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# CARDIOVASCULAR RISK FACTORS AND THEIR RELATIONSHIP TO PLAQUE TYPE AND SEVERITY ON CORONARY CT ANGIOGRAPHY

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**Abstract**

***Background***

*Coronary arteries supply oxygen-rich blood to the heart muscles, with the right and left coronary arteries branching from the aorta. Coronary artery disease (CAD) is highly prevalent in Indo-Asians, with diabetes mellitus (DM) as a key risk factor, significantly increasing susceptibility due to metabolic dysfunctions like hyperglycemia and dyslipidemia. The rising global prevalence of DM and its strong association with CAD underscores the urgent need for targeted interventions.*

***Objective*** *Assessment of Cardiovascular Risk Factors and Their Relationship to Plaque Type and Severity on Coronary CT Angiography*

***Methodology*** *This study employs a cross-sectional comparative design, conducted at Obaid Noor hospital, Miawali, to assess the Cardiovascular Risk Factors and Their Relationship to Plaque Type and Severity on Coronary CT Angiography. A total sample size of 52 participants. The sampling technique adopted was convenient sampling, ensuring the inclusion of eligible participants during the study period.*

***Results***

*The study included 52 participants, with more females (65.4%) than males (34.6%), and most aged 50–64 years (46.2%). Most participants were non-smokers (78.8%), non diabetic (71.2%), and non-hypertensive (55.8%), while 46.2% had dyslipidemia. Laboratory findings showed low BSR (82.7%), low LDL (69.2%), low HDL (75.0%), and low cholesterol (65.4%). Calcified plaques were predominant (84.6%), with mild to moderate stenosis more common than severe stenosis. Lesions in the left main artery were present in 55.8% of participants, indicating overall predominance of middle-aged, female, and metabolically healthier individuals with mainly calcified plaques and mild to moderate stenosis.*

***Conclusion***

*The study concludes that diabetic individuals have a higher prevalence and severity of coronary artery stenosis, particularly in the 40–60-year age group. They*

*also experienced more severe symptoms, including chest pain, shortness of breath, and nausea. Calcified plaques and moderate stenosis were most common across major coronary arteries. These findings highlight the importance of early screening, risk factor management, and lifestyle interventions. Targeted strategies are essential to reduce adverse cardiovascular outcomes in middle-aged diabetic patients.*

## INTRODUCTION

Coronary artery disease and atherosclerosis is the leading cause of death in men and women,globally(1).The primary risk factor for cardiovascular disease (CVD), atherosclerosis, is caused by endothelial activation, which is followed by lipid buildup, fibrous tissue deposition, and calcification, which results in inflammation and artery narrowing.(2). The development of atherosclerosis and its clinical manifestation are significantly influenced by smoking-induced alterations in coronary vasomotor tone, platelet activation, and endothelial integrity. Smoking damages the arterial intima, which can cause atherosclerosis to develop and grow more quickly(6).By thickening artery walls, causing atherosclerotic plaques to form, and making them more prone to rupture, hypertension is likely to have an impact on the arterial tree(7).Chronic inflammation and cholesterol deposition are the two primary processes in the pathophysiology of atherosclerosis(8).Both cellular and atherosclerosis are significantly impacted by dyslipidemia, which is primarily defined as increased plasma levels of atherogenic lipids or lipoproteins or functional impairment of anti-atherogenic lipids or lipoproteins(9).

Coronary CT scans are very good in identifying the presence of atherosclerotic plaque and determining its composition. Plaques can be categorized as noncalcified, calcified, or mixed based on CCTA(10).More accurate atherosclerotic plaque quantification and characterization are now possible thanks to significant advancements in computed tomography (CT) scanners and CCTA procedures during the past 20 years. Single-source 64-row detector scanners were the first CT scanners utilized in extensive CCTA experiments.The most recent third-generation dual-source 2 × 192-row detector CT scanners have a temporal resolution of up to 66 ms and a maximum spatial resolution of 0.24 mm(11).≥320-row CT scanners enable single-rotation heart imaging with radiation doses as low as ~1 mSv, further reduced below 3 mSv using prospective triggering(12).It is not specifically advised to use the best test as a first-line test. When choosing the test, factors such as patient preferences, local expertise and availability, patient characteristics, and individualized clinical risk assessment should all be taken into account(12).Invasive diagnostic techniques such as vascular endoscopy, intravascular ultrasonography, or catheter angiography may be employed on symptomatic patients. However, non-invasive techniques like stress imaging, single-photon emission computed tomography (SPECT), and coronary artery calcification grading are increasingly frequently used for primary prevention of atherosclerotic coronary artery disease in asymptomatic patients(13). This study aims to correlate individual cardiovascular risk factors with specific plaque features seen on CCTA, such as:Plaque composition (calcified, non-calcified, mixed),which individual factor are more strongly linked to specific plaque features(like calcified or soft plaque)on coronary computed tomography angiography.Coronary artery disease and atherosclerosis is the leading cause of death in men and women,globally(1).The primary risk factor for cardiovascular disease (CVD), atherosclerosis, is caused by endothelial activation, which is followed by lipid buildup, fibrous tissue deposition, and calcification, which results in inflammation and artery narrowing.(2). The development of atherosclerosis and its clinical manifestation are significantly influenced by smoking-induced alterations in coronary vasomotor tone, platelet activation, and endothelial integrity. Smoking damages the arterial intima, which can cause atherosclerosis to develop and grow more quickly(6).By thickening artery walls, causing

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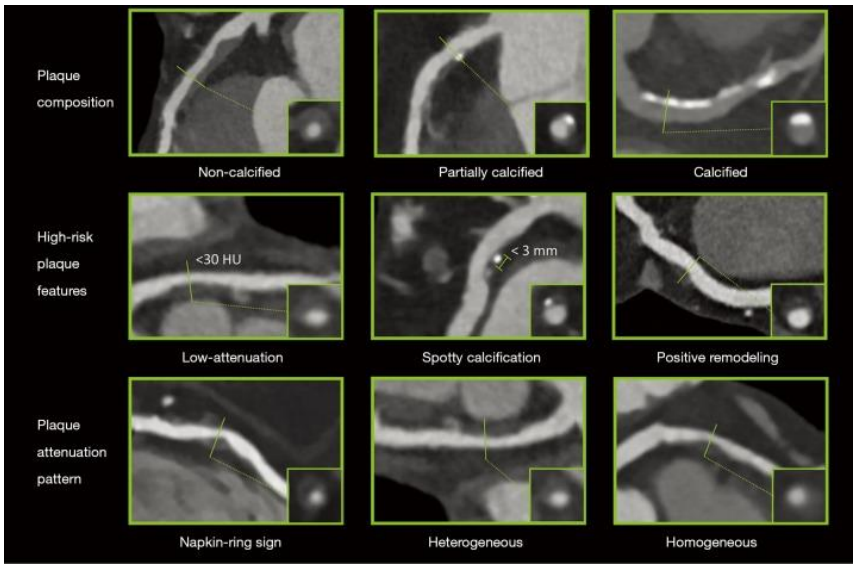
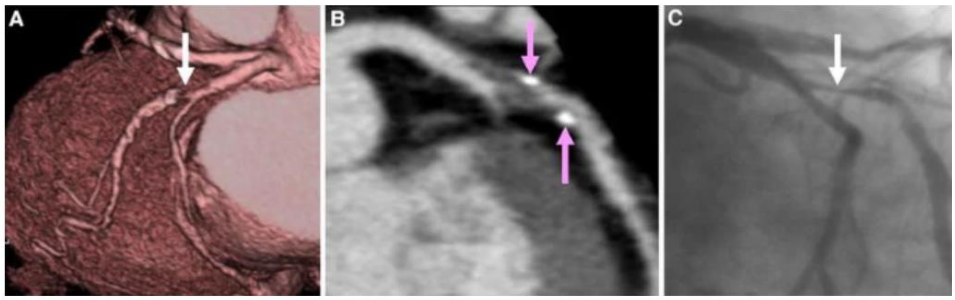



**Representative images of plaque characteristics identifiable using coronary CT angiography (CTA)(15)**

**Fig. 1**




CT characteristics of another culprit lesion in a 79-year old, female patient presenting with acute coronary syndrome. A Volume rendering, B curved multiplanar reformation image, C coronary angiogram. The *white arrows* in **a** and **c** demonstrate the site of luminal obstruction or culprit lesion. In addition to positive remodeling and low attenuation plaque, spotty calcification (*pink arrow*) is evident.(16)

## MATERIAL AND METHODS:

This cross-sectional analytical study will be conducted at Obaid Noor Hospital, Mianwali, over a period of four months following approval of the synopsis. A total of 52 participants will be included using a non-probability consecutive sampling technique. Adults aged 20 to 75 years undergoing Coronary Computed Tomography Angiography (CCTA) and willing to provide informed consent will be eligible for inclusion. Patients with known coronary artery disease, poor-quality CCTA imaging, any chronic systemic illness, or a history of contrast allergy will be excluded from the study.

## RESULTS:

The study included 52 participants, most of whom were female (65.4%) and between 50–64 years old (46.2%). A large majority were non-smokers (78.8%), non-diabetic (71.2%), and non-hypertensive (55.8%). Over half (53.8%) did not have dyslipidemia. Most participants had low blood sugar (82.7%), low LDL (69.2%), low HDL (75.0%), and low total cholesterol levels (65.4%). Calcified plaques were highly prevalent (84.6%), while non-calcified plaques were less common. Stenosis severity was mostly mild (44.2%) or moderate (48.1%), with only a small portion showing severe stenosis (7.7%). Left main coronary lesions were present in slightly more than half of the participants (55.8%). Overall, the results show a sample dominated by middle-aged, generally low-risk individuals based on metabolic measures, but with a high occurrence of calcified plaques and mild-to-moderate stenosis.

## Merged Demographic Table

| Variable | Category | Frequency | Percent |
|---|---|---|---|
| **Age** | Group 1: < 50 | 10 | 19.2% |
| | Group 2: 50–64 | 24 | 46.2% |
| | Group 3: ≥ 65 | 18 | 34.6% |
| | **Total Age** | **52** | **100.0%** |
| **Gender** | Female | 34 | 65.4% |
| | Male | 18 | 34.6% |
| | **Total Gender** | **52** | **100.0%** |

Table 5.2: Frequency of variables

| Variable | Category | Frequency | Percent (%) |
|---|---|---|---|
| **Smoking Status** | Non-smoker | 41 | 78.8 |
| | Smoker | 11 | 21.2 |
| **Diabetes Mellitus** | Absent | 37 | 71.2 |
| | Present | 15 | 28.8 |
| **Hypertension** | Absent | 29 | 55.8 |
| | Present | 23 | 44.2 |
| **Dyslipidemia** | Absent | 28 | 53.8 |
| | Present | 24 | 46.2 |
| **BSR (mg/dL)** | Low (86–168) | 43 | 82.7 |

| | | | |
|---|---|---|---|
| | Medium (169–251) | 9 | 17.3 |
| **LDL (mg/dL)** | Low (74.9–109.8) | 36 | 69.2 |
| | Medium (109.9–144.8) | 16 | 30.8 |
| **HDL (mg/dL)** | Low (30.1–44.8) | 39 | 75.0 |
| | Medium (44.9–59.6) | 13 | 25.0 |
| **Total Cholesterol (mg/dL)** | Low (130.8–184.2) | 34 | 65.4 |
| | Medium (184.3–237.5) | 18 | 34.6 |
| **Plaque Type** | Non-calcified | 8 | 15.4 |
| | Calcified | 44 | 84.6 |
| **Left Main Coronary Lesion** | Absent | 23 | 44.2 |
| | Present | 29 | 55.8 |
| **Stenosis Severity** | Mild | 23 | 44.2 |
| | Moderate | 25 | 48.1 |
| | Severe | 4 | 7.7 |

## DISCUSSION:

In the present study, females represented a slightly higher proportion of participants compared to males. This observation aligns with prior evidence demonstrating that women often engage more in preventive health measures and seek timely care for cardiovascular symptoms (1). Conversely, historical cohorts of coronary artery disease (CAD) typically report male predominance, highlighting possible differences in health seeking behaviors, sampling strategies, or population characteristics (2).The age distribution revealed that the majority of participants were between 40 and 60 years, consistent with prior studies indicating peak atherosclerotic burden and plaque accumulation in middle-aged adults (3). Stone et al. reported that cumulative exposure to risk factors accelerates coronary plaque development in this age range (4).Similarly, data from the Multi-Ethnic Study of Atherosclerosis (MESA) corroborate higher prevalence of subclinical atherosclerosis among individuals aged 45–64 years (5).The observed lower stenosis rates in participants over 60 years may reflect survivor bias or the impact of prior preventive interventions. Hypertension and dyslipidemia emerged as the most prevalent risk factors, affecting 44.2% and 46.2% of participants,respectively. These findings mirror global evidence indicating these as major

contributors to coronary artery disease, such as the INTERHEART study (6). Diabetes was present in 28.8% and smoking in 21.2% of participants, reflecting patterns seen in regional South Asian populations with high metabolic risk profiles (7).The predominance of metabolic syndrome components reinforces the need for early screening and preventive interventions, as South Asians are known to develop atherosclerosis at younger ages and with accelerated progression (8). These results emphasize the importance of aggressive management of modifiable risk factors to reduce long-term cardiovascular morbidity. Coronary CT angiography (CCTA) revealed a predominance of calcified plaques (84.6%) and a smaller proportion of noncalcified plaques (15.4%). This pattern aligns with prior studies showing that chronic exposure to hypertension and dyslipidemia favors calcification and more stable plaque morphology (9). Non-calcified plaques, though less frequent, are generally considered 4445 more prone to rupture, contributing to acute coronary events (10). Our findings are consistent with Williams et al., who reported higher calcified plaque prevalence among older adults and those with metabolic risk factors (12). This distribution suggests that the study population may predominantly represent chronic, stable atherosclerotic disease rather than acute inflammatory lesions.When combined across all arteries, moderate stenosis was the most frequent (48%), followed by mild (44.2%) and severe stenosis 7.7%). Similar patterns have been reported in the CONFIRM registry, which observed higher prevalence of non-obstructive and moderate CAD compared to severe disease (13). The low proportion of severe stenosis may reflect early detection through CCTA or effective risk factor control in the population studied (14). The left main (LM) artery was affected in 55.8% of participants, followed by the right coronary artery (RCA, 51.9%), left anterior descending (LAD, 50%), and left circumflex (LCx, 42.3%). LAD involvement is typically the most common site for atherosclerotic lesions due to hemodynamic stress and vessel anatomy, consistent with prior reports (15). Multi-vessel disease was most frequently observed in two-vessel involvement (38.5%), reflecting the tendency for plaque to affect multiple arteries simultaneously, as reported in MESA and SCOT-HEART trials (16). his reinforces the clinical significance of identifying multi-vessel disease to stratify risk for adverse cardiovascular events. Participants aged 40–60 years demonstrated the highest plaque burden and stenosis severity, corroborating findings from Budoff et al., who highlighted accelerated coronary calcification progression in middle-aged adults due to cumulative metabolic and lifestyle risks (17). Slightly lower stenosis severity in participants over 60 years may reflect survivor bias, prior interventions, or improved cardiovascular management in older adults.The clustering of risk factors—particularly hypertension and dyslipidemia—alongside high prevalence of calcified plaques and moderate stenosis, underscores the importance of early preventive interventions. Significant involvement of LM and LAD arteries indicates potential risk for severe clinical outcomes, emphasizing the utility of CCTA in early diagnosis and risk stratification. These findings support current ACC/AHA guidelines recommending non invasive imaging for subclinical CAD detection (18).

## RECOMMENDATION

Future studies should adopt randomized sampling and larger sample sizes to enhance reliability.Longitudinal studies are recommended to assess the progression of plaque type over time on the basis of cardiovascular risk factors.

## LIMITATION

Insufficient data on how improvements in modifiable risk factors (e.g., LDL lowering, smoking cessation, BP control, glycemic control) change plaque composition over time.Sex- and age-specific differences in risk-factor → plaque-type associations are under-characterized.

## CONCLUSION

The study concludes that diabetic individuals have a higher prevalence and severity of coronary artery stenosis, particularly in the 40–60-year age group. They also experienced more severe symptoms, including chest pain, shortness of breath, and nausea. Calcified plaques and moderate stenosis were most common across major coronary arteries. These findings highlight the importance of early

screening, risk factor management, and lifestyle interventions. Targeted strategies are essential to reduce adverse cardiovascular
outcomes in middle-aged diabetic patients.

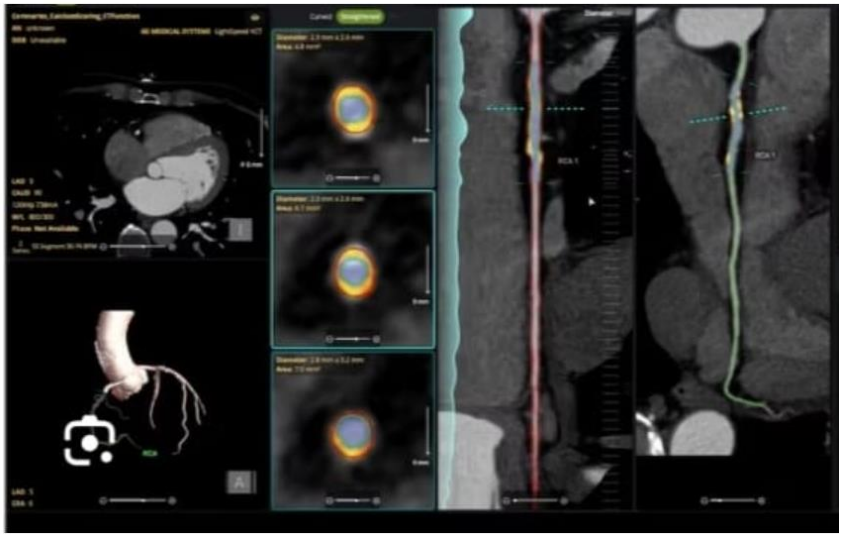
**Case 1**

CTA shows well-opacified coronary and thoracic vessels with no clear high-grade stenosis in the visible sections. Overall findings suggest no major obstructive coronary, aortic, or pulmonary pathology on the shown slice




**Case 2**

The Curved MPR view shows a straightened coronary artery with mixed soft and calcified plaque along the vessel wall. This plaque causes narrowing (stenosis) of the lumen, indicating the presence of Coronary Artery Disease



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