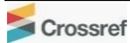
DOI: https://doi.org/10.70749/ijbr.v3i6.3016

INDUS JOURNAL OF BIOSCIENCE RESEARCH

https://ijbr.com.pk

ISSN: 2960-2793/ 2960-2807



Correlation Between Carotid Intima-Media Thickness and Modified Gensini Score in Acute Coronary Syndrome Patients at a Tertiary Care Hospital

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ARTICLE INFO

Keywords: CIMT, modified Gensini score, Atherosclerosis, Acute coronary syndrome, Coronary artery disease, B-mode ultrasonography

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Declaration

Authors' Contribution: All authors equally contributed to the study and approved the final manuscript.

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History

Received: 01-05-2025 Revised: 17-06-2025
Accepted: 23-06-2025 Published: 30-06-2025

ABSTRACT

Background: Cardiovascular disease remains a leading cause of mortality globally, with acute coronary syndrome (ACS) being a critical manifestation. carotid intima-media thickness (CIMT), measured via B-mode ultrasonography, has emerged as a non-invasive marker of systemic atherosclerosis. The modified Gensini score, derived from coronary angiographic findings, is a validated measure of coronary artery disease (CAD) severity. Establishing a correlation between these two parameters may allow CIMT to serve as a surrogate for assessing coronary artery atherosclerotic burden. **Objective:** To determine the correlation between CIMT measured on B-mode ultrasonography and the modified Gensini score in patients with ACS. **Methods:** This descriptive cross-sectional study was conducted at Benazir Bhutto Hospital, Rawalpindi. A total of 170 patients diagnosed with ACP were initially enrolled. After applying exclusion criteria—eliminating 37 patients with diabetes mellitus or hypertension a final sample of 133 patients aged 35–75 years was included. CIMT was measured bilaterally using high-resolution B-mode ultrasonography. Coronary angiograms were reviewed to calculate the modified Gensini score. Data were analyzed using SPSS version 25. Pearson's correlation coefficient was used to assess the relationship between CIMT and Gensini scores. A $p < 0.05$ was considered statistically significant. **Results:** Among 133 patients, 69.9% were male and 30.1% female. The mean CIMT was 0.85 ± 0.15 mm, and the mean modified Gensini score was 34.7 ± 12.4. A significant positive correlation was observed between CIMT and Gensini score ($r = 0.612$, $p < 0.001$), indicating that higher CIMT values were associated with more severe coronary artery disease. **Conclusion:** There is a significant correlation between CIMT and the severity of coronary artery disease, as assessed by the modified Gensini score in patients with ACS. with the severity of coronary artery disease as assessed by the modified Gensini score in ACS patients. These findings support the role of CIMT as a non-invasive and reliable marker for estimating atherosclerotic burden, particularly in clinical settings where coronary angiography is not readily accessible.

INTRODUCTION

Background

Atherosclerosis is a chronic, systemic condition and the leading underlying cause of cardiovascular diseases, including acute coronary syndrome (ACS), a spectrum that comprises unstable angina and myocardial infarction. ACS is a major contributor to global morbidity and mortality and requires timely diagnosis and appropriate stratification of disease severity for optimal management. Atherosclerotic involvement is not limited to the coronary vasculature but extends to extracoronary vessels such as the carotid arteries, allowing the possibility of using non-invasive imaging modalities for systemic disease assessment. [1,2]

Carotid intima-media thickness CIMT, measured via B-mode ultrasonography, has emerged as a reliable, reproducible, and non-invasive marker of subclinical atherosclerosis [3,4]. CIMT reflects arterial wall remodeling and is predictive of future cardiovascular events. On the other hand, the modified Gensini score is a well-established semi-quantitative tool used to assess the severity of coronary artery disease (CAD) through coronary angiography. It assigns weighted scores based on both the degree of luminal narrowing and the anatomical importance of the affected vessels [5,6].

Rationale

Given the systemic nature of atherosclerosis, it is hypothesized that structural changes in carotid arteries, as

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evidenced by increased CIMT, may reflect the extent and severity of CAD. Establishing a correlation between CIMT and the modified Gensini score could validate the use of CIMT as a surrogate marker for CAD, especially in settings where invasive coronary angiography is either unavailable or contraindicated. This correlation would be particularly useful in the early risk stratification and monitoring of patients presenting with ACS, thereby aiding in clinical decision-making and prognostication [7,8].

Objectives

The primary objective of this study is to determine the correlation between carotid intima-media thickness measured via B-mode ultrasonography and the severity of coronary artery disease as quantified by the modified Gensini score in patients presenting with acute coronary syndrome.

Operational Definitions

Acute Coronary Syndrome (ACS): A clinical condition characterized by symptoms of myocardial ischemia, including unstable angina and myocardial infarction, diagnosed based on clinical presentation, electrocardiographic changes, and cardiac enzyme levels.
Carotid Intima-Media Thickness (CIMT): The combined thickness of the intima and media layers of the carotid artery wall, measured in millimeters using B-mode ultrasonography.
Modified Gensini Score: A scoring system that quantifies the severity of coronary artery disease (CAD) by assigning weighted scores based on both the degree of stenosis and the anatomical significance of the affected coronary segment.

Statistical Analysis

Data analysis was performed using SPSS software. Pearson's correlation coefficient was applied to assess the linear relationship between CIMT and modified Gensini scores. A p-value of <0.05 was considered statistically significant.

METHODOLOGY

Study Design and Setting: This descriptive cross-sectional study was conducted in the Department of Cardiology and Radiology at Benazir Bhutto Hospital, Rawalpindi. The study was conducted over a period of six months.
Sample Size and Sampling Technique: A total of 170 patients presenting with acute coronary syndrome ACS were initially enrolled using non-probability, consecutive sampling technique. After applying the exclusion criteria, 133 patients were included in the final analysis.
Inclusion Criteria: Patients aged between 35 and 75 years Diagnosed with ACS, including STEMI, NSTEMI, or unstable angina
Exclusion Criteria: Patients with a history of diabetes mellitus or hypertension
Patients taking any medication known to affect serum lipid or glucose levels
Operational Definitions: Patients included in the analysis were coded as "1" in the SPSS dataset (n = 133)
Patients excluded due to comorbid conditions were coded as "0" (n = 37)

Data Collection Procedure: After obtaining ethical approval, eligible patients were enrolled after written informed consent. Carotid intima-media thickness (CIMT) was measured using B-mode ultrasonography. Coronary angiography was performed, and the severity of coronary artery disease was scored using the modified Gensini scoring system. Demographic variables including age and gender, CIMT (left and right), and modified Gensini scores were recorded.
Variables Collected: The variables included were age, gender, inclusion status, CIMT (left and right), and modified Gensini scores. Important cardiovascular risk factors such as BMI, smoking status, dyslipidemia, and socioeconomic status were not analyzed due to incomplete patient records.
Statistical Analysis: Data were entered and analyzed using SPSS version 25.0. Continuous variables such as age, CIMT, and Gensini scores were presented as mean ± standard deviation (SD) values. Categorical variables were reported as frequencies and percentages. The Pearson correlation coefficient was used to assess the relationship between CIMT and modified Gensini scores. A p-value < 0.001 was considered statistically significant.
Ethical Considerations: The study was conducted after obtaining approval from the Institutional Ethical Review Committee. Written informed consent was obtained from all participants. Patient confidentiality and data privacy were maintained throughout the study.
Limitations: This study did not include certain important cardiovascular risk factors, such as body mass index (BMI), smoking status, dyslipidemia, and socioeconomic status, due to the incomplete or unreliable patient data.

Results

Demographic Characteristics

A total of 133 patients with acute coronary syndrome (**ACS**) were included in the final analysis. The age of patients ranged from 35 to 75 years.

Table 1
Age Distribution of Included Patients (n=133)

Age group(years)	Frequency (n)	Percentage (%)
35-44	24	18
45-54	41	30.8
55-64	46	34.6
65-75	22	16.5
Total	133	100.0

Figure 1
Age Distribution Bar Chart

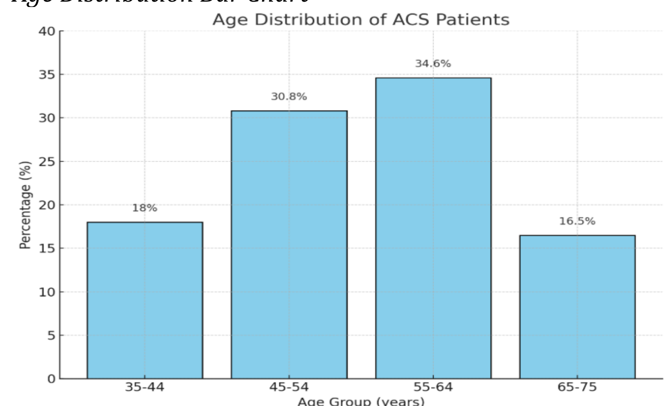

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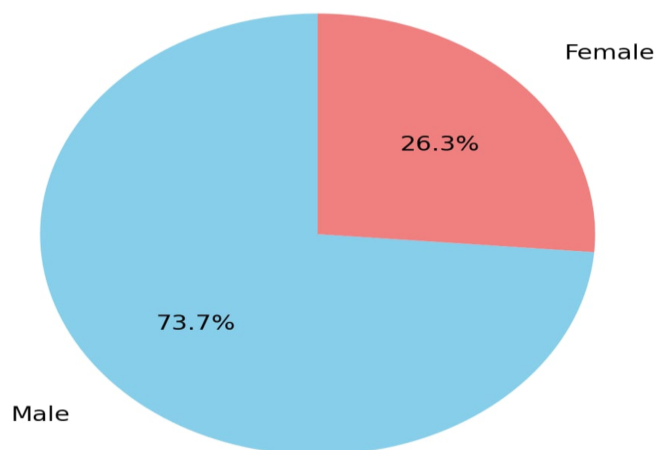
Table 2
Gender Distribution (n=133)

Gender	Frequency (n)	Percentage (%)
Male	98	73.7
Female	35	26.3
Total	133	100.0

Figure 2
Gender Distribution Pie Chart



Carotid Intima-Media Thickness CIMT and Modified **Gensini Score Analysis**: Mean CIMT was 0.85 ± 0.15 mm. The mean modified Gensini score was 34.7 ± 12.4.

Correlation Analysis: Pearson's correlation coefficient demonstrated a statistically significant positive correlation between CIMT and the modified Gensini score:
$r = 0.612$
$p < 0.001$
This indicates that higher CIMT values are associated with greater coronary artery disease severity.

DISCUSSION

This descriptive cross-sectional study aimed to assess the correlation between carotid intima-media thickness CIMT, measured through B-mode ultrasonography, and the modified Gensini score in patients presenting with acute coronary syndrome ACS at Benazir Bhutto Hospital, Rawalpindi. A total of 170 patients were initially enrolled; however, 37 were excluded based on operational definitions of comorbid diabetes mellitus and hypertension—conditions known to independently affect both carotid and coronary artery morphology. Thus, a final sample of 133 patients was analyzed.

The results demonstrated a statistically significant positive correlation between CIMT and the modified Gensini score ($r = 0.612$, $p < 0.001$), indicating that patients with higher CIMT values also had higher angiographic severity of coronary artery disease CAD. This statistically significant p-value of less than 0.001—strongly rejects the null hypothesis and suggests that the probability of this correlation occurring by chance is less than 0.1%. This far exceeds the conventional 5% threshold typically used in medical research to denote statistical significance, thus affirming the strength and reliability of our results.

These findings align with and reinforce the conclusions of prior studies. A study [9] demonstrated that increased CIMT was associated with a higher risk of future cardiovascular events, including myocardial infarction and stroke, making CIMT a valid marker of systemic atherosclerosis. Similarly, another study [10] highlighted the predictive utility of CIMT in evaluating atherosclerotic burden and cardiovascular risk, validating it as a non-invasive surrogate for coronary artery disease assessment. Polak et al. also confirmed that CIMT progression correlates with cardiovascular events, further supporting its clinical relevance.

Carotid intima-media thickness (CIMT) has become a valid non-invasive non-imaging surrogate endpoint of systemic atherosclerosis and is becoming an important surrogate endpoint to assess the severity of coronary artery disease (CAD). The current literature is clearly showing that CIMT has a positive correlation with angiographic scoring systems which are used to measure the degree and severity of coronary artery stenosis like Gensini score (11–16). It has been demonstrated that higher CIMT indicates a cumulative atherosclerotic load that is associated with the development of coronary lesions. Xu et al. and Jiang et al. pointed out that the severity of coronary stenosis and the Gensini score are significantly correlated with higher CIMT values, which validates its predictive value (11,12). Likewise, Dahmardeh et al. and Rashid et al. found out that patients with high CIMT tend to have multivessel disease and more severe CAD (13,15).

Notably, CIMT has also been tested in specifically in patients with acute coronary syndrome (ACS), in which patients with this condition require risk stratification early. Nguyen et al. showed that CIMT and modified Gensini scores were directly and significantly correlated in ACS patients, indicating that CIMT can be used to indicate acute plaque burden and the complexity of coronary lesions in this high-risk patient population (17). This result justifies the clinical utility of CIMT during not only stable CAD but also acute manifestations, when quick, non-invasive diagnostic devices are desirable.

Additional evidence based on larger populations shows that CIMT is highly related to other indices of coronary atherosclerosis such as plaque scores and coronary calcium indices (18-21). Sekar et al. stressed that CIMT could be used to successfully determine persons at increased cardiovascular risk prior to the development of symptomatic disease (8). Similarly, Pathakota et al. have shown a relationship between CIMT and coronary artery calcium scores, which further confirms that CIMT is a useful measure of subclinical atherosclerosis (21). Other studies by Petrovic et al. and Korkmaz et al. also revealed that CIMT is correlated with other scoring systems of angiography like SYNTAX score, which means that it can be more widely used to determine the complexity of coronary (14,22).

Furthermore, CIMT when combined with biochemical and clinical parameters is more predictive. In the case of CIMT, such as the use of CIMT in combination with inflammatory markers or lipid indices has been proven to enhance the severity of CAD (11,19). Wu et al. emphasized that there is a connection between atherogenic indices and Gensini scores, which indirectly substantiates the idea that

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structural vascular alterations, as assessed by CIMT, are tightly coupled with metabolic and inflammatory events that lead to atherosclerosis (19).

In general, all the evidence points to the fact that CIMT is a strong, reproducible and clinically useful measure in assessment of the severity of coronary artery disease. Its non-invasive quality, affordability and broad availability makes it especially useful in resource constrained environments. More to the point, its proven association with Gensini and modified Gensini scores in both stable CAD and ACS patients highlight its possible use in early diagnosis, risk stratification, and informing therapeutic decision-making (22). Thus, the integration of CIMT into the process of cardiovascular examination can enhance the detection of potential risk patients and help improve clinical outcomes.

The modified Gensini score, based on coronary angiography, is a well-established and objective metric for quantifying the severity of coronary artery stenosis. It incorporates both the degree and anatomical location of luminal narrowing, providing a comprehensive assessment of CAD burden. Despite being invasive and resource dependent, it remains a gold standard in evaluating coronary pathology. In this study, the ability of CIMT—a simple, inexpensive, and non-invasive ultrasound measure—to reflect similar levels of disease severity underscores its potential as a diagnostic alternative in primary and secondary care settings.

Our study's strength lies in its focus on a specific subset of the population—non-diabetic and non-hypertensive patients with ACS—thereby controlling for two major confounders and isolating the effect of subclinical atherosclerosis. However, this stringent exclusion of certain groups, while increasing internal validity, may also limit external applicability. Moreover, other relevant atherosclerotic risk factors such as body mass index (BMI), lipid profile (dyslipidemia), smoking status, and socioeconomic background were not included due to incomplete patient data in hospital records. Although these were outlined in the operational definitions, the lack of Statistical analysis of these parameters may reduce the generalizability and scope of the conclusions.

The single-center design and relatively modest sample size are additional limitations. While the sample size of 133 patients is reasonable for a single-center study, a multicenter approach with a larger and more diverse population would increase generalizability and provide stronger statistical power. The cross-sectional nature of this study also precludes temporal or causal inferences. A longitudinal follow-up would help determine whether CIMT progression correlates with worsening coronary pathology or adverse clinical outcomes over time.

Future directions for research should include a broader range of cardiovascular risk factors, stratification by ACS subtypes (STEMI vs NSTEMI vs unstable angina), gender-based analysis, and the incorporation of inflammatory biomarkers such as CRP or lipoprotein(a). Additionally, the potential role of CIMT in guiding medical therapy (e.g., statin initiation or intensification) could be explored through interventional trials.

CONCLUSION

This study demonstrates a statistically significant positive correlation between carotid intima-media thickness CIMT and the modified Gensini score in patients presenting with acute coronary syndrome ACS. The findings reinforce that CIMT, as measured by B-mode ultrasonography, can serve as a reliable, non-invasive indicator of the severity of coronary artery disease CAD. Given the burden of cardiovascular disease and the limited availability of invasive diagnostic modalities in many healthcare settings, CIMT holds promise as a practical screening tool for atherosclerotic burden. The correlation observed between CIMT and modified Gensini score in this study aligns with previous literature and adds further support to the role of vascular ultrasound in cardiovascular risk stratification.

While coronary angiography remains the gold standard for evaluating CAD, its invasive nature, cost, and limited accessibility can be barriers, particularly in resource-constrained environments. Therefore, the use of CIMT can be a useful adjunct in early diagnosis and assessment, allowing for better risk prediction and timely intervention in patients with ACS.

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