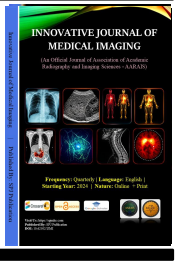
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Original Research

Correlation Between Coronary Artery Calcium Score and Cardiovascular Risk Factors: A Cross-Sectional Observational Study

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ABSTRACT

Background: Coronary Artery Calcium Score (CACS) is a non-invasive imaging marker of coronary atherosclerosis and an important predictor of future cardiovascular events. This study evaluated the correlation between CACS and traditional cardiovascular risk factors.
Methods: A hospital-based cross-sectional observational study was conducted from January to March 2026 involving 48 patients aged ≥40 years who underwent coronary calcium scoring by non-contrast multidetector computed tomography. Demographic characteristics and cardiovascular risk factors, including hypertension, diabetes mellitus, dyslipidemia, smoking, obesity, and family history of coronary artery disease, were recorded. Coronary calcification was quantified using the Agatston scoring method.
Results: The study included 31 (64.6%) males and 17 (35.4%) females, with a mean age of 58.3 ± 9.6 years. Hypertension (60.4%), dyslipidemia (52.1%), and diabetes mellitus (43.8%) were the most common risk factors. Coronary calcium scores were 0 in 25.0% of patients, 1–99 in 31.3%, 100–399 in 27.1%, and ≥400 in 16.6%. Higher CACS was significantly associated with increasing age, male gender, hypertension, diabetes mellitus, dyslipidemia, smoking, and obesity. Patients with multiple risk factors demonstrated greater coronary calcification.
Conclusion: CACS showed a significant positive correlation with established cardiovascular risk factors and may serve as a valuable tool for cardiovascular risk stratification and early detection of subclinical coronary artery disease.

Keywords: Coronary Artery Calcium Score, cardiovascular risk factors, coronary artery disease, atherosclerosis, computed tomography.

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INTRODUCTION

Cardiovascular disease (CVD) remains one of the leading causes of mortality and morbidity worldwide, accounting for a substantial burden on healthcare systems and economies. Among the various forms of cardiovascular disease, coronary artery disease (CAD) is the most prevalent and is responsible for a significant proportion of cardiovascular-related deaths. CAD develops primarily due to atherosclerosis, a chronic inflammatory process characterized by the accumulation of lipids, fibrous tissue, and calcium within the walls of coronary arteries. This progressive narrowing of the coronary vessels reduces blood flow to the myocardium and may eventually result in myocardial infarction, heart failure, or sudden cardiac death. [1] The identification of individuals at increased risk of developing cardiovascular disease is essential for implementing preventive strategies and reducing adverse clinical outcomes. Traditionally, cardiovascular risk assessment has relied on established risk factors such as age, sex, hypertension, diabetes mellitus, dyslipidemia, smoking, obesity, and family history of premature coronary artery disease. Several risk prediction models, including the Framingham Risk Score and other cardiovascular risk calculators, have been developed to estimate an individual's

likelihood of experiencing future cardiovascular events. Although these tools are widely used in clinical practice, they may not accurately identify all high-risk individuals, particularly those with subclinical atherosclerosis who remain asymptomatic despite ongoing vascular disease. [2] Advances in imaging technology have enabled the direct assessment of atherosclerotic burden through non-invasive methods. One of the most widely accepted imaging biomarkers is the Coronary Artery Calcium Score (CACS), which is measured using non-contrast cardiac computed tomography (CT). The presence of coronary artery calcification reflects the cumulative effect of atherosclerotic plaque development over time and serves as an indicator of coronary artery disease severity. The Agatston scoring system, introduced in 1990, remains the standard method for quantifying coronary calcium and categorizing cardiovascular risk based on the extent of calcified plaque detected within the coronary arteries. [3]

Numerous studies have demonstrated that coronary artery calcium is a strong and independent predictor of future cardiovascular events. Individuals with higher calcium scores are more likely to experience myocardial infarction, coronary revascularization, and cardiovascular mortality compared with those who have little or no detectable coronary calcification. Importantly, CACS provides incremental prognostic information beyond traditional cardiovascular risk factors, thereby improving risk stratification and clinical decision-making. The incorporation of coronary calcium scoring into preventive cardiology has been increasingly recommended for selected patient populations, particularly those classified as having intermediate cardiovascular risk. [4] The relationship between coronary artery calcium and conventional cardiovascular risk factors has attracted considerable research interest. Age is recognized as one of the strongest determinants of coronary calcification, as the burden of atherosclerosis generally increases with advancing years. Similarly, male sex has been associated with higher calcium scores compared to females of similar age. Other major risk factors, including hypertension, diabetes mellitus, smoking, and dyslipidemia, contribute to endothelial dysfunction, chronic inflammation, and vascular remodeling, all of which accelerate the process of coronary calcification. Obesity and a positive family history of coronary artery disease have also been linked to increased coronary calcium deposition through both metabolic and genetic mechanisms. [5]

Understanding the correlation between CACS and cardiovascular risk factors is important for improving early detection of atherosclerosis and optimizing preventive interventions. By evaluating the extent to which traditional risk factors influence coronary calcification, clinicians can better identify individuals who may benefit from aggressive risk-factor modification, lifestyle changes, and pharmacological therapy. Furthermore, the assessment of coronary artery calcium may help refine existing risk prediction models and support personalized approaches to cardiovascular disease prevention. [6] Therefore, the present study aims to investigate the correlation between Coronary Artery Calcium Score and established cardiovascular risk factors, including age, gender, hypertension, diabetes mellitus, dyslipidemia, smoking, obesity, and family history of cardiovascular disease. The findings may contribute to a better understanding of the role of coronary calcium scoring in cardiovascular risk assessment and preventive cardiology.

MATERIALS AND METHODS

Study Design: The present study was designed as a hospital-based cross-sectional observational study to investigate the correlation between Coronary Artery Calcium Score (CACS) and various cardiovascular risk factors. The study aimed to evaluate the association between coronary artery calcification and established risk factors for cardiovascular disease among patients undergoing coronary calcium scoring by computed tomography.

Study Setting and Duration: The study was conducted in the Department of Radiology in collaboration with the Department of Cardiology. Data collection was carried out over a period of three months, from January 2026 to March 2026. During this period, all eligible patients referred for coronary artery calcium scoring were screened for inclusion in the study.

Study Population: The study population consisted of adult patients who underwent Coronary Artery Calcium Score assessment for cardiovascular risk evaluation. A total of 48 patients meeting the predefined inclusion and exclusion criteria were enrolled consecutively during the study period. The participants represented both genders and various age groups, providing a diverse sample for assessing the relationship between coronary calcification and cardiovascular risk factors.

Sample Size: A total of 48 patients were included in the study. The sample size was determined based on the number of eligible patients who underwent coronary calcium scoring during the study period and consented to participate. Consecutive sampling was employed to minimize selection bias and ensure representation of the target population.

Inclusion Criteria: Patients aged 40 years and above who underwent Coronary Artery Calcium Score assessment as part of cardiovascular risk evaluation were considered eligible for inclusion. Individuals with one or more cardiovascular risk factors, including hypertension, diabetes mellitus, dyslipidemia, obesity, smoking history, or family history of coronary artery disease, were included. Participation was voluntary, and only those who provided informed written consent were enrolled in the study.

Exclusion Criteria: Patients with previously diagnosed coronary artery disease, prior coronary artery bypass graft surgery, percutaneous coronary intervention, or congenital heart disease were excluded from the study. Pregnant women and patients unwilling to provide informed consent were also excluded. These criteria were established to avoid confounding factors that could influence coronary artery calcium measurements.

Data Collection: Data were collected using a structured proforma designed specifically for the study. Demographic information, including age and gender, was recorded for each participant. Clinical information regarding hypertension, diabetes mellitus, smoking status, obesity, and family history of cardiovascular disease was obtained from medical records and patient interviews. Relevant laboratory investigations, including lipid profile parameters and fasting blood glucose levels, were documented where available. All collected data were verified for accuracy and completeness before analysis.

Coronary Artery Calcium Score Assessment: Coronary Artery Calcium Scoring was performed using a non-contrast multidetector computed tomography (MDCT) scanner according to standard imaging protocols. Scanning was conducted during a single breath-hold to minimize motion artifacts and ensure image quality. The Agatston scoring method was used to quantify coronary artery calcification. Based on the calculated calcium score, participants were categorized into four groups: score 0 indicating no detectable coronary calcification, score 1–99 indicating mild calcification, score 100–399 indicating moderate calcification, and score ≥400 indicating severe calcification.

Study Variables: The primary outcome variable of the study was the Coronary Artery Calcium Score. Independent variables included age, gender, hypertension, diabetes mellitus, smoking status, dyslipidemia, body mass index, and family history of coronary artery disease. These variables were selected because of their established association with cardiovascular disease and potential influence on coronary artery calcification.

Statistical Analysis: The collected data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. Continuous variables were summarized as mean and standard deviation, while categorical variables were expressed as frequencies and percentages. Pearson's correlation coefficient or Spearman's rank correlation coefficient was used to assess the relationship between Coronary Artery Calcium Score and cardiovascular risk factors, depending on the distribution of the data. The Chi-square test was applied to evaluate associations between categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULT

A total of 48 patients who underwent Coronary Artery Calcium Score (CACS) assessment between January 2026 and March 2026 were included in the study. The study population comprised 31 (64.6%) males and 17 (35.4%) females. Participants ranged in age from 42 to 78 years, with a mean age of 58.3 ± 9.6 years. The largest proportion of patients belonged to the 51–60 years age group (37.5%), followed by the 61–70 years age group (29.2%). Patients aged 40–50 years constituted 20.8% of the study population, while those older than 70 years represented 12.5% of the participants.

Table 1. Demographic Characteristics of the Study Population (n = 48)

Variable	Frequency	Percentage (%)
Gender		
Male	31	64.6
Female	17	35.4
Age Group (Years)		
40–50	10	20.8
51–60	18	37.5
61–70	14	29.2
>70	6	12.5

Distribution of Cardiovascular Risk Factors: Cardiovascular risk factor analysis revealed that hypertension was the most prevalent risk factor, affecting 29 (60.4%) patients. Dyslipidemia was observed in 25 (52.1%) participants, while diabetes mellitus was present in 21 (43.8%) individuals. A history of smoking was reported by 18 (37.5%) patients, and obesity was identified in 16 (33.3%) participants. Furthermore, a positive family history of coronary artery disease (CAD) was documented in 11 (22.9%) patients. These findings indicate a substantial burden of conventional cardiovascular risk factors within the study population.

Table 2. Distribution of Cardiovascular Risk Factors (n = 48)

Risk Factor	Frequency	Percentage (%)
Hypertension	29	60.4
Diabetes Mellitus	21	43.8
Dyslipidemia	25	52.1
Smoking	18	37.5
Obesity	16	33.3
Family History of CAD	11	22.9

Distribution of Coronary Artery Calcium Scores: Assessment of Coronary Artery Calcium Scores demonstrated varying degrees of coronary artery calcification among participants. Twelve (25.0%) patients showed no detectable coronary calcification (CACS = 0). Mild coronary calcification (CACS 1–99) was observed in 15 (31.3%) patients, representing the largest subgroup. Moderate coronary calcification (CACS 100–399) was identified in 13 (27.1%) patients, while severe calcification (CACS ≥400) was present in 8 (16.6%) participants. Overall, 75% of the study population exhibited some degree of coronary artery calcification.

Table 3. Distribution of Coronary Artery Calcium Scores (n = 48)

CACS Category	Frequency	Percentage (%)
0	12	25.0
1–99	15	31.3
100–399	13	27.1
≥400	8	16.6

Correlation Between Age and Coronary Artery Calcium Score: A progressive increase in Coronary Artery Calcium Score was observed with advancing age. Participants aged above 60 years exhibited significantly higher calcium scores compared with younger age groups. Moderate and severe coronary calcification categories were predominantly observed among older patients. Statistical analysis demonstrated a significant positive correlation between age and CACS ($p < 0.05$), indicating that coronary artery calcification increases with advancing age.

Association Between Gender and Coronary Artery Calcium Score: Gender-based analysis revealed that male participants had higher Coronary Artery Calcium Scores compared with female participants. Severe coronary calcification (CACS ≥400) was predominantly observed among male patients, suggesting a greater burden of coronary atherosclerotic disease in men. This finding supports previous evidence indicating a higher prevalence and severity of coronary artery calcification among males.

Correlation Between Hypertension and Coronary Artery Calcium Score: Patients with hypertension demonstrated substantially higher calcium scores compared with normotensive individuals. Moderate-to-severe coronary calcification was more frequently observed among hypertensive participants, highlighting a significant association between elevated blood pressure and coronary artery calcification. These findings suggest that hypertension contributes to the progression of coronary atherosclerosis and vascular calcification.

Correlation Between Diabetes Mellitus and Coronary Artery Calcium Score: Diabetic patients exhibited a higher prevalence of moderate and severe coronary artery calcification compared with non-diabetic individuals. Increased calcium scores among diabetic participants indicate a greater burden of atherosclerotic plaque formation. The results emphasize the significant role of diabetes mellitus in accelerating coronary artery disease and calcific changes within the coronary vasculature.

Correlation Between Dyslipidemia and Coronary Artery Calcium Score: Participants with dyslipidemia showed higher Coronary Artery Calcium Scores than those with normal lipid profiles. Elevated levels of atherogenic lipoproteins were associated with increased coronary calcification, supporting the well-established relationship between lipid abnormalities and atherosclerotic plaque development. Patients with dyslipidemia were more likely to be classified within the moderate and severe calcification categories.

Correlation Between Smoking and Coronary Artery Calcium Score: A positive association was observed between smoking history and Coronary Artery Calcium Score. Smokers demonstrated higher calcium scores than non-smokers, with a greater proportion of smokers falling within the moderate and severe calcification groups. These findings indicate that tobacco exposure contributes significantly to the development and progression of coronary artery calcification.

Correlation Between Obesity and Coronary Artery Calcium Score: Obese individuals tended to exhibit higher Coronary Artery Calcium Scores compared with non-obese participants. Although the association was less pronounced than those observed for age, hypertension, diabetes mellitus, and dyslipidemia, obesity remained an important contributor to coronary artery calcification and overall cardiovascular risk. Analysis of the cumulative effect of cardiovascular risk factors demonstrated that patients with multiple risk factors had significantly higher Coronary Artery Calcium Scores than those with fewer or no risk factors. Age,

hypertension, diabetes mellitus, and dyslipidemia emerged as the strongest predictors of elevated CACS. The findings indicate that coronary artery calcification increases with the accumulation of cardiovascular risk factors and support the use of CACS as a valuable non-invasive marker for identifying individuals at increased risk of future cardiovascular events. Furthermore, the results underscore the potential role of Coronary Artery Calcium Scoring in cardiovascular risk stratification and early preventive intervention strategies.

DISCUSSION

The present study evaluated the correlation between Coronary Artery Calcium Score (CACS) and established cardiovascular risk factors among 48 patients who underwent coronary calcium scoring between January 2026 and March 2026. The findings demonstrated a positive association between increasing CACS and the presence of traditional cardiovascular risk factors, including age, male gender, hypertension, diabetes mellitus, dyslipidemia, smoking, and obesity. These observations support the growing evidence that coronary artery calcification is an important marker of subclinical atherosclerosis and future cardiovascular risk.

In the present study, increasing age was significantly associated with higher Coronary Artery Calcium Scores. Older individuals demonstrated a greater prevalence of moderate and severe coronary calcification compared to younger age groups. This finding is consistent with previous studies, which have shown that coronary artery calcification increases progressively with age due to cumulative exposure to atherosclerotic risk factors and vascular aging processes. [7,8] Age has consistently been identified as one of the strongest predictors of coronary artery calcium burden in both symptomatic and asymptomatic populations. Gender differences were also observed in the study, with male participants exhibiting higher calcium scores than female participants. This observation is in agreement with earlier research demonstrating that men generally develop coronary atherosclerosis and vascular calcification at an earlier age than women. Hormonal factors, particularly the protective effects of estrogen before menopause, may contribute to the lower prevalence of coronary calcification among females. [9-13] Hypertension was one of the most prevalent cardiovascular risk factors among the study participants and showed a positive association with elevated CACS. Chronic hypertension promotes endothelial injury, arterial stiffness, and vascular remodeling, which contribute to the progression of atherosclerosis and subsequent calcium deposition within coronary arteries. Similar findings have been reported in previous studies, where hypertensive individuals were found to have significantly higher coronary calcium scores compared with normotensive subjects. [14]

Diabetes mellitus was also associated with increased coronary artery calcification in the present study. Diabetic patients demonstrated a greater frequency of moderate-to-severe CACS categories than non-diabetic patients. Hyperglycemia, insulin resistance, oxidative stress, and chronic inflammation accelerate atherosclerotic plaque formation and vascular calcification, thereby increasing cardiovascular risk. These findings are consistent with earlier investigations that identified diabetes mellitus as an independent predictor of elevated coronary calcium burden. [15] Dyslipidemia and smoking were found to be important contributors to coronary artery calcification. Elevated serum lipid levels promote cholesterol accumulation within arterial walls, leading to plaque formation and subsequent calcification. Similarly, smoking induces endothelial dysfunction, inflammation, and oxidative damage, thereby accelerating atherosclerotic changes. Previous studies have reported strong associations between these risk factors and increased coronary calcium scores, supporting the findings of the present study.

Furthermore, participants with multiple cardiovascular risk factors demonstrated higher calcium scores than those with fewer risk factors. This suggests a cumulative effect of risk factors on coronary artery calcification and reinforces the concept that atherosclerosis is a multifactorial disease process. The results indicate that CACS may provide valuable information beyond conventional risk assessment tools by directly quantifying the burden of coronary atherosclerosis. The findings of this study support the clinical utility of Coronary Artery Calcium Scoring as a non-invasive imaging biomarker for cardiovascular risk stratification. By identifying asymptomatic individuals with significant coronary calcification, clinicians can implement timely preventive interventions, including lifestyle modifications and pharmacological therapy, to reduce the likelihood of future cardiovascular events. However, the study has certain limitations. The sample size was relatively small, comprising only 48 patients, which may limit the generalizability of the findings. The study was conducted over a short duration of three months and at a single center. Additionally, the cross-sectional design allows

assessment of associations but does not establish causal relationships between cardiovascular risk factors and coronary artery calcification. Larger multicenter studies with longer follow-up periods are recommended to further validate these findings.

CONCLUSION

The present study demonstrated a significant positive correlation between Coronary Artery Calcium Score and established cardiovascular risk factors. Increasing age, male gender, hypertension, diabetes mellitus, dyslipidemia, smoking, and obesity were associated with higher levels of coronary artery calcification. Among these factors, age, hypertension, diabetes mellitus, and dyslipidemia showed particularly strong associations with elevated CACS. The findings suggest that Coronary Artery Calcium Score is an effective indicator of subclinical coronary atherosclerosis and can serve as a valuable adjunct to traditional cardiovascular risk assessment methods. Individuals with multiple cardiovascular risk factors were found to have a greater burden of coronary artery calcification, highlighting the cumulative impact of these risk factors on coronary artery disease development. Incorporation of Coronary Artery Calcium Scoring into routine cardiovascular risk evaluation may improve early detection of high-risk individuals, facilitate personalized preventive strategies, and ultimately contribute to the reduction of cardiovascular morbidity and mortality. Further large-scale prospective studies are warranted to establish the long-term prognostic value of coronary artery calcium scoring in diverse populations.

DECLARATIONS

Ethics Approval and Consent to Participate: This observational cross-sectional study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Institutional Ethics Committee of the affiliated institution prior to the commencement of the study. Written informed consent was obtained from all participants before enrollment. Participation was voluntary, and the confidentiality of patient information was strictly maintained throughout the study.

Consent for Publication: Not applicable.

Availability of Data and Materials: The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request, subject to institutional policies and ethical regulations.

Conflict of Interest: The authors declare that they have no competing interests related to this study.

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Authors' Contributions: All authors contributed substantially to the conception and design of the study. Patient recruitment, data collection, Coronary Artery Calcium Score assessment, statistical analysis, interpretation of results, and manuscript preparation were performed collaboratively by the authors. All authors critically reviewed, revised, and approved the final manuscript and agree to be accountable for all aspects of the work.

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Data Confidentiality Statement: All patient-related information was anonymized prior to analysis. Confidentiality and privacy of participants were maintained throughout the study, and no identifying information has been disclosed in this manuscript.

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