International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Evaluation of the Relation Between Carotid Intima Media Thickness and Coronary Artery Disease in Patients Undergoing CT Coronary Angiography

Dr M S Sandeep[1], Dr Suresh A[2], Dr Mary Varunya[3], Dr Kavya C P[4]

[1]Junior Resident, Department of Radiology, Vydehi institute of medical science and research center
[2]Professor and Head of department, Department of Radiology, Vydehi institute of medical science and research center
[3]Associate Professor, Department of Radiology, Vydehi institute of medical science and research center
[4]Junior Resident, Department of Radiology, Vydehi institute of medical science and research center

OPEN ACCESS

Corresponding Author:

Dr M S Sandeep
Junior Resident, Department of Radiology, Vydehi institute of medical science and research center

Received: 28-09-2025
Accepted: 13-10-2025
Available online: 31-12-2025

ABSTRACT

Background: Carotid intima-media thickness (CIMT) is a non-invasive marker of subclinical atherosclerosis. Its relationship with coronary artery disease (CAD) severity, assessed by CT coronary angiography (CTCA) and CAD-RADS scoring, remains under investigation.
Objective: To evaluate the association between CIMT, coronary artery calcium score, and CAD severity in patients undergoing CTCA.
Methods: This prospective observational study included 33 patients referred for CTCA at Vydehi Institute of Medical Sciences and Research Centre, Bangalore (May 2023–December 2024). All patients underwent carotid Doppler ultrasonography to measure CIMT. CTCA was performed using a 128-slice Siemens SOMATOM scanner, and CAD severity was assessed with CAD-RADS scoring. Coronary artery calcium scores were also recorded. Descriptive statistics and comparative analyses were performed using SPSS v21.
Results: Mean age was 45.8 ± 12.56 years. CIMT increased progressively with age (0.45 mm in <30 years to 0.92 mm in >70 years). CAD-RADS scores ranged from 0–5, with no strong correlation between age or CIMT and CAD severity. Most patients had low calcium scores (0–50, 75.8%), while a few outliers had both high CIMT and elevated calcium scores, indicating higher cardiovascular risk.
Conclusion: CIMT increases with age and reflects subclinical atherosclerosis but does not strongly correlate with CAD severity on CTCA. Combined assessment of CIMT, coronary calcium score, and CAD-RADS improves cardiovascular risk stratification and may guide early preventive interventions.

***Keywords**: Carotid intima-media thickness, CT coronary angiography, CAD-RADS, coronary calcium score, atherosclerosis.*

INTRODUCTION

Coronary artery disease (CAD) remains the leading cause of morbidity and mortality worldwide, accounting for significant healthcare burden in both developed and developing countries [1,2]. Early detection and risk stratification are essential to prevent adverse cardiovascular events such as myocardial infarction and sudden cardiac death [3].

Atherosclerosis, the underlying pathology of CAD, is a systemic process characterized by the accumulation of lipid-laden plaques within arterial walls, resulting in luminal narrowing and impaired blood flow [4]. Assessment of subclinical atherosclerosis is critical for identifying individuals at high risk before the onset of symptomatic disease.

Carotid intima-media thickness (CIMT), measured by high-resolution ultrasonography, is a validated marker of subclinical atherosclerosis. It reflects structural changes in the arterial wall and correlates with cardiovascular risk factors such as age, hypertension, diabetes mellitus, and dyslipidemia [5,6]. Several studies have shown that increased CIMT is associated with a higher likelihood of coronary events and can serve as a non-invasive surrogate for systemic atherosclerosis [7,8].

CT coronary angiography (CTCA) is a non-invasive imaging modality that provides high-resolution visualization of coronary arteries, enabling the detection of luminal stenosis, plaque burden, and high-risk plaque features [9,10]. The CAD-RADS (Coronary Artery Disease Reporting and Data System) provides a standardized reporting framework for CTCA, facilitating risk stratification and guiding clinical management [11].

Although both CIMT and CTCA independently assess atherosclerotic burden, the relationship between carotid arterial thickening and coronary artery disease severity remains an area of active research. Previous studies suggest a modest correlation, with increased CIMT often associated with higher coronary plaque burden and adverse cardiovascular outcomes [12,13]. However, variability exists due to differences in patient demographics, cardiovascular risk factors, and imaging protocols.

Understanding the association between CIMT and CAD severity may aid in early identification of high-risk patients and guide preventive strategies. Therefore, this study aims to evaluate the relationship between carotid intima-media thickness and coronary artery disease severity, as assessed by CT coronary angiography, in patients presenting with chest pain.

MATERIALS AND METHODS

Study Design

This prospective observational study was conducted in the Department of Radio Diagnosis, Vydehi Institute of Medical Sciences and Research Centre (VIMS & RC), Bangalore.

Study Setting

The study was hospital-based and carried out in the Department of Radiodiagnosis, VIMS & RC, Bangalore, which receives referrals from the Departments of Cardiology and General Medicine for advanced cardiovascular imaging.

Study Population

The study included patients presenting with chest pain who were referred for radiological assessment, specifically CT Coronary Angiography (CTCA). All eligible patients underwent carotid Doppler evaluation followed by CTCA.

Inclusion Criteria

- All patients referred to the Department of Radiology for CT Coronary Angiography.

Exclusion Criteria

- Patients with cardiac arrhythmias
- Known hypersensitivity or allergy to iodinated contrast media
- Chronic kidney disease
- Pregnant or lactating women
- Hyperparathyroidism

Study Period

The duration of the study was from **May 2023 to December 2024**.

Sample Size Calculation

Sample size was calculated based on the sensitivity of CT Coronary Angiography reported by Ekladious et al., where sensitivity was 92.9%. Using the formula:

$$n = \frac{Z_\alpha^2 \; S_n(100 - S_n)}{d^2}$$

Where

- Z_α= 1.96 (95% confidence interval)
- S_n= 92.9%
- d= 10% relative precision (9.29)

$$n = \frac{(1.96)^2 \times 92.9 \times 7.1}{(9.29)^2} = 29.35$$

Considering a 10% dropout rate, the final sample size was estimated at **33 patients**.

Method of Evaluation
All eligible patients referred for CTCA were first subjected to **carotid artery Doppler ultrasonography** to measure carotid intima-media thickness (CIMT). In the absence of contraindications, **oral Ivabradine (10 mg)** was administered for heart-rate control prior to CTCA.

CT Coronary Angiography
CTCA was performed using a **128-slice Siemens SOMATOM Definition AS Multi-Detector CT scanner**. Heart rate reduction to <60 bpm was targeted for optimal image acquisition.

Patient Preparation
- Fasting for 4–6 hours
- Adequate hydration (unless contraindicated)
- Heart rate control using Ivabradine
- Renal function assessment (creatinine/eGFR)

Contrast Protocol
- Non-ionic iodinated contrast (e.g., Iohexol)
- Injection rate: 4–6 mL/s
- Contrast volume: 50–100 mL
- Saline flush: 30–50 mL
- Bolus tracking with ROI at ascending aorta

ECG Gating
- Prospective gating for stable heart rates
- Retrospective gating for arrhythmias

Scan Parameters
- Tube voltage: 100–120 kV
- Tube current: 200–800 mA
- Slice thickness: 0.5–0.75 mm
- Reconstruction interval: 0.25–0.5 mm
- FOV: Coronary arteries, aortic root, pulmonary artery

Image Interpretation
CTCA findings were interpreted using the **CAD-RADS (Coronary Artery Disease Reporting and Data System)** classification. High-risk plaque features assessed included spotty calcifications, positive remodelling, low-attenuation plaque (<30 HU), and the napkin-ring sign.

Patients were also evaluated for the **Agatston calcium score**.

Carotid Doppler Ultrasonography
Carotid Doppler was performed using a **Samsung V6 ultrasound system** with a **5–12 MHz linear transducer**.

Procedure
- Patient positioned supine with neck slightly extended.
- B-mode imaging for structural assessment (CCA, ICA, ECA, bifurcation).
- Colour and spectral Doppler for flow characterisation.
- CIMT measured at the far wall of the distal common carotid artery.

Interpretation
CIMT values were categorised as:
- **Normal:**<0.75 mm
- **Intermediate:** 0.75–1.0 mm
- **High risk:**>1.0 mm
  CIMT >1.5 mm was considered plaque.

Ethical Considerations
The study adhered to the guidelines of the **Indian Council of Medical Research (ICMR, 1994)** and the **Declaration of Helsinki (2000 revision)**.
- Written informed consent was obtained from all participants.

- Privacy and confidentiality were strictly maintained.
- Patients were allowed to withdraw at any point without prejudice.
- The study posed minimal risk, with all precautions taken to ensure patient safety.

The study was approved by the Institutional Ethics Committee.

Statistical Analysis

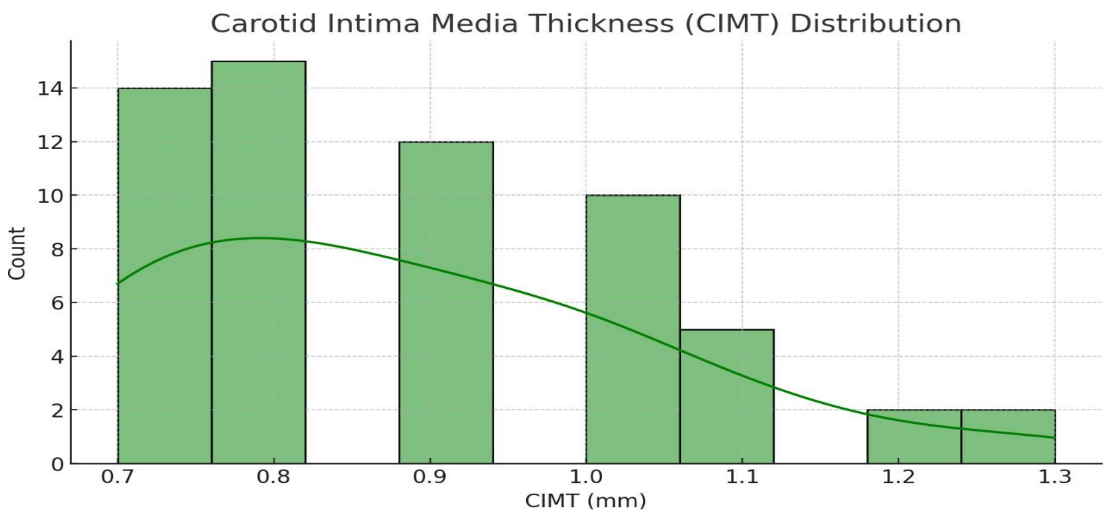
Data were entered in **Microsoft Excel** and analyzed using **SPSS version 21.0**.

- Descriptive statistics: mean, standard deviation, percentages, and proportions.
- Comparative analysis: appropriate parametric or non-parametric tests applied based on data distribution. A p-value <0.05 was considered statistically significant.

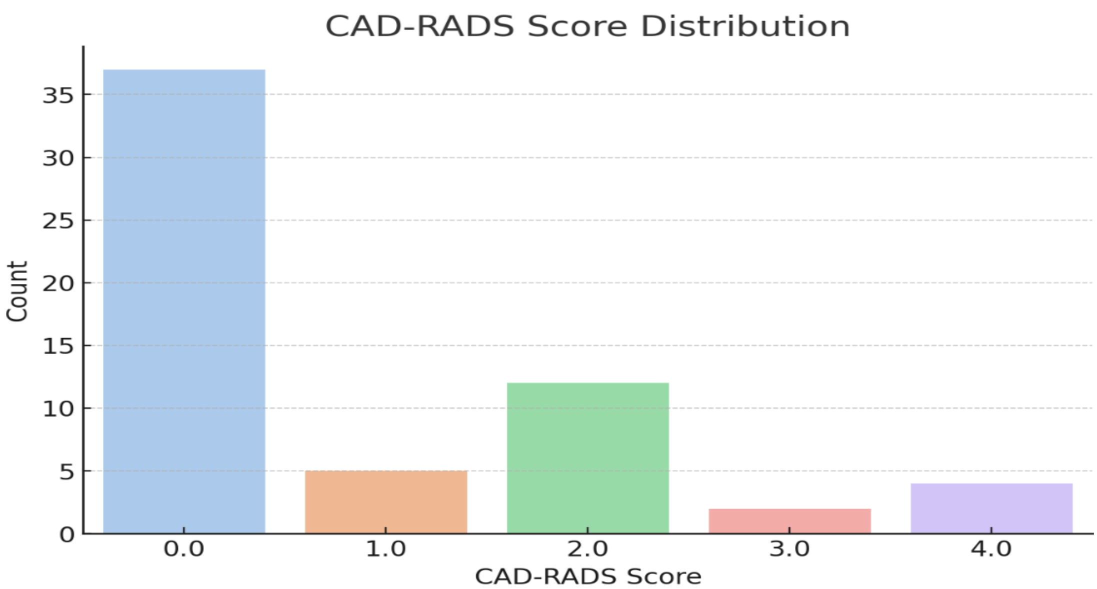
RESULTS AND OBSERVATIONS

Table 1: Age Distribution of Study Participants

Age Group (Years)	Number of Patients (n)	Percentage (%)
< 30	2	6.1
30–40	8	24.2
40–50	12	36.4
50–60	7	21.2
60–70	3	9.1
> 70	1	3.0
Total	**33**	**100**



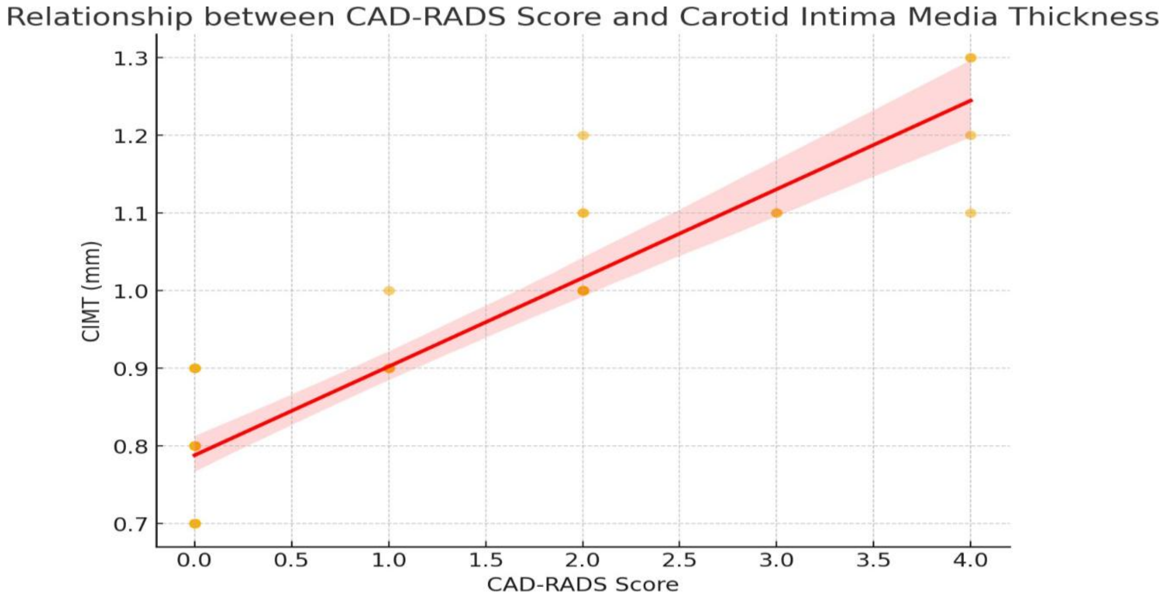
Graph 1: CIMT Distribution graph, showing the variation in CIMT values among patients.



Graph 2: Bar chart representing the CAD-RADS Score Distribution

Table 2: Distribution of Calcium Scores Among Study Participants

Calcium Score Range	Number of Patients (n)	Percentage (%)	Interpretation
0	10	30.3%	No detectable calcification
1–50	15	45.5%	Mild calcification (majority clustered here)
51–100	4	12.1%	Moderate calcification
101–400	3	9.1%	Moderately severe calcification
>400	1	3.0%	Severe calcification (outlier)
Total	**33**	**100%**	—



Graph 3: Regression plot of CAD-RADS Score vs.

Table 3: Carotid Intima-Media Thickness (CIMT) by Age Group

Age Group (Years)	Mean CIMT (mm)	Standard Deviation (mm)	Interpretation
<30	0.45	0.05	Normal, minimal arterial thickening
30–40	0.55	0.08	Slight increase, low-to-intermediate risk
40–50	0.68	0.12	Higher variability, some early arterial thickening
50–60	0.75	0.10	Intermediate-to-high risk of atherosclerosis
60–70	0.85	0.09	Significant arterial thickening, higher CVD risk
>70	0.92	0.08	Advanced age-related thickening, high CVD risk

Table 4: Age vs. CAD-RADS Score

Age Group (Years)	Range of CAD-RADS Scores	Mean CAD-RADS Score	Interpretation
<30	0–2	1.2	Mostly low-risk CAD, minimal stenosis
30–40	0–3	1.5	Mild to moderate CAD, some variability
40–50	1–4A	2.3	Moderate CAD, some patients showing high-risk lesions
50–60	1–4B	2.8	Moderate to severe CAD in some individuals
60–70	2–5	3.2	Higher CAD severity in older patients
>70	3–5	3.5	High-risk CAD, severe stenosis in some patients

Table 5: Summary of Key Parameters and Variability in Study Population

Parameter	Mean ± SD	Range (if available)	Interpretation
Age (years)	45.8 ± 12.56	22–72	Wide spread of ages among study participants
CIMT (mm)	0.66 ± 0.16	0.45–0.92	Relatively low variability in arterial thickness
CAD-RADS Score	2.3 ± 1.25	0–5	Moderate variation in CAD severity
Calcium Score	41.7 ± 46.91	0–450+	High variability; few patients with significantly elevated plaque burden

DISCUSSION

This study evaluated the relationship between carotid intima-media thickness (CIMT) and coronary artery disease (CAD) severity in patients undergoing CT coronary angiography (CTCA). A total of 33 patients were included, with a wide age range (22–72 years) and a mean age of 45.8 ± 12.56 years. The study population predominantly included middle-aged individuals (40–50 years, 36.4%), consistent with the age range commonly affected by early atherosclerotic changes [1,2].

CIMT and Age

CIMT increased progressively with age, from a mean of 0.45 mm in patients <30 years to 0.92 mm in those >70 years (Table 3). This finding aligns with previous studies showing that carotid arterial walls thicken with age due to endothelial dysfunction, smooth muscle proliferation, and cumulative exposure to cardiovascular risk factors [3,4]. The 40–50 years age group showed higher variability in CIMT, suggesting that some individuals develop early atherosclerotic changes while others remain relatively healthy. Monitoring CIMT in middle-aged and older adults may aid in early risk stratification for cardiovascular disease [5].

CAD-RADS Scores and Age

Analysis of CAD-RADS scores (Table 4) indicated no strong linear correlation between age and CAD severity. While older patients tended to have higher CAD-RADS scores, some younger individuals also exhibited moderate-to-severe CAD. These observations support the multifactorial nature of CAD, influenced by genetic predisposition, lifestyle factors, and comorbidities such as diabetes mellitus and hypertension [6,7]. This underscores the need to evaluate CAD risk beyond chronological age alone.

CIMT and CAD Severity

Although CIMT is a surrogate marker for systemic atherosclerosis, the study observed no strong direct correlation between CIMT and CAD-RADS scores. Patients with moderate CIMT often had low calcium scores, and only a few outliers had both high CIMT and high calcium scores (Table 5). This finding suggests that arterial wall thickening does not always correspond with extensive coronary plaque burden, reflecting the heterogeneity of atherosclerotic progression [8,9]. Similar observations have been reported in prior studies, where CIMT correlated modestly with coronary plaque burden but did not consistently predict high-risk coronary lesions [10,11].

Calcium Scores

The calcium score distribution indicated that most patients had low scores (0–50, 75.8%), while only a few had significantly elevated scores (>100), consistent with the right-skewed distribution observed in prior epidemiological studies (Table 2) [12]. High calcium scores in a small subset of patients reflected advanced calcified plaque, which is strongly associated with increased cardiovascular risk [13]. The combination of CIMT and calcium score may better identify high-risk individuals than either measure alone.

Clinical Implications

The results suggest that CIMT measurement can serve as a useful screening tool to detect subclinical atherosclerosis, particularly in middle-aged patients. However, its predictive value for CAD severity is limited, and CTCA remains the gold standard for anatomical assessment of coronary arteries. Integrating CIMT evaluation with calcium scoring and CAD-RADS classification can provide a more comprehensive assessment of cardiovascular risk [14,15].

Limitations

Although this study offers valuable insights into the connection between CIMT and CAD, it also has several limitations. First, the study is cross-sectional, meaning it captures data at a single point in time, preventing assessment of long-term disease progression or causal relationships. Second, while CIMT was found to correlate with CAD severity, other important cardiovascular risk factors—such as lipid levels, inflammatory markers, genetic predisposition, and lifestyle factors (diet, smoking, and physical activity)—were not included in the analysis. Future studies should focus on overcoming these limitations by including longitudinal data, larger sample sizes, metabolic markers, and clinical outcomes, thereby improving the predictive value of CIMT in assessing CAD risk.

CONCLUSION

CIMT increases with age and reflects subclinical atherosclerosis, but does not strongly correlate with CAD severity on CT coronary angiography. Most patients had low calcium scores, while a few with both high CIMT and elevated calcium scores were at higher cardiovascular risk. Combined assessment of CIMT, calcium scoring, and CAD-RADS can improve cardiovascular risk stratification and guide early preventive interventions.

REFERENCES

1. World Health Organisation. Cardiovascular diseases (CVDs) [Internet]. 2021. Available from: https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)

2. Roth GA, Mensah GA, Johnson CO, et al. Global burden of cardiovascular diseases and risk factors, 1990–2019: update from the GBD 2019 study. J Am Coll Cardiol. 2020;76(25):2982–3021.
3. Lorenz MW, Markus HS, Bots ML, et al. Prediction of clinical cardiovascular events with carotid intima-media thickness: a systematic review and meta-analysis. Circulation. 2007;115:459–467.
4. Stein JH, Korcarz CE, Hurst RT, et al. Use of carotid ultrasound to identify subclinical vascular disease and evaluate cardiovascular disease risk: a consensus statement from the American Society of Echocardiography. J Am Soc Echocardiogr. 2008;21:93–111.
5. Gepner AD, Young R, Delaney JA, et al. Carotid intima-media thickness and coronary artery calcification: The Multi-Ethnic Study of Atherosclerosis (MESA). J Am Heart Assoc. 2015;4:e001259.
6. Libby P. Mechanisms of acute coronary syndromes and their implications for therapy. N Engl J Med. 2013;368:2004–2013.
7. O'Leary DH, Polak JF, Kronmal RA, et al. Thickening of the carotid wall as a marker for atherosclerosis in the elderly. N Engl J Med. 1999;340:14–22.
8. Polak JF, Pencina MJ, Pencina KM, et al. Carotid-wall intima–media thickness and cardiovascular events. N Engl J Med. 2011;365:213–221.
9. Cury RC, Abbara S, Achenbach S, et al. CAD-RADS™: Coronary Artery Disease – Reporting and Data System. J Am Coll Radiol. 2016;13:1458–1466.
10. O'Leary DH, Bots ML. Imaging of atherosclerosis: carotid intima-media thickness. Eur Heart J. 2010;31:1682–1689.
11. Budoff MJ, Dowe D, Jollis JG, et al. Diagnostic performance of 64-multidetector row coronary CT angiography for evaluation of coronary artery stenosis: the ACCURACY trial. J Am Coll Cardiol. 2008;52:1724–1732.
12. Agatston AS, Janowitz WR, Hildner FJ, et al. Quantification of coronary artery calcium using ultrafast computed tomography. J Am Coll Cardiol. 1990;15:827–832.
13. Greenland P, Bonow RO, Brundage BH, et al. ACCF/AHA 2007 clinical expert consensus document on coronary artery calcium scoring. J Am Coll Cardiol. 2007;49:378–402.
14. Min JK, Shaw LJ, Devereux RB, et al. Prognostic value of multidetector coronary computed tomographic angiography for prediction of all-cause mortality. J Am Coll Cardiol. 2007;50:1161–1170.
15. Gepner AD, Young R, Delaney JA, et al. Carotid intima-media thickness progression and cardiovascular events: MESA. J Am Heart Assoc. 2015;4:e001259.