025). Therefore, BMI should not be considered a standalone predictor but rather one component of a more comprehensive risk assessment.

The clinical implications of these findings are substantial. Overweight and obese individuals demonstrated greater CAD severity, underscoring the need for early risk assessment and preventive interventions. Lifestyle modification programs focusing on diet, physical activity, and weight management are particularly important in this population. Furthermore, reliance on additional anthropometric indices, such as waist circumference and waist-to-hip ratio, may improve cardiovascular risk stratification compared to BMI alone (Khanna et al., 2022).

The study also emphasizes the importance of context-specific research. South Asian populations, including Pakistanis, are more vulnerable to CAD at comparatively lower BMI thresholds than Western populations. This may be attributed to genetic predispositions, dietary habits, or higher prevalence of metabolic syndrome. Consequently, extrapolating findings from Western studies to South Asian populations

may be misleading, making local evidence from Bahawalpur particularly relevant for tailored prevention and management strategies.

Despite its contributions, this study has limitations. The cross-sectional design prevents causal inference regarding the association between BMI and CAD severity. Potential confounding factors, such as dietary intake, physical activity, and genetic predispositions, were not comprehensively assessed. Moreover, while BMI is a practical measure, it does not differentiate between lean and fat mass or capture fat distribution, both of which are critical determinants of cardiovascular risk. Future research should adopt more precise measures of body composition, include metabolic health markers, and employ larger, multi-center designs to validate and extend these findings.

In conclusion, this study demonstrates that higher BMI is significantly associated with greater CAD severity among patients undergoing angiography in Bahawalpur. While BMI has limitations as a predictor, the findings reinforce evidence linking obesity to adverse cardiovascular outcomes. These results highlight the urgency of implementing obesity-focused preventive strategies and conducting further research to elucidate the biological and epidemiological pathways linking BMI and CAD severity in South Asian populations.

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