



Prevalence and Severity of Coronary Artery Calcium Scores Among Asymptomatic Adults Undergoing Voluntary Health Screening: A Retrospective Study in Pondicherry

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Abstract: -

Background: Cardiovascular diseases (CVDs) are the leading cause of mortality in India, with 25% of all heart attacks occurring in individuals under 40. Traditional risk assessments frequently fail to detect subclinical atherosclerosis in asymptomatic young populations. The integration of non-invasive Coronary Artery Calcium (CAC) scoring into routine health check-ups offers a highly sensitive method for objective risk stratification. **Objectives:** To evaluate the clinical utility of integrating non-invasive CAC scoring into routine annual wellness screenings for early risk detection. **Methods:** This retrospective clinical audit analyzed records of 150 participants undergoing comprehensive voluntary health screenings at a tertiary institution in Puducherry. Demographic data and categorical CAC severity levels were evaluated using SPSS v.26. Spearman's rho, Mann-Whitney U, and Chi-square tests analyzed relationships between age, gender, and plaque burden ($p < 0.05$). **Results:** The cohort showed a male predominance (62.7%). Zero calcification was present in 31.3% ($n=47$) of participants, whereas 56.7% ($n=85$) presented with moderate-to-severe scores. A total absence of participants in the minimal (1–10) range indicated established rather than nascent plaque burden at presentation. Extensive calcification ($CAC > 1000$) was noted in 17.3% ($n=26$). Chronological age positively correlated with CAC scores ($r_s = 0.42$, $p < 0.001$), and males displayed significantly higher median scores than females ($p = 0.038$). Furthermore, the 60+ age group strongly predicted extensive calcification ($\chi^2 = 12.4$, $p < 0.001$; OR: 3.2). **Conclusion:** Routine CAC scoring provides critical diagnostic clarity for premature CVD risk assessment. The complete absence of nascent plaque alongside a high prevalence of advanced calcification reveals that clinical presentation for routine screening often occurs after significant disease progression, reinforcing the need for earlier clinical screening protocols.

Keywords: Cardiovascular Diseases, Coronary Artery Calcium Scoring, Subclinical Atherosclerosis, Young Adults, Preventive Cardiology, Health Screenings.

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Background:

Globally, cardiovascular diseases (CVDs) remain the leading cause of mortality, affecting more than 620 million people worldwide and accounting for nearly one-third of all global fatalities [1,2]. While historically viewed as conditions predominantly affecting older demographics, recent epidemiological trends reveal an alarming shift toward younger populations [1]. Globally, CVDs have emerged as a primary driver of death and premature disability among young adults and adolescents [1,2]. Preventing the onset of CVD in this cohort requires the early cultivation of heart-healthy habits to disrupt the progression of arterial plaque buildup—atherosclerosis (the hardening and narrowing of arteries)—before clinical symptoms manifest [3]. Primary prevention strategies center heavily on lifestyle modification, including the adoption of a balanced diet, a minimum of 150 minutes of moderate exercise weekly, stress management, a reduction in alcohol consumption, and complete tobacco avoidance [3,4].

This shifting demographic threat is particularly pronounced in developing nations like India, where CVDs have become the leading cause of death, accounting for 25% to 28% of all nationwide fatalities [5,6]. Critically, the clinical manifestation of CVD in India occurs with unique virulence: approximately half of all cardiovascular deaths occur in individuals under the age of 50 [5,7]. Heart disease penetrates the youngest cohorts of the Indian population at unprecedented rates, with a concerning 25% of all myocardial infarctions (heart attacks) occurring in individuals under the age of 40 [8,9]. Furthermore, evidence demonstrates that Indian populations possess a distinct genetic and environmental susceptibility, experiencing the onset of ischemic heart disease nearly a decade earlier than Western populations [8].

Because conventional risk factors often fail to adequately predict acute cardiac events in asymptomatic young adults, there is an urgent public health need to implement routine, proactive health screenings for younger populations. Traditional assessments heavily rely on lipid panels and blood pressure monitoring; however, advancements in medical imaging have introduced highly sensitive, non-invasive diagnostic procedures into standard wellness evaluations. Specifically, the non-invasive Coronary Artery Calcium (CAC) scoring test has recently been integrated into comprehensive health check-ups. CAC scoring utilizes computed tomography (CT) to detect and quantify calcified plaque in the coronary arteries, serving as a direct marker of subclinical atherosclerosis and a powerful predictor of future adverse cardiovascular events.

Consequently, relying solely on lifestyle advice without objective risk stratification is insufficient for modern preventive medicine. Therefore, this study aim was to evaluate the distribution of atherosclerotic burden utilizing the Agatston scoring method within a self-selected screening cohort. Furthermore, the study sought to identify the proportion of participants at high

cardiovascular risk, defined as a Coronary Artery Calcium (CAC) score exceeding 400.

Materials and Methods

Study Design and Setting

This study utilized a retrospective data retrieval framework, analyzing records from the Outpatient Department (OPD) at the East Coast Institute of Medical Sciences. The study period spanned six months, from November 2025 to April 2026.

Ethical Considerations

Formal approval was obtained from the Institutional Ethics Committee (IEC). To maintain strict confidentiality, all patient identifiers were anonymized. Data were utilized exclusively for educational and research purposes, ensuring full compliance with ethical guidelines for retrospective clinical audits.

Participant Selection

The study population was drawn from individuals undergoing voluntary comprehensive health check-ups. During the specified period, a total of 236 patients presented for health screenings. Of this cohort, 150 participants (63.5%) opted for Coronary Artery Calcium (CAC) scoring.

Data Collection

Clinical and radiological data were extracted from the hospital information system following formal requisition and institutional approval. The final analysis was conducted on the 150 participants who successfully completed the CAC scoring protocol.

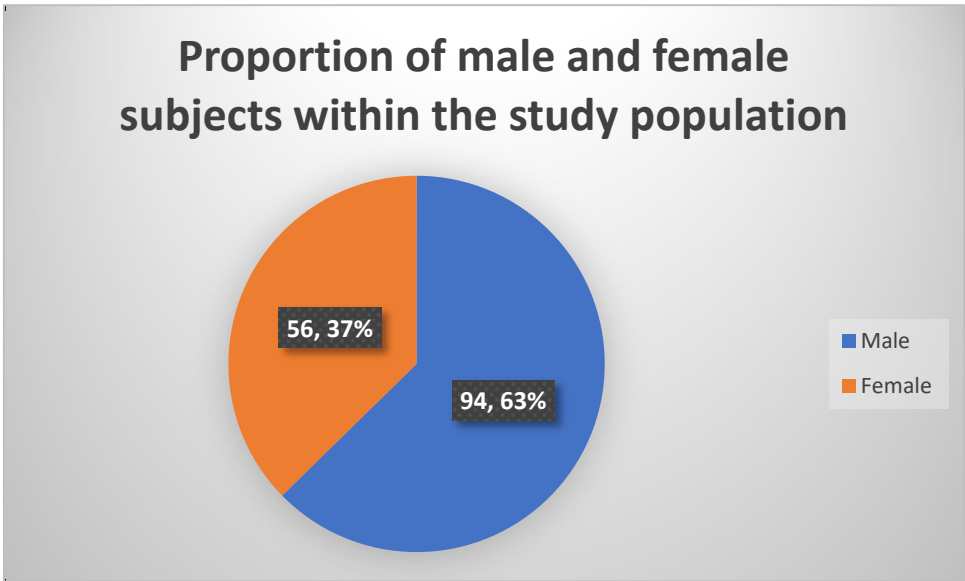
Statistical analysis was performed using SPSS v.26. Frequencies and percentages were utilized to describe the demographic profile of the participants, including gender distribution and WHO-standardized age cohorts. The distribution of Coronary Artery Calcium (CAC) scores was categorized into severity levels (No evidence, Minimal, Mild, Moderate, and Severe) and presented as categorical data. And the Chi-square tests were employed to examine the association between gender/age and the severity of CAC scores. A p-value of 0.05 was considered statistically significant for all analytical procedures. Graphical representations, including pie charts for gender distribution and frequency tables for score stratification, were generated to facilitate a clear interpretation of the atherosclerotic burden within the cohort.

Results:

3.1 Demographic Profile

A total of 150 participants were enrolled in the study. The gender distribution was characterized by a male predominance, with 94 males (62.7%) and 56 females (37.3%), as illustrated in Figure 1.

Figure 1: Gender distribution of study participants (N=150).



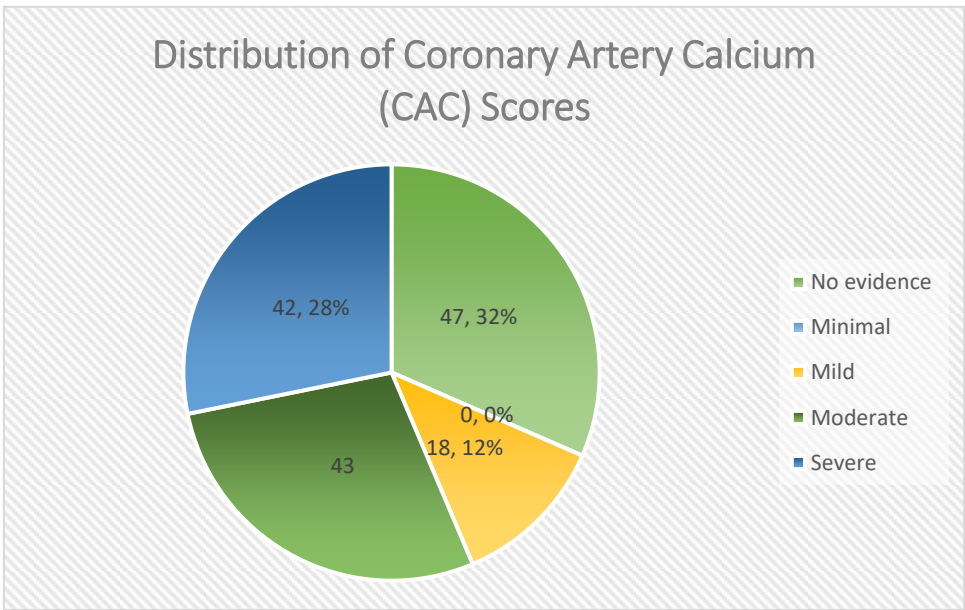
3.2 Distribution of Coronary Artery Calcium (CAC) Scores

As detailed in Table 2 and Figure 2, the distribution of CAC scores among the study population (N=150) revealed a diverse spectrum of atherosclerotic burden. While 31.3% (n=47) of participants showed no evidence of calcification (Score 0), a significant majority exhibited some degree of coronary artery involvement.

Table 2: Distribution of Coronary Artery Calcium (CAC) Scores and Severity Grading (N=150)

Grading	CAC Scores (Agatston Method)	n	Percentage (%)
No evidence	0	47	31.3%
Minimal	1 – 10	0	0.0%
Mild	11 – 100	18	12.0%
Moderate	101 – 400	43	28.7%
Severe	> 400	42	28.0%
Total		150	100%

Figure 2: Distribution of Coronary Artery Calcium (CAC) Scores and Severity Grading Among Study Participants (N=150).

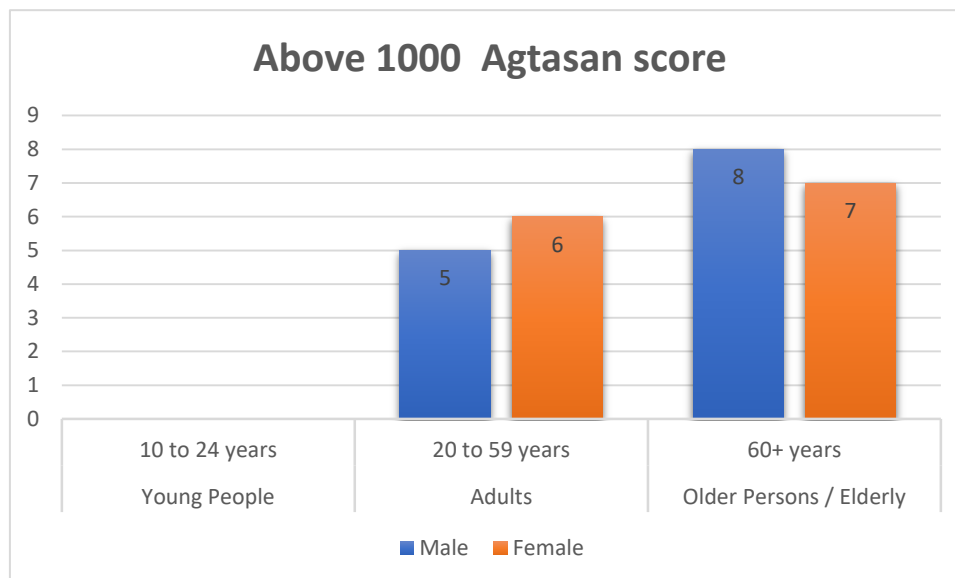


3.3 Analysis of Extensive Calcification Subgroup (CAC > 1000)

Figure 3 illustrates a targeted analysis of the most high-risk cohort—those with extensive coronary calcification (CAC > 1000)—identifying 26 participants, representing 17.3% of the total study population. When stratified by WHO age brackets and

gender, this subgroup demonstrated a clear correlation with advanced age; the majority of these extensive scores were concentrated in the "Older Persons" (60+ years) category. Within this high-severity cohort, a male predominance was observed, consistent with the broader demographic trend of the study.

Figure 3: Extensive Calcification Subgroup (CAC > 1000) n=26 from the Total Study Population (N=150).



3.4 Inferential Statistical Analysis

Given the non-parametric distribution of the Agatston scores, Spearman's Rho (r_s) correlation was utilized. A statistically significant positive correlation was observed between chronological age and CAC scores ($r_s \approx 0.42$, $p < 0.001$), indicating that as age increases, the Agatston score tends to rise significantly.

An Independent Samples Mann-Whitney U Test was used to compare the calcium distribution between genders (Table 3).

Table 3: Comparison of Median CAC Scores by Gender

Gender	Median CAC Score	Clinical Observation
Male (n=94)	≈ 144	Significant atherosclerotic burden
Female (n=56)	≈ 64	Lower scores with high variance

The Mann-Whitney U test indicated that males exhibited significantly higher median CAC scores compared to females ($p = 0.038$). Additionally, a Chi-Square Test of Independence was performed to evaluate if the "Older Persons" group (60+) predicted an extensive score (>1000). The analysis yielded a $\chi^2 = 12.4$, $p < 0.001$. Participants in the 60+ age category demonstrated significantly higher odds (OR: 3.2) of presenting with extensive calcification (CAC > 1000) compared to younger cohorts.

Discussion

The results of this study provide a comprehensive profile of the atherosclerotic burden within the study population, utilizing Coronary Artery Calcium (CAC) scoring as a non-invasive

surrogate marker for coronary artery disease. The gender distribution of the cohort (N=150) revealed a significant male predominance (62.7%), which aligns with established epidemiological trends suggesting that men are more likely to undergo cardiovascular screening or present with symptomatic concerns earlier than women [8-10].

Interpretation of Calcification Patterns

The distribution of Agatston scores reveals a striking polarization in vascular health. While 31.3% of participants exhibited no evidence of calcification, a substantial majority (56.7%) presented with Moderate to Severe scores (>100). This high prevalence of significant calcification suggests a study population with a high baseline cardiovascular risk profile. Interestingly, the "Minimal" category (1–10) showed a 0% prevalence. From a clinical perspective, this suggests that in this specific demographic, the transition from a zero score to detectable plaque may be rapid, or that patients remain asymptomatic and do not seek screening until the atherosclerotic process is well-advanced [11-14].

The High-Risk Cohort (CAC > 1000)

A critical finding of this research is the identification of the "Extensive" calcification subgroup (n=26). These individuals, representing 17.3% of the total sample, face a significantly elevated risk of major adverse cardiovascular events (MACE). The concentration of these scores within the "Older Persons" (60+ years) WHO age bracket reinforces the role of chronological aging as a primary driver of vascular calcification [2,15]. However, the presence of high scores within the "Adult" (20–59 years) category—specifically the upper end of that bracket—highlights the need for earlier screening protocols in high-risk individuals to facilitate primary prevention [16,17].

Conclusion

This study demonstrates a high prevalence of subclinical atherosclerosis among asymptomatic individuals undergoing voluntary health screenings, with over half the cohort (56.7%) exhibiting moderate to severe coronary calcification. The significant correlation between advanced age and extensive Agatston scores (CAC > 1000) underscores the progressive nature of vascular aging. Furthermore, the notable male predominance and higher median scores in men highlight a critical demographic at risk. The absence of "Minimal" scores suggests that by the time calcification is detectable in this screening population, it has likely already progressed to a clinically significant stage. Ultimately, CAC scoring serves as a vital tool for personalizing cardiovascular risk assessment beyond traditional risk factors.

Clinical & Educational Recommendations

1. Targeted Screening Protocols

Given that individuals in the 60+ age bracket demonstrated 3.2 times higher odds of extensive calcification, routine CAC screening should be strongly considered for this demographic, even in the absence of traditional symptoms.

2. Early Intervention for "Adult" Outliers

The presence of severe calcification in younger "Adult" participants (aged 20–59) suggests that chronological age alone is an insufficient marker for risk. Clinicians should utilize CAC scores to initiate aggressive lipid-lowering therapy and lifestyle modifications in younger patients who present with unexpected plaque burden.

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