“Relationship of Epicardial Adipose Tissue and LDL Cholesterol with Coronary Artery Disease in Patients Admitted with Suspected Coronary Artery Disease: A One-Year Observational Study"

BY

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ABSTRACT

Background: Coronary artery disease (CAD) remains one of the leading causes of morbidity and mortality worldwide. Epicardial adipose tissue (EAT), a metabolically active visceral fat depot surrounding the myocardium and coronary arteries, has emerged as an important marker associated with inflammation, endothelial dysfunction, atherosclerosis, and coronary artery disease progression. Elevated low-density lipoprotein (LDL) cholesterol is a well-established risk factor for atherosclerotic plaque formation and cardiovascular disease. Increasing evidence suggests that echocardiographically measured epicardial adipose tissue thickness may correlate with the presence and severity of coronary artery disease. However, limited data are available regarding the combined association between epicardial adipose tissue thickness, LDL cholesterol, and angiographically proven CAD in the Indian population.

Aim and Objectives: [redacted]

Materials and Methods: [redacted]

Results and Discussion: [redacted]

[redacted]

[redacted]

[redacted]

Conclusion: [redacted]

Keywords: Epicardial adipose tissue; coronary artery disease; LDL cholesterol; Echocardiography; Coronary angiography; Atherosclerosis; Dyslipidemia; Multivessel disease; Cardiovascular risk; Visceral adiposity

LIST OF ABBREVIATIONS

Abbreviation	Full Form
ACS	Acute Coronary Syndrome
BMI	Body Mass Index
bpm	Beats Per Minute
CAD	Coronary Artery Disease
CT	Computed Tomography
DVD	Double Vessel Disease
DBP	Diastolic Blood Pressure
DM	Diabetes Mellitus
EAT	Epicardial Adipose Tissue
HDL	High-Density Lipoprotein
Kg/m^2	Kilogram per Square Meter
LDL	Low-Density Lipoprotein
mg/dL	Milligrams per Decilitre
mmHg	Millimetres of Mercury
NEC	Normal Epicardial Coronaries
NSTEMI	Non-ST Elevation Myocardial Infarction
PLAX	Parasternal Long Axis View
PSAX	Parasternal Short Axis View
SBP	Systolic Blood Pressure
SPSS	Statistical Package for the Social Sciences
STEMI	ST-Elevation Myocardial Infarction
SVD	Single Vessel Disease
TVD	Triple Vessel Disease

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INTRODUCTION

INTRODUCTION

According to the World Health Organization (WHO), cardiovascular diseases (CVDs) are a group of disorders of the heart and blood vessels that include coronary artery disease, cerebrovascular disease, peripheral arterial disease, rheumatic heart disease, congenital heart disease, and deep vein thrombosis. [redacted]

In recent years, increasing attention has been given to the role of adipose tissue in cardiovascular diseases. Epicardial adipose tissue (EAT) is a metabolically active visceral fat depot located between the myocardium and the visceral layer of the pericardium. [redacted]

[redacted]

Therefore, evaluating the association between epicardial adipose tissue thickness, LDL cholesterol levels, and coronary artery disease in patients with suspected CAD may provide valuable insights into the pathophysiology and risk stratification of coronary artery disease (10).

Epidemiology

Global Epidemiology

[redacted]

Although improvements in diagnosis and treatment have reduced mortality rates in some regions, CAD continues to impose a major economic and healthcare burden globally (11).

Epidemiology in India

[redacted]

Both urban and rural populations are increasingly affected, although urban populations tend to show a higher prevalence due to sedentary lifestyles and dietary patterns (13).

Epidemiology in Karnataka

Karnataka, like many other Indian states, has witnessed a growing burden of coronary artery disease in recent years. [redacted]

Early identification of risk factors and improved awareness of preventive measures are essential to reduce the burden of CAD in the state (14).

AIMS AND OBJECTIVES

AIMS AND OBJECTIVES

Objective of the study:

[redacted]

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Coronary Artery Disease

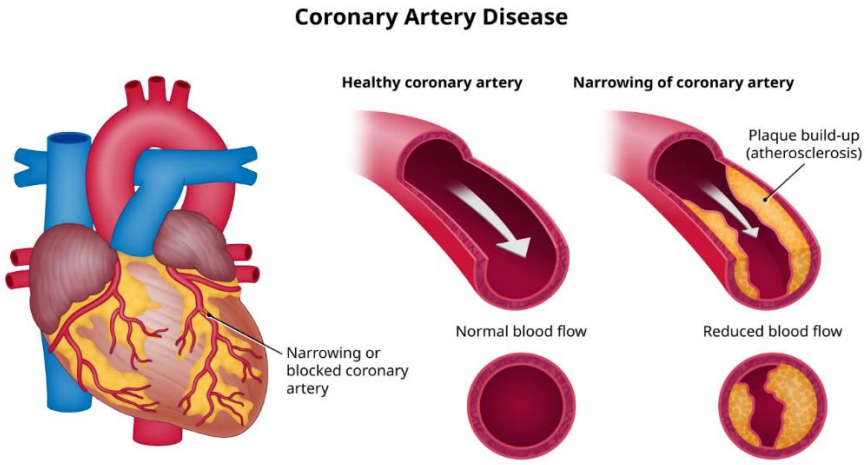


Fig 1. Coronary Artery Disease

Coronary artery disease is a pathological condition in which the coronary arteries fail to supply adequate blood flow to the myocardium because of narrowing or obstruction within their lumen. [redacted]

- It is a major cause of cardiovascular morbidity and mortality

Pathophysiology of Coronary Artery Disease

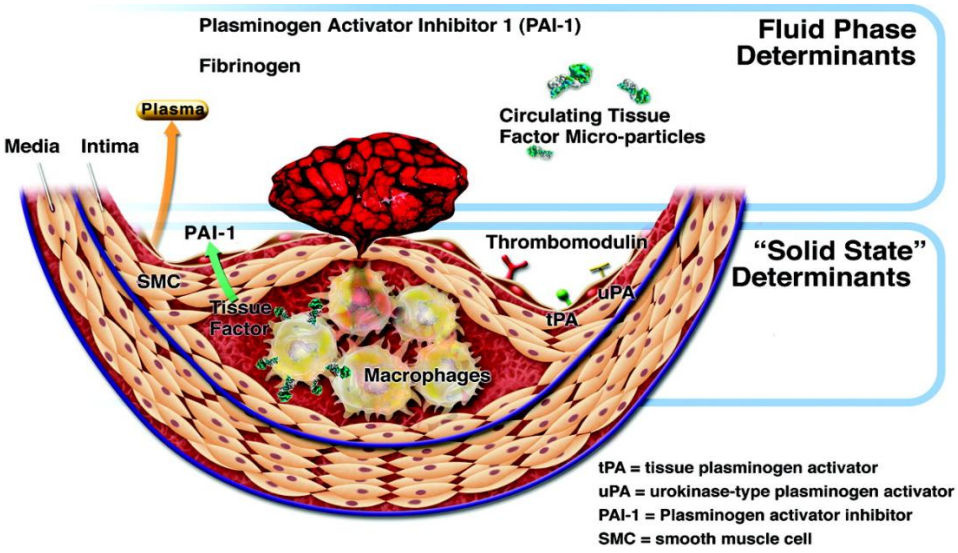


Fig 2. Pathophysiology of Coronary Artery Disease

The pathophysiology of coronary artery disease is a complex and progressive process involving endothelial dysfunction, lipid accumulation, inflammation, plaque formation, and eventual compromise of coronary blood flow. [redacted]

[redacted]

- Plaque rupture can precipitate acute coronary syndrome

Atherosclerosis and Coronary Artery Disease

Atherosclerosis is the principal pathological basis of coronary artery disease and represents a chronic inflammatory disorder of medium and large arteries. [redacted]

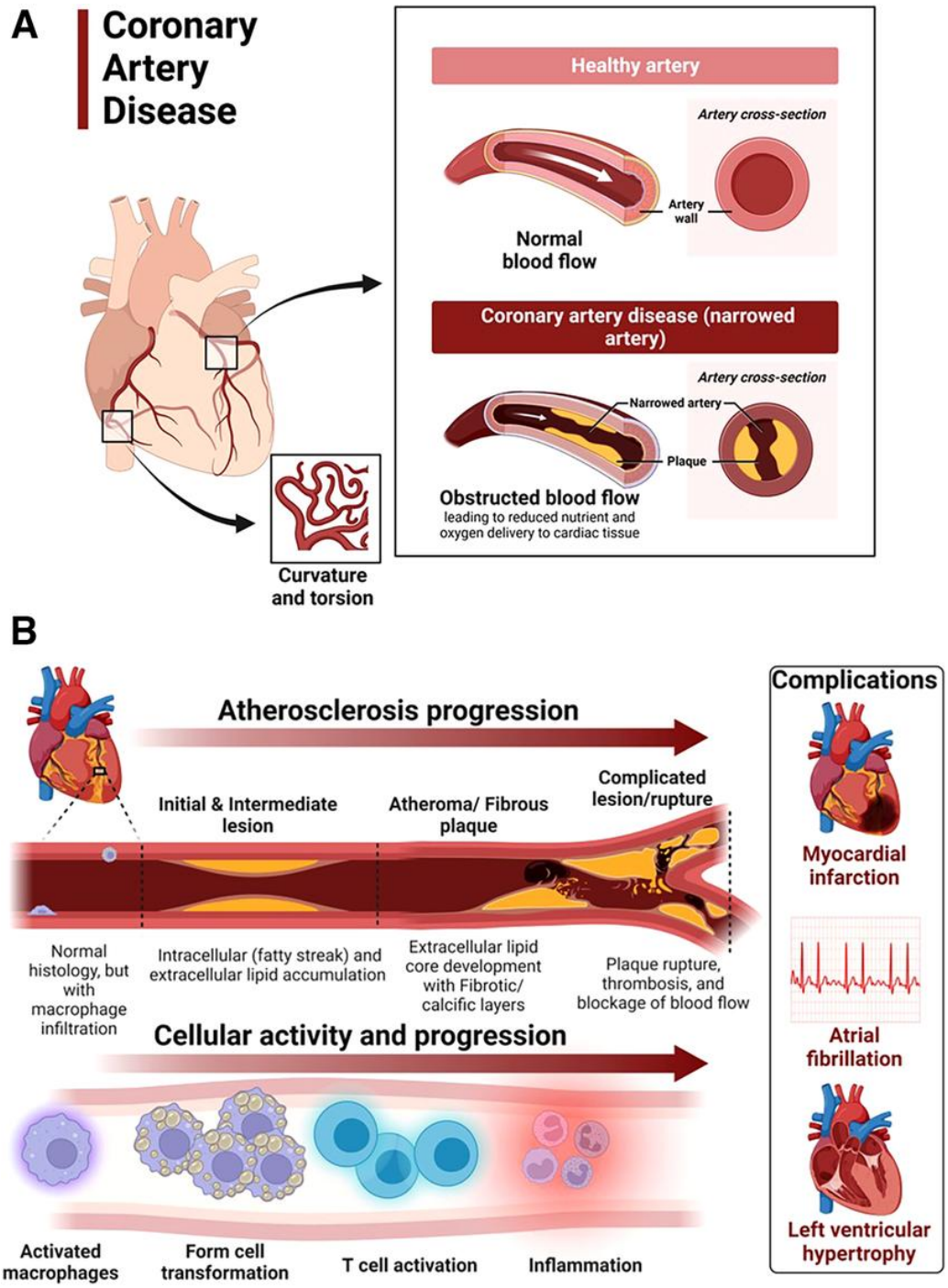


Fig 3. Atherosclerosis Progression in Coronary Artery Disease

Risk Factors for Coronary Artery Disease

Risk factors for coronary artery disease are variables that increase the likelihood of developing atherosclerosis and its clinical consequences. [redacted]

[redacted]

In the present topic, LDL cholesterol represents a classical modifiable factor, while epicardial adipose tissue may reflect an additional metabolic-inflammatory burden related to coronary artery disease (22).

Non-modifiable risk factors

[redacted]

Modifiable risk factors

[redacted]

Clinical Spectrum of Coronary Artery Disease

The clinical spectrum of coronary artery disease is broad and ranges from asymptomatic ischemia to chronic stable angina, acute coronary syndrome, heart failure, arrhythmias, and sudden cardiac death. [redacted]

[redacted]

- Presentation may vary depending on age, diabetes, and disease severity

Atherosclerosis

Pathogenesis of Atherosclerosis

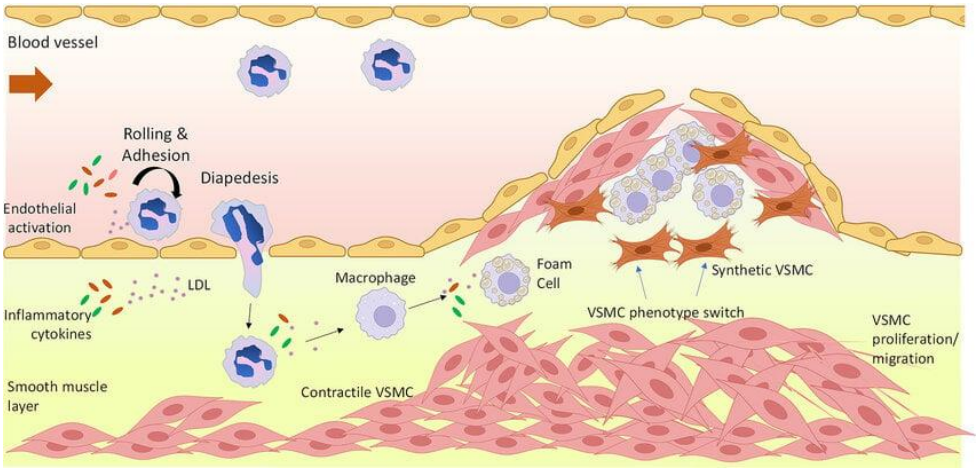


Fig 4. Pathogenesis of Atherosclerosis

Atherosclerosis is a chronic, progressive disease of the arterial wall and is the fundamental pathological process underlying most cases of coronary artery disease. [redacted]

[redacted]

Lipid Deposition and Plaque Formation

Lipid deposition is a central event in the development of atherosclerotic plaque and is closely linked to coronary artery disease. [redacted]

[redacted]

Inflammatory Mechanisms in Atherosclerosis

Inflammation plays a central role in every stage of atherosclerosis, from initiation of the lesion to plaque destabilization and rupture. [redacted]

Plaque Progression and Plaque Rupture

As atherosclerosis advances, the initially small and silent lesion evolves into a mature plaque capable of producing chronic coronary narrowing or sudden acute events. [redacted]

[redacted]

Dyslipidemia

Definition of Dyslipidemia

Dyslipidemia refers to an abnormal concentration of lipids or lipoproteins in the blood that predisposes individuals to the development of atherosclerosis and cardiovascular diseases, particularly coronary artery disease. [redacted]

[redacted]

Lipoprotein Metabolism

Lipoprotein metabolism describes the processes through which lipids are transported, transformed, and utilized in the body. [redacted]

Types of Lipoproteins

Lipoproteins are classified according to their density, composition, and function in lipid transport. [redacted]

[redacted]

Chylomicrons

Chylomicrons are the largest and least dense lipoprotein particles and are primarily responsible for transporting dietary lipids from the intestine to peripheral tissues. [redacted]

Very Low Density Lipoprotein (VLDL)

Very low density lipoprotein is synthesized in the liver and is responsible for transporting endogenous triglycerides and cholesterol to peripheral tissues. [redacted]

Intermediate Density Lipoprotein (IDL)

Intermediate density lipoprotein represents a transitional lipoprotein formed during the metabolism of very low density lipoprotein. [redacted]

[redacted]

Low Density Lipoprotein (LDL)

Low density lipoprotein is the major cholesterol-carrying lipoprotein in human plasma and plays a central role in the development of atherosclerosis. [redacted]

High Density Lipoprotein (HDL)

High density lipoprotein is a small and dense lipoprotein particle that plays a protective role in cardiovascular health. [redacted]

[redacted]

Low Density Lipoprotein Cholesterol

Structure and Composition of LDL

Low density lipoprotein is a cholesterol-rich lipoprotein particle responsible for transporting cholesterol from the liver to peripheral tissues. [redacted]

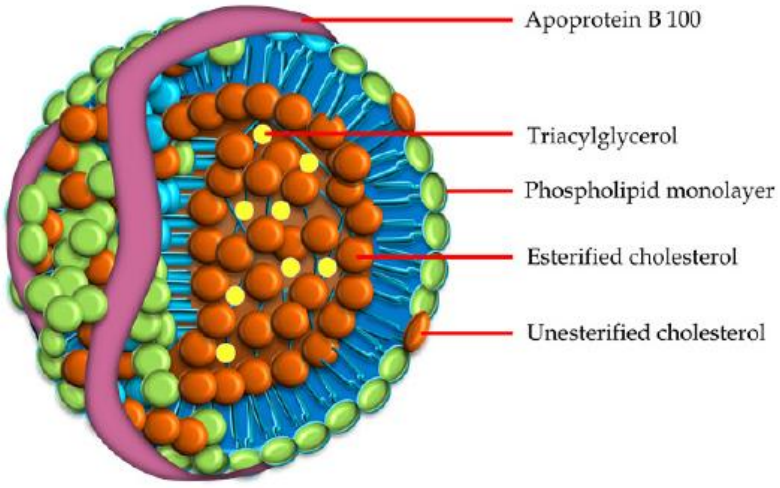


Fig 5. LDL Molecular Structure

Metabolism of LDL Cholesterol

LDL cholesterol metabolism represents a crucial step in lipid transport and homeostasis within the body. [redacted]

Role of LDL in Atherosclerotic Plaque Formation

Low density lipoprotein cholesterol plays a central role in the initiation and progression of atherosclerotic plaque formation. [redacted]

[redacted]

Oxidized LDL and Endothelial Dysfunction

Oxidized LDL is a modified form of LDL that plays a critical role in endothelial dysfunction and the development of atherosclerosis. [redacted]

- It accelerates atherosclerotic plaque development

Clinical Importance of LDL Cholesterol in Coronary Artery Disease

LDL cholesterol has immense clinical importance in the development, progression, and management of coronary artery disease. [redacted]

[redacted]

Adipose Tissue

Types of Adipose Tissue

Adipose tissue is a specialized connective tissue responsible for energy storage, metabolic regulation, and endocrine activity within the body. [redacted]

[redacted]

Type of adipose tissue	Location	Characteristics
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

Subcutaneous adipose tissue

Subcutaneous adipose tissue is the fat layer located directly beneath the skin and represents the largest adipose tissue depot in the human body. [redacted]

[redacted]

[redacted]

Feature	Subcutaneous adipose tissue
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

Visceral adipose tissue

Visceral adipose tissue is located within the abdominal cavity and surrounds internal organs such as the liver, intestines, and pancreas. [redacted]

Feature	Visceral adipose tissue
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

Metabolic Functions of Adipose Tissue

Adipose tissue plays a central role in metabolic regulation by maintaining energy balance and regulating lipid metabolism. [redacted]

[redacted]

Metabolic function	Role
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

Endocrine Function of Adipose Tissue

Adipose tissue functions as an endocrine organ by secreting a wide range of biologically active molecules known as adipokines. [redacted]

[redacted]

Adipokine	Major function
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

Epicardial Adipose Tissue

Definition of Epicardial Adipose Tissue

Epicardial adipose tissue is a specialized visceral fat depot located between the myocardium and the visceral layer of the pericardium. [redacted] Its measurement, particularly through echocardiography, has been increasingly used in clinical studies to evaluate its association with coronary artery disease (20).

Anatomy and Location of Epicardial Adipose Tissue

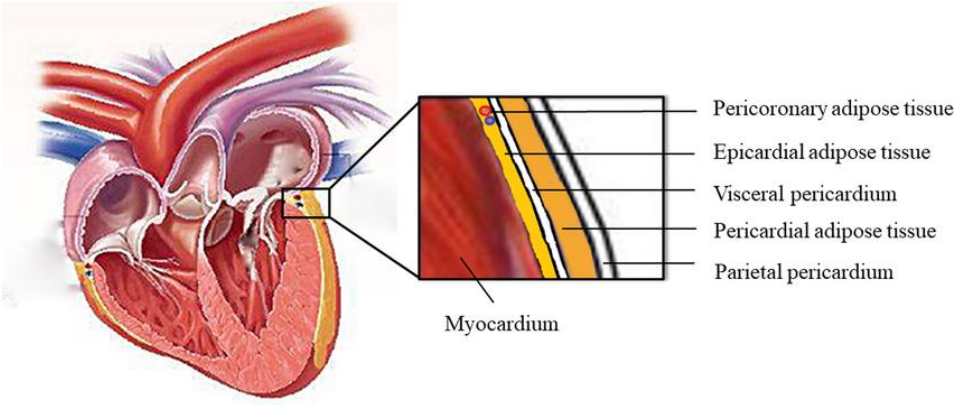


Fig 6. Anatomy of Epicardial Tissue

Epicardial adipose tissue is anatomically situated on the surface of the heart, specifically between the outer wall of the myocardium and the visceral layer of the pericardium. [redacted]

- Allows direct metabolic interaction with coronary vessels

Embryological Origin of Epicardial Adipose Tissue

Epicardial adipose tissue originates from the splanchnopleuric mesoderm during embryonic development and is therefore classified as a visceral fat depot. [redacted]

[redacted]

- Influenced by metabolic and genetic factors

Physiological Functions of Epicardial Adipose Tissue

Epicardial adipose tissue performs several physiological functions that contribute to normal cardiac metabolism and protection of the heart. [redacted]

[redacted]

- Participates in local cardiac metabolism

Distribution of Epicardial Adipose Tissue Around the Heart

Epicardial adipose tissue is not uniformly distributed across the surface of the heart but tends to accumulate in specific anatomical regions. [redacted]

- Uneven distribution across cardiac surfaces

Metabolic and Inflammatory Role of Epicardial Adipose Tissue

Adipokines Secreted by Epicardial Adipose Tissue

Epicardial adipose tissue is a metabolically active visceral fat depot that functions as an endocrine organ by secreting various bioactive molecules known as adipokines. [redacted]

[redacted]

- Interleukins regulate immune responses in vascular tissue

Pro-inflammatory Mediators

Epicardial adipose tissue is capable of producing several pro-inflammatory mediators that contribute to vascular inflammation and atherosclerosis. [redacted]

- Reactive oxygen species enhance oxidative stress

Anti-inflammatory Mediators

In addition to pro-inflammatory substances, epicardial adipose tissue also produces anti-inflammatory mediators that contribute to cardiovascular protection. [redacted]

[redacted]

- Protective mediators maintain endothelial health

Paracrine and Vasocrine Effects on Coronary Arteries

Epicardial adipose tissue influences coronary arteries primarily through paracrine and vasocrine mechanisms. [redacted]

[redacted]

Epicardial Adipose Tissue and Coronary Artery Disease

Mechanisms Linking Epicardial Adipose Tissue with Atherosclerosis

Epicardial adipose tissue is closely linked with atherosclerosis because of its unique anatomical, metabolic, and inflammatory properties. [redacted]

[redacted]

- Supports progression from fatty streak to mature plaque

Influence on Coronary Artery Disease Progression

Epicardial adipose tissue has a significant influence on the progression of coronary artery disease by sustaining a pro-inflammatory, pro-oxidative, and metabolically adverse environment around the coronary arteries. [redacted]

- Interacts with other metabolic risk factors to worsen disease

Measurement of Epicardial Adipose Tissue

Imaging Modalities for Measurement

Epicardial adipose tissue can be measured using several imaging techniques that allow visualization of cardiac structures and surrounding fat deposits. [redacted]

- Selection of modality depends on clinical and research requirements

Echocardiography

Echocardiography is one of the most widely used methods for assessing epicardial adipose tissue because of its availability and noninvasive nature. [redacted]

[redacted]

- Operator-dependent measurement

Computed Tomography

Computed tomography is a highly accurate imaging modality for evaluating epicardial adipose tissue. [redacted]

- Involves exposure to ionizing radiation

Magnetic Resonance Imaging

Magnetic resonance imaging is another advanced technique used for evaluating epicardial adipose tissue. [redacted]

[redacted]

- Limited availability and higher cost

Comparison of Imaging Modalities

Different imaging techniques used for measuring epicardial adipose tissue vary in their accuracy, practicality, and clinical application. [redacted]

- Selection depends on clinical and research requirements

Advantages and Limitations of Each Modality

Each imaging modality used for measuring epicardial adipose tissue has specific advantages and limitations that influence its use in clinical and research settings. [redacted]

[redacted]

- Patient safety and clinical purpose must be considered

Echocardiographic Assessment of Epicardial Adipose Tissue

Principles of Echocardiographic Measurement

Echocardiography is a widely used noninvasive imaging technique for evaluating cardiac structures and surrounding tissues using ultrasound waves. [redacted]

[redacted]

- Safe and repeatable without radiation exposure

Technique of Epicardial Adipose Tissue Measurement

The technique of measuring epicardial adipose tissue using echocardiography involves careful visualization of the cardiac structures and identification of the fat layer located between the myocardium and visceral pericardium. [redacted]

- Multiple cardiac cycles observed for accuracy

Standard Echocardiographic Views Used

Accurate measurement of epicardial adipose tissue requires appropriate echocardiographic imaging views. [redacted]

[redacted]

- Standard views ensure reproducibility in studies

Parasternal Long Axis (PLAX)

The parasternal long axis view is one of the standard echocardiographic windows used for evaluating cardiac anatomy and epicardial adipose tissue thickness. [redacted]

- Frequently used in routine echocardiography

Parasternal Short Axis (PSAX)

The parasternal short axis view provides a cross-sectional image of the heart and is another commonly used echocardiographic window for evaluating epicardial adipose tissue. [redacted]

[redacted]

- Useful for evaluating regional fat distribution

Timing of Measurement (Systolic and Diastolic EAT)

The timing of epicardial adipose tissue measurement during the cardiac cycle is an important factor in echocardiographic evaluation. [redacted]

- Timing should remain uniform within a study

Normal and Abnormal Epicardial Fat Thickness

Epicardial adipose tissue thickness varies among individuals depending on age, body composition, and metabolic status. [redacted]

[redacted]

- Thickness values may vary across populations

Coronary Angiography

Role of Coronary Angiography in Diagnosis of CAD

Coronary angiography is considered the reference imaging method for evaluating coronary artery disease because it allows direct visualization of the coronary arterial lumen. [redacted]

- Used in patients with suspected ischemic heart disease

Techniques of Coronary Angiography

Coronary angiography can be performed using different vascular access techniques, the most common being the transradial and transfemoral approaches. [redacted]

- Both methods provide accurate coronary imaging

Transradial approach

The transradial approach involves introducing a catheter through the radial artery located at the wrist. [redacted]

- May be technically challenging in small arteries

Transfemoral approach

The transfemoral approach is the traditional technique used for coronary angiography and involves insertion of a catheter through the femoral artery in the groin. [redacted]

- Higher risk of bleeding compared with radial access

Angiographic Definition of Coronary Artery Disease

Coronary artery disease is defined angiographically by the presence of significant narrowing within the coronary arteries. [redacted]

[redacted]

Assessment of Severity of Coronary Artery Disease

Coronary angiography not only confirms the presence of coronary artery disease but also helps determine its severity and extent. [redacted]

Relationship Between Epicardial Adipose Tissue and LDL Cholesterol

Pathophysiological Interaction

Epicardial adipose tissue and low density lipoprotein cholesterol interact through multiple biological pathways that influence cardiovascular health. [redacted]

[redacted]

- Interaction influences coronary vascular function

Inflammatory and Metabolic Mechanisms

The relationship between epicardial adipose tissue and LDL cholesterol is strongly influenced by inflammatory and metabolic mechanisms within the cardiovascular system. [redacted]

Impact on Atherosclerosis Development

The combined influence of epicardial adipose tissue and LDL cholesterol plays a significant role in the development of atherosclerosis within coronary arteries. [redacted]

[redacted]

Association Between Epicardial Adipose Tissue and Coronary Artery Disease

Correlation with Presence of Coronary Artery Disease

Epicardial adipose tissue has attracted considerable attention as a potential indicator of coronary artery disease because of its close anatomical and metabolic relationship with coronary vessels. [redacted]

[redacted]

Relationship with Severity of Coronary Artery Disease

Epicardial adipose tissue not only correlates with the presence of coronary artery disease but also appears to be related to its severity. [redacted]

Clinical Significance

Epicardial Adipose Tissue as a Cardiovascular Risk Marker

Epicardial adipose tissue has emerged as an important cardiovascular risk marker due to its close relationship with coronary arteries and its metabolic activity. [redacted]

[redacted]

Role in Early Detection of Coronary Artery Disease

Early detection of coronary artery disease is essential for preventing serious cardiovascular complications such as myocardial infarction and heart failure. [redacted]

- Helps identify individuals who may require further investigation

Role in Risk Stratification

Risk stratification is an essential component of cardiovascular disease management because it helps identify patients who are more likely to develop adverse cardiac events. [redacted]

- Useful in guiding clinical monitoring and management

Rationale for the Present Study

Coronary artery disease remains one of the leading causes of morbidity and mortality worldwide and continues to represent a major public health challenge. [redacted]

The adipokines and inflammatory mediators secreted by epicardial adipose tissue may influence endothelial function, oxidative stress, and atherosclerotic plaque formation.

Research Studies

Jin et al. (2026) examined the relationship between cumulative low-density lipoprotein cholesterol exposure and progression of coronary artery lesions, emphasizing the long-term atherogenic burden of LDL rather than a single time-point value. Overall, this study contributes strong evidence linking LDL cholesterol directly to the advancement of coronary artery pathology, and it is especially relevant in understanding how lipid burden may interact with other markers of cardiometabolic risk and vascular inflammation in patients undergoing evaluation for coronary artery disease (22).

Charisopoulou et al. (2026) conducted a prospective echocardiographic study evaluating epicardial fat thickness as a marker of coronary artery disease severity and ischemic burden.

[redacted]

Overall, the article reinforces the growing evidence that epicardial adipose tissue is closely linked to coronary disease severity and may have value as an adjunctive imaging biomarker in cardiovascular assessment (95).

Jolfayi et al. (2025) explored epicardial adipose tissue features as both a biomarker and a potential therapeutic target in coronary artery disease. [redacted]

Overall, the article provides a contemporary understanding of how epicardial adipose tissue may be integrated into coronary artery disease evaluation, prognosis, and future therapeutic planning, making it a highly relevant reference for research focused on epicardial fat and coronary pathology (56).

Akhter et al. (2025) investigated epicardial fat thickness as a marker of coronary artery disease in diabetic patients in a single-center clinical study. [redacted]

[redacted]

Overall, this paper adds useful clinical evidence to the growing literature that epicardial fat is an important marker of coronary artery disease burden (92).

El-Naggar et al. (2025) evaluated the ability of epicardial fat thickness to predict severe coronary artery disease and mortality risk among patients presenting with ST-elevation myocardial infarction. [redacted]

Overall, this paper contributes strong clinical evidence that increased epicardial fat thickness is associated with both severity of coronary artery disease and adverse prognosis, reinforcing its value in cardiovascular risk assessment (96).

Filtz et al. (2024) evaluated the relationship between epicardial adipose tissue and coronary atherosclerosis using coronary computed tomography angiography in young adults aged 18–45 years. [redacted]

[redacted]Overall, the findings suggest that assessment of epicardial adipose tissue may provide valuable information for early cardiovascular risk detection and may help identify individuals who are at increased risk of developing coronary artery disease (9).

Song et al. (2023) reviewed recent advances in the understanding of epicardial adipose tissue and its relationship with metabolic disorders and cardiovascular diseases. [redacted]Overall, the review underscores the growing importance of epicardial adipose tissue in cardiovascular research and clinical risk assessment (81).

Li et al. (2023) reviewed the role of epicardial adipose tissue dysfunction in cardiovascular diseases, with particular emphasis on its contribution to coronary artery disease. [redacted]

[redacted]Overall, the article provides valuable insight into the biological mechanisms linking epicardial adipose tissue to coronary artery disease (5).

Romano et al. (2023) investigated the relationship between epicardial fat thickness and the need for coronary revascularization in patients with coronary artery disease. [redacted]Overall, the study contributes to the growing body of evidence that epicardial adipose tissue is not only associated with the presence of coronary artery disease but may also correlate with its clinical severity and the likelihood of requiring invasive coronary interventions (10).

Stanciulescu et al. (2023) explored the relationship between low-density lipoprotein cholesterol subfractions and major adverse cardiovascular outcomes. [redacted]

[redacted]

Overall, the review reinforces the critical role of LDL cholesterol in atherosclerotic disease and highlights the importance of lipid management in preventing coronary artery disease and its complications (44).

Park et al. (2022) investigated the relationship between epicardial adipose tissue thickness and coronary plaque composition in patients with coronary artery disease. [redacted]

Overall, the findings support the concept that increased epicardial adipose tissue thickness is closely linked with adverse coronary plaque characteristics and may serve as an important imaging biomarker in the assessment of coronary artery disease (66).

Iacobellis (2022) provided a comprehensive overview of epicardial adipose tissue and its emerging importance in contemporary cardiology. [redacted]

[redacted]

Overall, this article offers important conceptual understanding of the pathophysiological significance of epicardial adipose tissue in cardiovascular disorders (6).

Jiang et al. (2022) explored the mechanisms through which oxidized low-density lipoprotein contributes to endothelial dysfunction and the development of atherosclerosis. [redacted] Overall, the article provides a detailed explanation of the molecular and cellular mechanisms linking LDL cholesterol to endothelial dysfunction and atherosclerotic plaque development, reinforcing its importance as a major determinant of coronary artery disease (17).

Jebari-Benslaiman et al. (2022) described the complex pathophysiological mechanisms involved in the development of atherosclerosis, emphasizing the central role of lipid metabolism, inflammation, and endothelial dysfunction. [redacted]

[redacted]

Overall, the study offers valuable insight into the biological processes responsible for atherosclerosis and reinforces the importance of lipid control and metabolic risk reduction in preventing coronary artery disease (16).

Hendricks et al. (2021) conducted a large meta-analysis involving more than 6600 patients to evaluate the association between epicardial adipose tissue and the risk of myocardial infarction. [redacted]

Overall, the study supports the growing recognition of epicardial adipose tissue as an important imaging biomarker associated with coronary artery disease and adverse cardiovascular outcomes (7).

Christensen et al. (2020) explored epicardial adipose tissue as a potential biomarker for cardiovascular complications, particularly in individuals with type 2 diabetes mellitus. [redacted]

Overall, the study suggests that epicardial adipose tissue may serve as a useful biomarker reflecting both metabolic disturbances and cardiovascular risk, particularly in high-risk populations (20).

Ouimet et al. (2019) discussed the structure and function of high-density lipoprotein and its role in reverse cholesterol transport, a process that counteracts the development of atherosclerosis.

Overall, the study provides insight into lipid metabolism and the dynamic balance between lipoproteins that influences the progression of atherosclerosis and cardiovascular disease (34).

Linton et al. (2019) provided an extensive overview of the role of lipids and lipoproteins in the development of atherosclerosis.

[redacted] Overall, the article provides a comprehensive explanation of how lipid abnormalities contribute to the initiation and progression of atherosclerosis (4).

Talman et al. (2014) described epicardial adipose tissue as an active visceral fat depot with significant implications for cardiovascular health. [redacted] Overall, the study highlighted the emerging role of epicardial adipose tissue as a contributor to cardiovascular disease and a potential biomarker of coronary risk (65).

Bertaso et al. (2013) conducted a systematic review addressing the definition, measurement, and clinical significance of epicardial adipose tissue. [redacted]

[redacted]

Overall, the article concluded that epicardial adipose tissue measurement may provide additional information regarding cardiovascular risk and may serve as a useful marker in the evaluation of coronary artery disease (79).

Iacobellis and Bianco (2011) provided an early comprehensive description of epicardial adipose tissue and its emerging clinical relevance in cardiovascular disease. [redacted]

Overall, the review highlighted the importance of epicardial adipose tissue in cardiovascular pathophysiology and laid the foundation for further research exploring its role in coronary artery disease (54).

Eroglu et al. (2009) investigated the relationship between epicardial adipose tissue thickness measured by echocardiography and the presence and severity of coronary artery disease. [redacted]

[redacted]

[redacted]Overall, the findings support the concept that epicardial adipose tissue is closely associated with coronary atherosclerosis and may play a role in the pathogenesis of coronary artery disease (8).

MATERIALS AND METHODS

MATERIALS AND METHODS

Source of Data

Study Design:

Study Period:

Sample Size:

Sampling technique:

Inclusion Criteria:

Exclusion Criteria:

Study protocol:

EAT measurement:

Coronary angiography:

Non-ST-segment elevation myocardial infarction (NSTEMI) was

Data Collection Procedure

Participant Recruitment:

Laboratory Investigations:

Electrocardiographic Assessment:

Echocardiographic Assessment of Epicardial Adipose Tissue:

Coronary Angiography:

Data Recording and Documentation:

Data Processing and Analysis / Statistical Analysis:

[redacted]

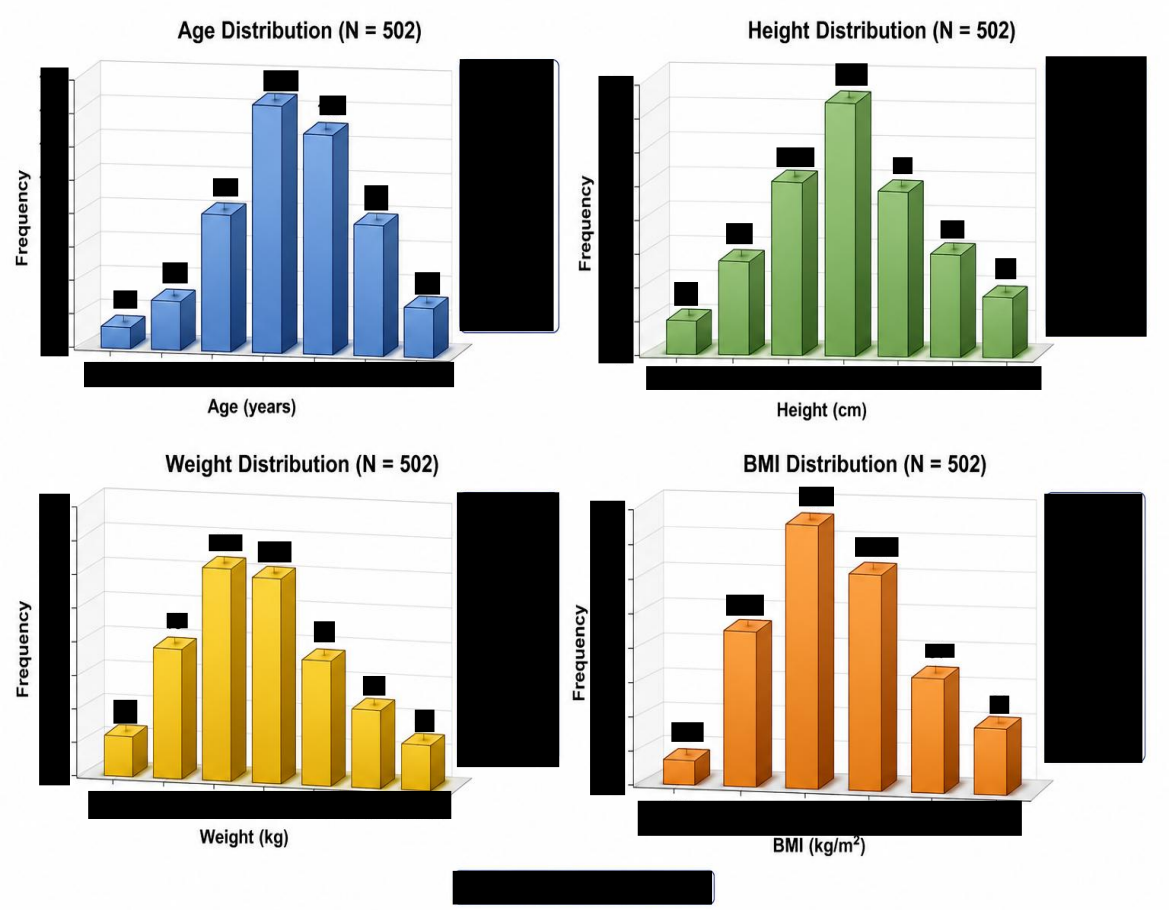
RESULTS

RESULTS

Table 1: Descriptive analysis of demographic parameter in study population (N=502)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C. I	
					Lower	Upper
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Graph 1: Descriptive analysis of demographic parameter in study population (N=502)



[redacted]

[redacted]

[redacted]

[redacted]

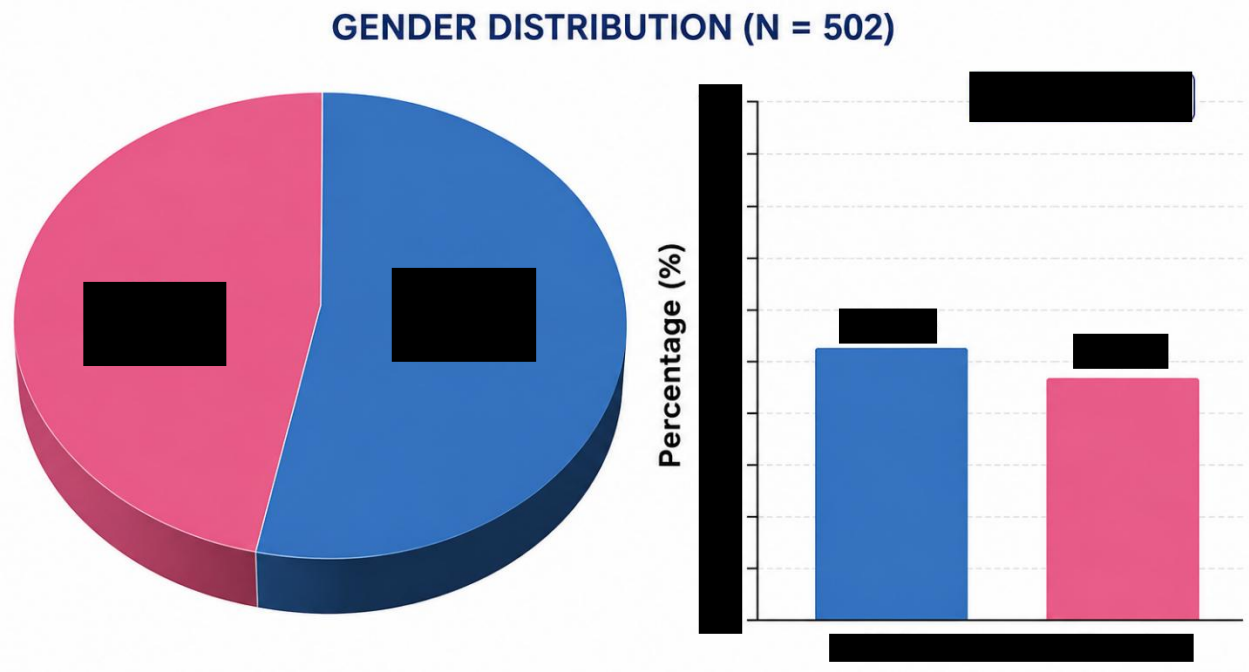
[redacted]The

[redacted]

Table 2: Descriptive analysis of gender in the study population (N=502)

Gender	Frequency	Percentages
Male	[redacted]	[redacted]
Female	[redacted]	[redacted]

Graph 2: Descriptive Analysis of Gender in the Study Population (N=502)



[redacted]

Table 3: Descriptive analysis of Chief Complaints in the study population (N=502)

Chief Complaints	Frequency	Percentages
Chest Pain		
Dyspnoea		
Syncope		
Palpitations		
Angina Equivalents		

Graph 3: Descriptive Analysis of Chief Complaints in the Study Population (N=502)

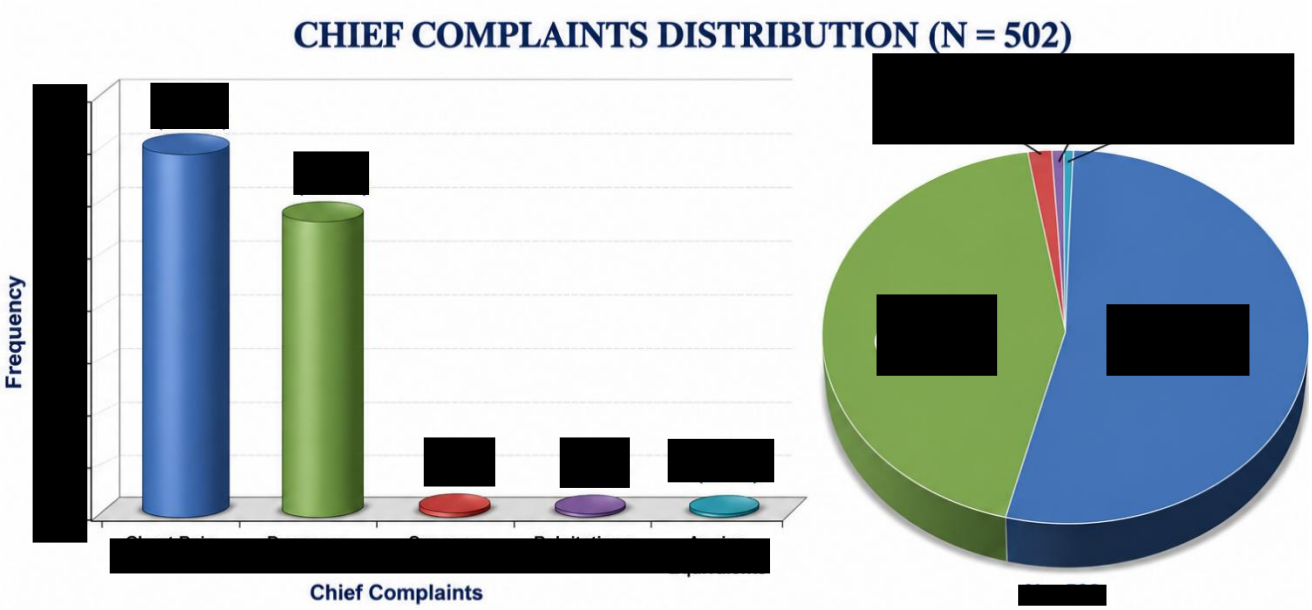
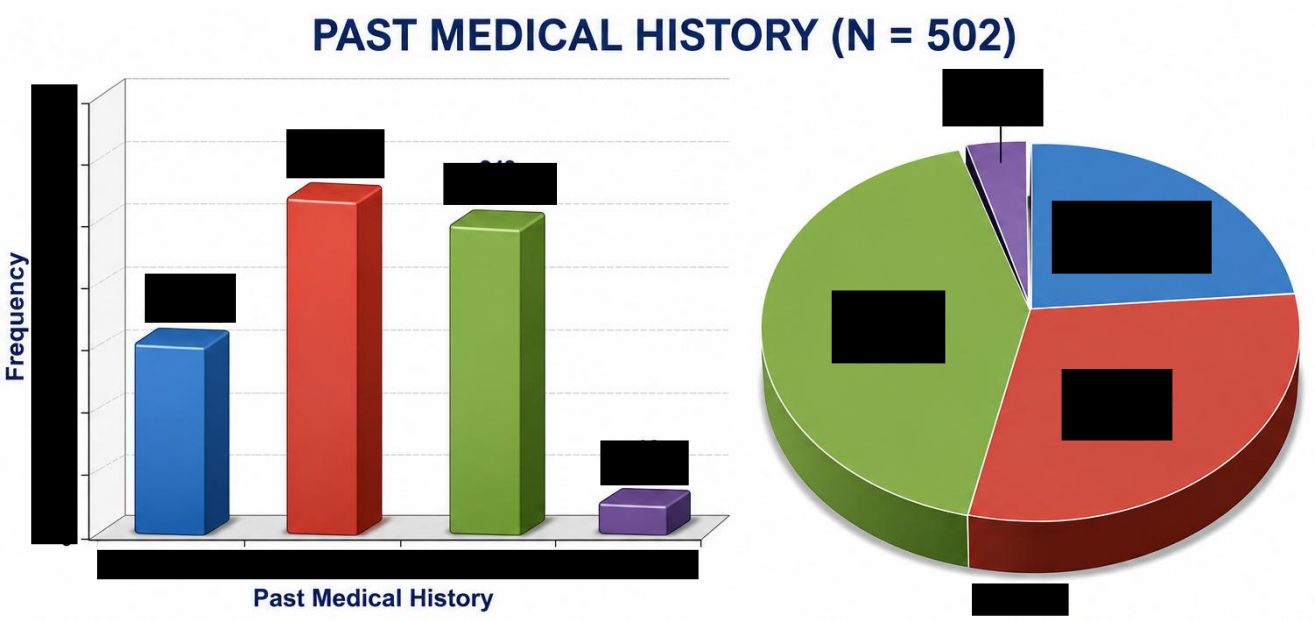


Table 4: Descriptive analysis of Past Medical History in the study population (N=502)

Past Medical History	Frequency	Percentages
HTN and DM	[redacted]	[redacted]
HTN	[redacted]	[redacted]
T2DM	[redacted]	[redacted]
CAD	[redacted]	[redacted]

Graph 4: Descriptive Analysis of Past Medical History in the Study Population (N=502)

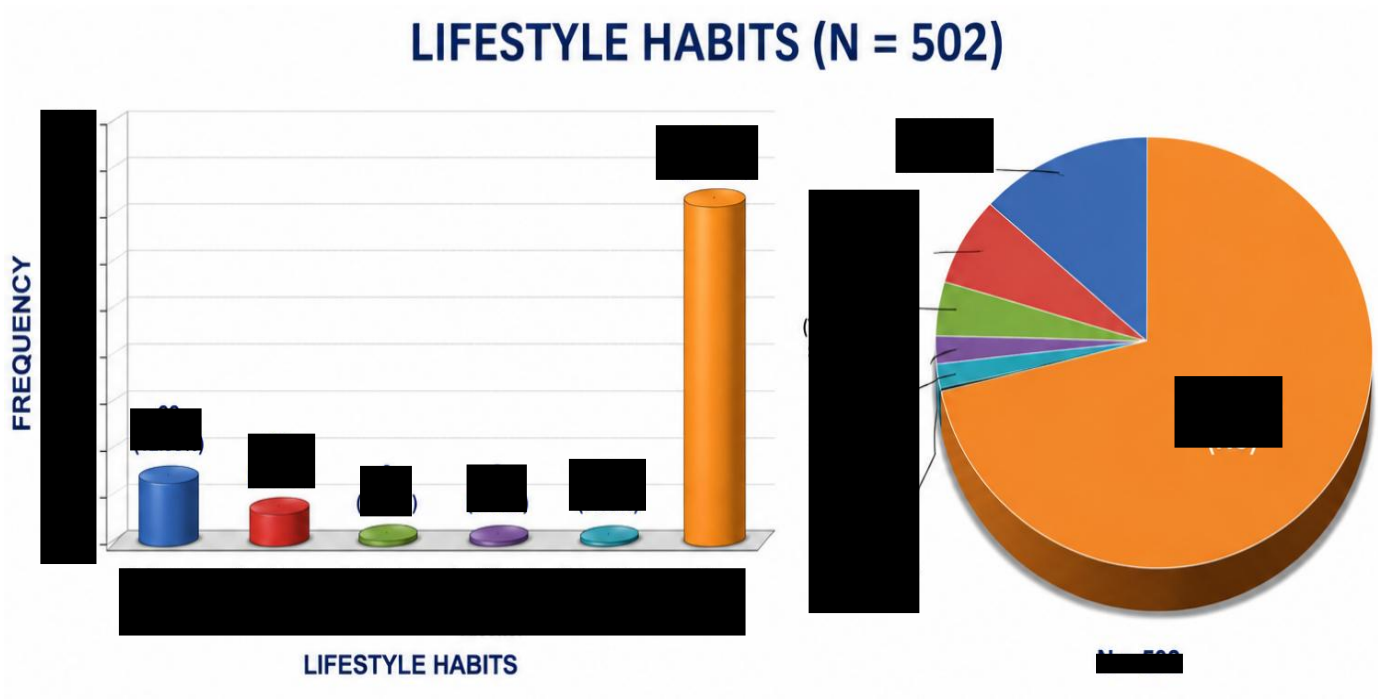


[redacted]

Table 5: Descriptive analysis of lifestyle habits in the study population (N=502)

Lifestyle Habits	Frequency	Percentages
Tobacco	[redacted]	[redacted]
Smoking	[redacted]	[redacted]
Tobacco + Smoking	[redacted]	[redacted]
Smoking + Tobacco + Alcohol	[redacted]	[redacted]
Tobacco + Alcohol	[redacted]	[redacted]
No	[redacted]	[redacted]

Graph 5: Descriptive Analysis of Lifestyle Habits in the Study Population (N=502)



[redacted]

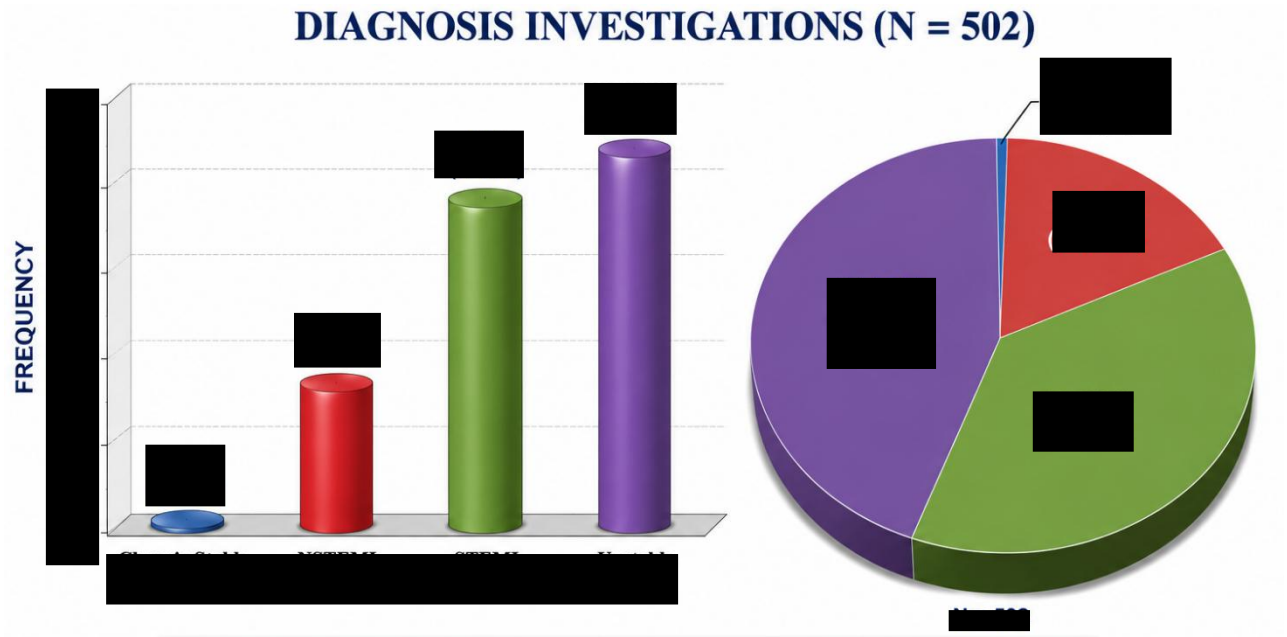
Table 6: Descriptive analysis of lab data in the study population (N=502)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C. I	
					Lower	Upper
Pulse (BPM)						
SBP (mmHG)						
DBP (mmHG)						
Resp Rate (Bpm)						
Hb (G/Dl)						
TLC						
Platelet						
Urea						
Creatinine						
RBS						
Total Cholesterol						
Triglyceride						
HDL						
LDL						

Table 7: Descriptive analysis of diagnosis investigations in the study population (N=502)

Diagnosis Investigations	Frequency	Percentages
Chronic Stable Angina	[redacted]	[redacted]
NSTEMI	[redacted]	[redacted]
STEMI	[redacted]	[redacted]
Unstable Angina	[redacted]	[redacted]

Graph 6: Descriptive Analysis of Diagnosis Investigations in the Study Population (N=502)

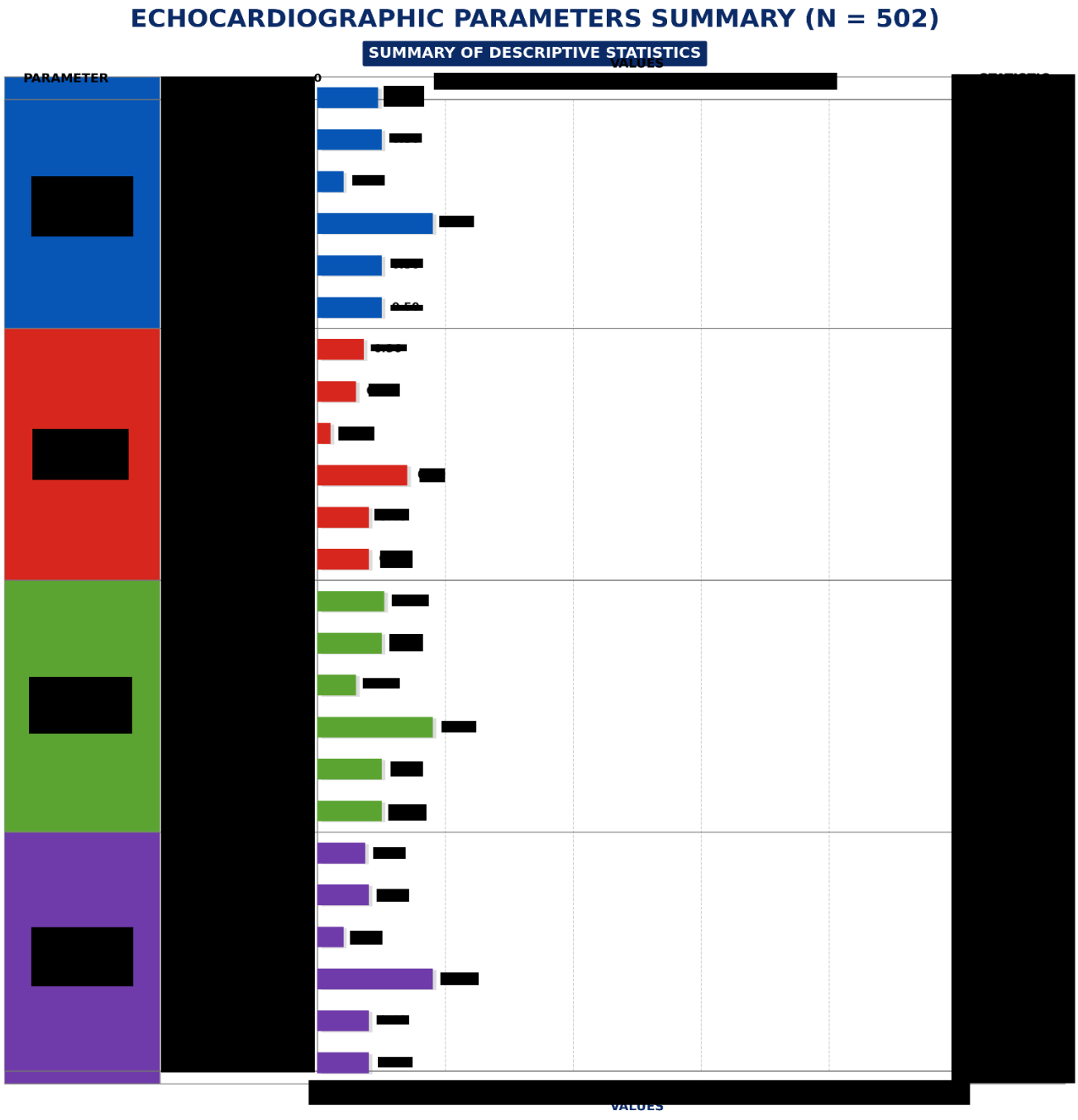


[redacted]

Table 8: Descriptive analysis of ECHO data in the study population (N=502)

Parameter	Mean ± SD	Median	Minimum	Maximum	95% C. I	
					Lower	Upper
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Graph 7: Descriptive analysis of ECHO data in the study population (N=502)

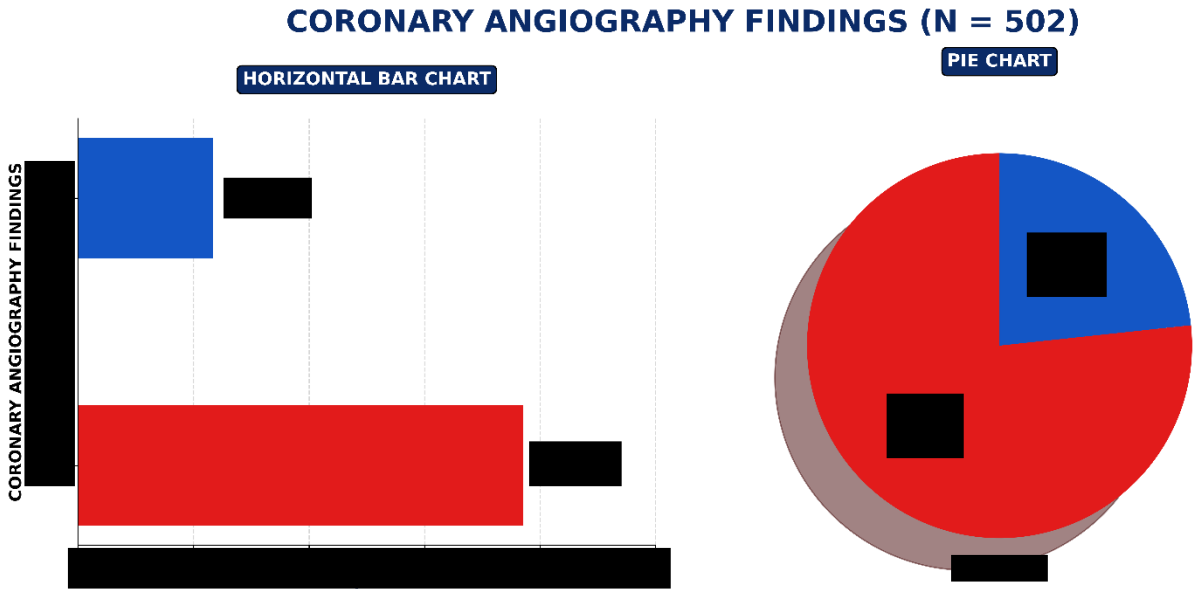


[redacted]

Table 9: Descriptive analysis of coronary angiography in the study population (N=502)

Coronary Angiography	Frequency	Percentages
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

Graph 8: Descriptive Analysis of Coronary Angiography in the Study Population (N=502)

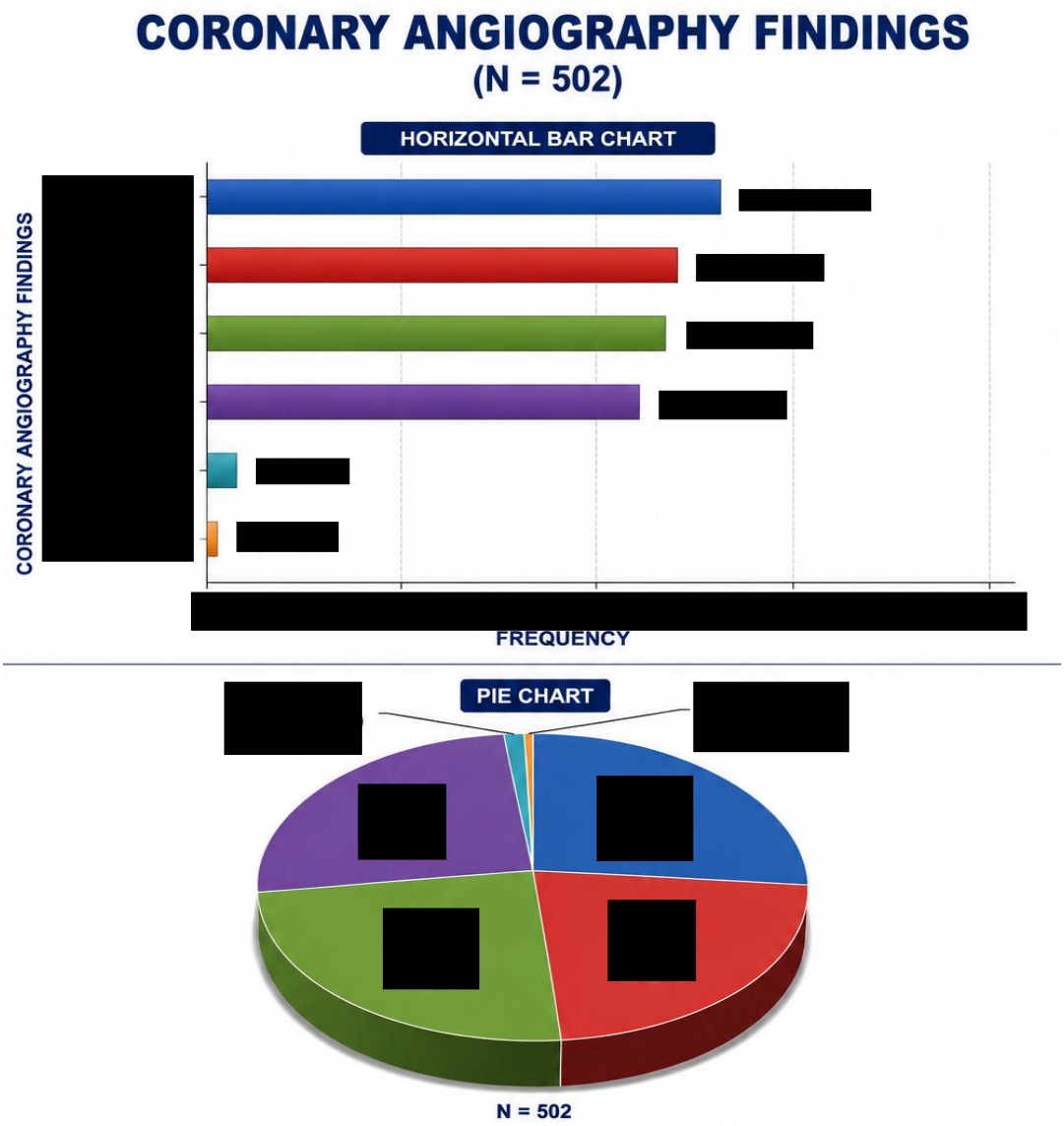


In the present study, coronary angiography revealed CAD findings in 385 participants, accounting for [redacted] of the study population, [redacted]

Table 10: Descriptive analysis of coronary angiography in the study population (N=502)

Coronary Angiography	Frequency	Percentages
SVD	[redacted]	[redacted]
DVD	[redacted]	[redacted]
TVD	[redacted]	[redacted]
NEC	[redacted]	[redacted]
TVD WITH LM	[redacted]	[redacted]
DVD WITH LM	[redacted]	[redacted]

Graph 9: Descriptive analysis of coronary angiography in the study population (N=502)

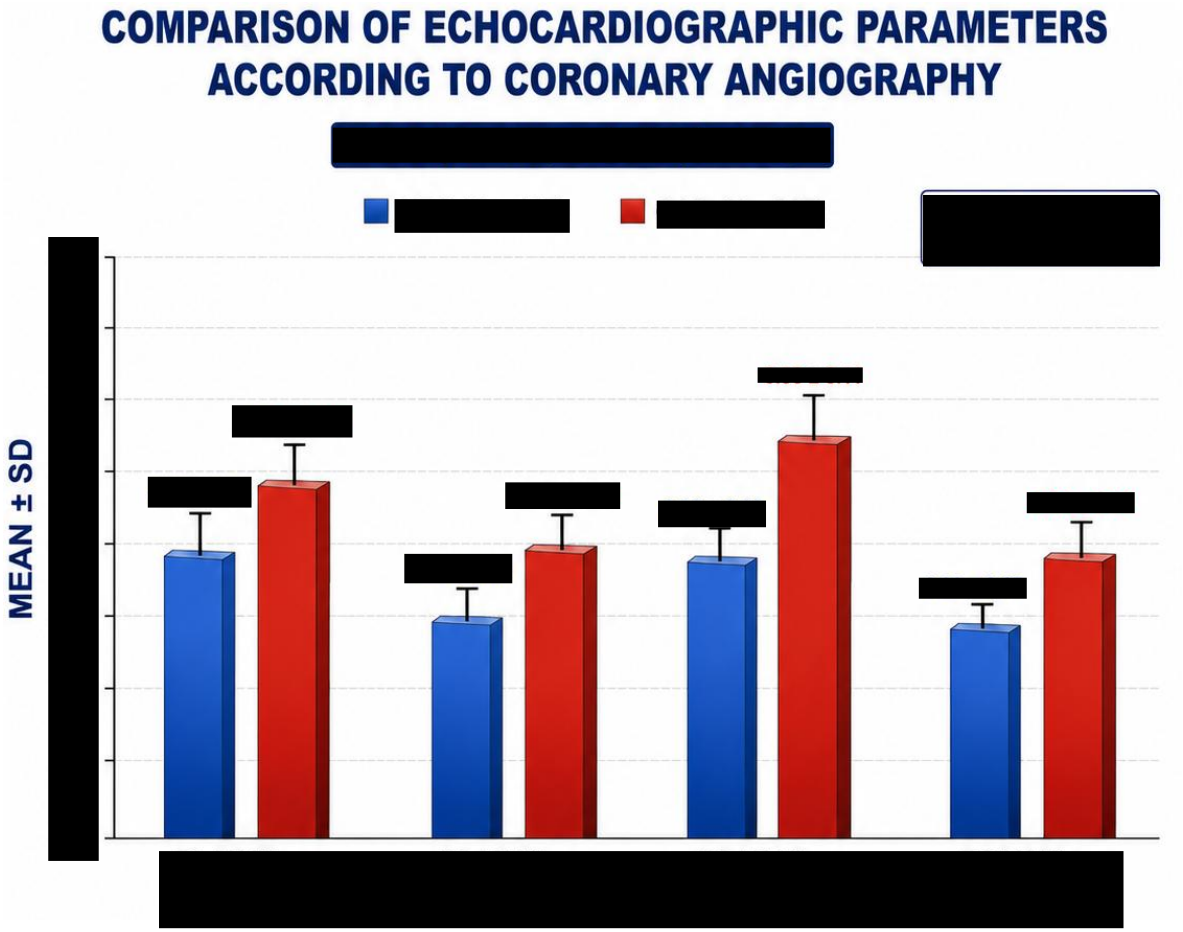


[redacted]

Table 11: Comparison of mean of ECHO data between coronary angiography(N=502)

Parameter	Coronary Angiography (Mean± SD)		P value
	NEC (N=117)	CAD (N=385)	
PLAX View End Systolic	[redacted]	[redacted]	[redacted]
PLAX View End Diastolic	[redacted]	[redacted]	[redacted]
PSAX View End Systolic	[redacted]	[redacted]	[redacted]
PSAX View End Diastolic	[redacted]	[redacted]	[redacted]

Table 10: Comparison of mean of ECHO data between coronary angiography(N=502)



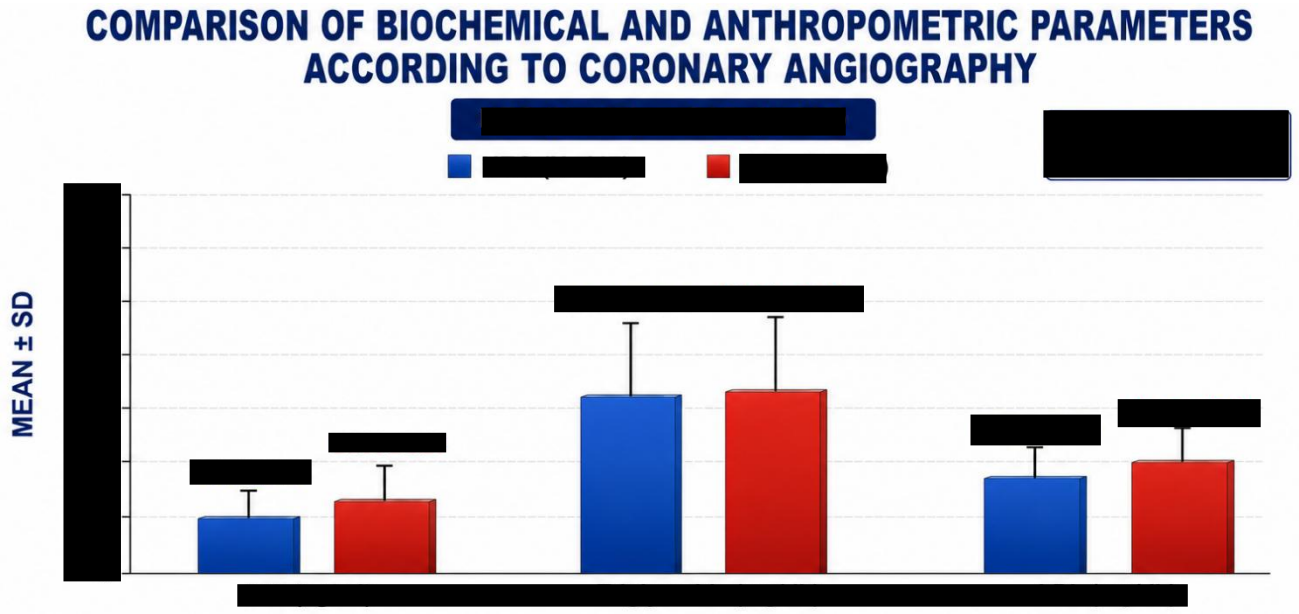
[redacted]

[redacted]

Table 12: Comparison of mean of BMI, LDL and Triglyceride data between coronary angiography(N=502)

Parameter	Coronary Angiography (Mean± SD)		P value
	NEC (N=117)	CAD (N=385)	
BMI (kg/m2)	[redacted]	[redacted]	[redacted]
Triglyceride	[redacted]	[redacted]	[redacted]
LDL	[redacted]	[redacted]	[redacted]

Graph 11: Comparison of mean of BMI, LDL and Triglyceride data between coronary angiography(N=502)

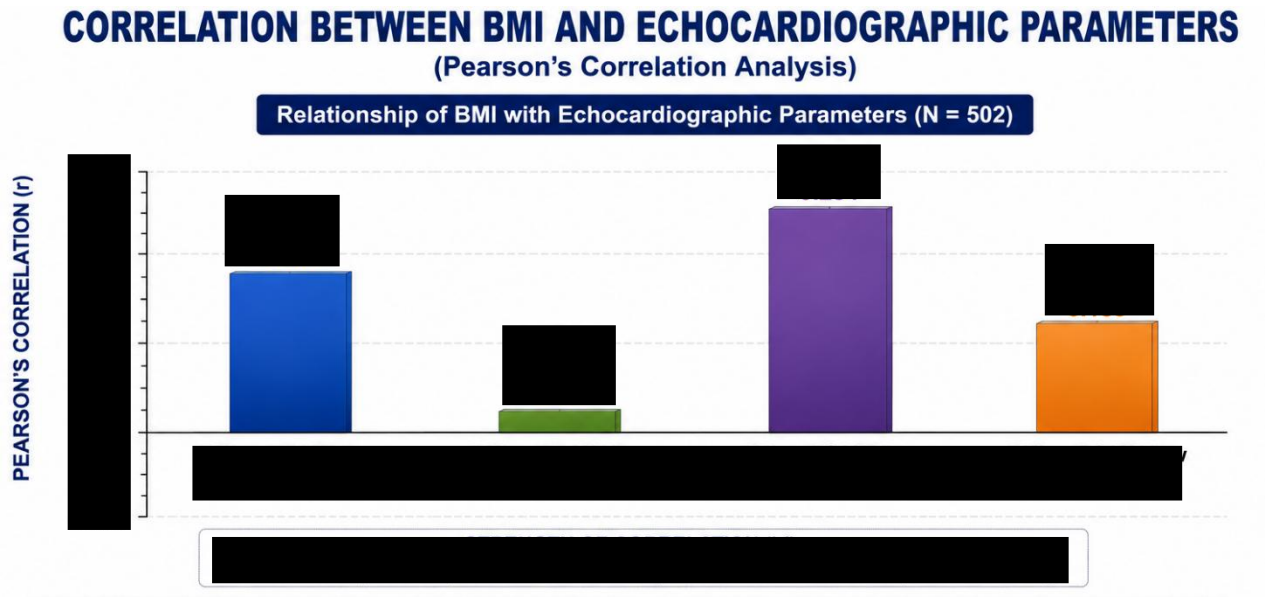


[redacted]

Table 13: Correlation analysis between BMI and ECHO data (N=502)

Pairs	Pearson's Correlation	P-value
BMI vs PLAX View End Systolic	[redacted]	[redacted]
BMI vs PLAX View End Diastolic	[redacted]	[redacted]
BMI vs PSAX View End Systolic	[redacted]	[redacted]
BMI vs PSAX View End Diastolic	[redacted]	[redacted]

Graph 12: Correlation analysis between BMI and ECHO data (N=502)

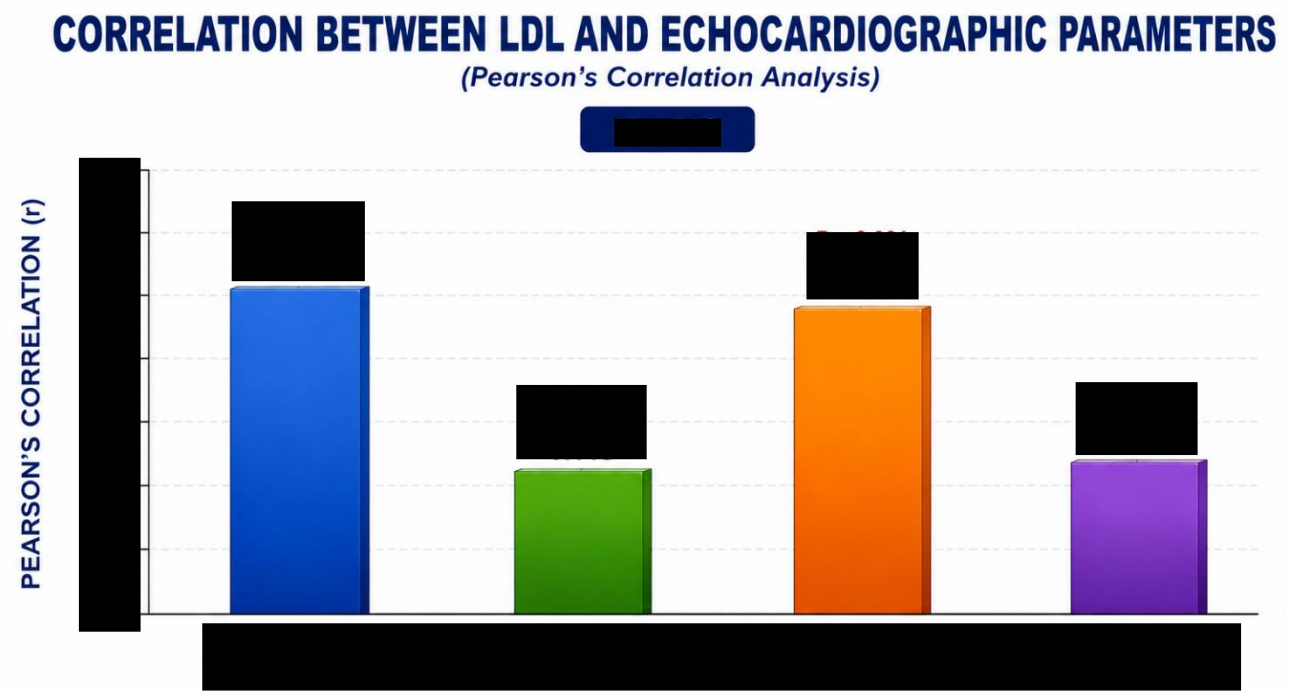


[redacted]

Table 14: Correlation analysis between LDL and ECHO data (N=502)

Pairs	Pearson's Correlation	P-value
LDL vs PLAX View End Systolic	[redacted]	[redacted]
LDL vs PLAX View End Diastolic	[redacted]	[redacted]
LDL vs PSAX View End Systolic	[redacted]	[redacted]
LDL vs PSAX View End Diastolic	[redacted]	[redacted]

Graph 13: Correlation analysis between LDL and ECHO data (N=502)

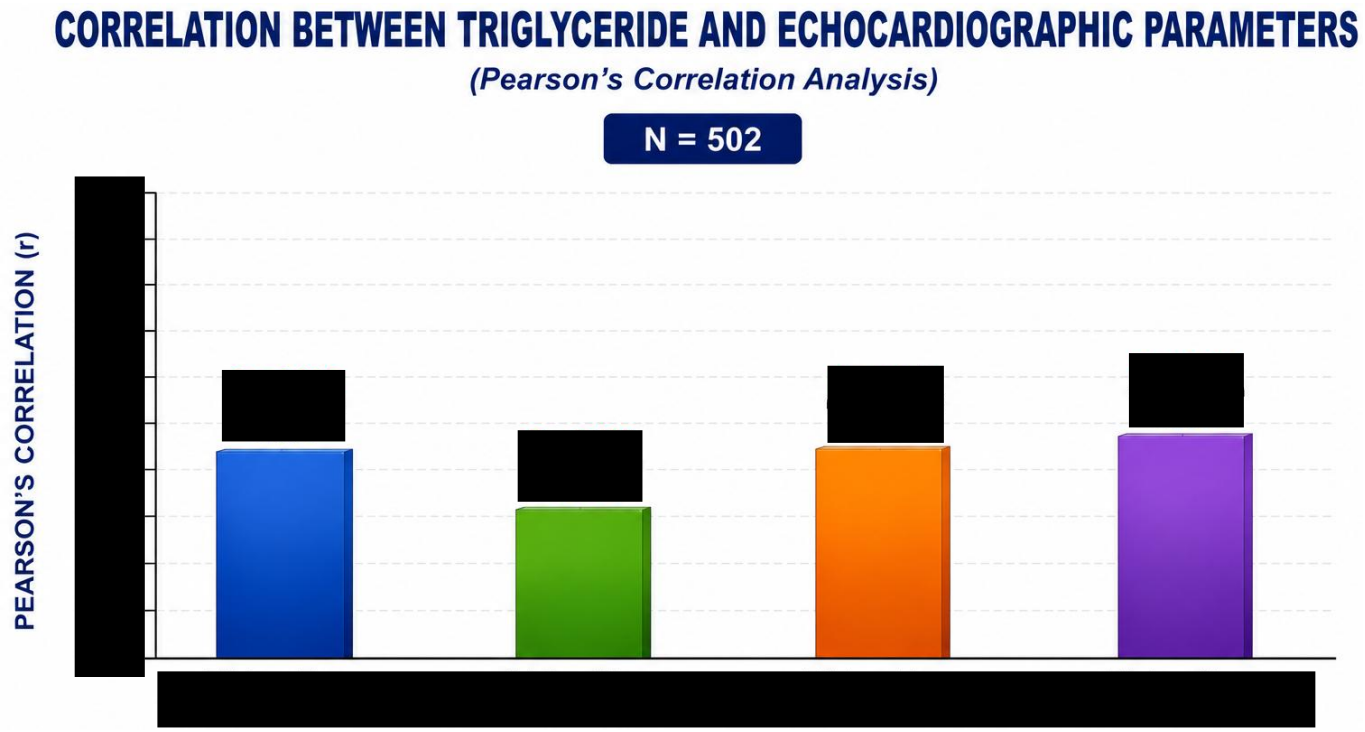


[redacted]

Table 15: Correlation analysis between Triglyceride and ECHO data (N=502)

Pairs	Pearson's Correlation	P-value
Triglyceride vs PLAX View End Systolic	[redacted]	[redacted]
Triglyceride vs PLAX View End Diastolic	[redacted]	[redacted]
Triglyceride vs PSAX View End Systolic	[redacted]	[redacted]
Triglyceride vs PSAX View End Diastolic	[redacted]	[redacted]

Graph 14: Correlation analysis between Triglyceride and ECHO data (N=502)

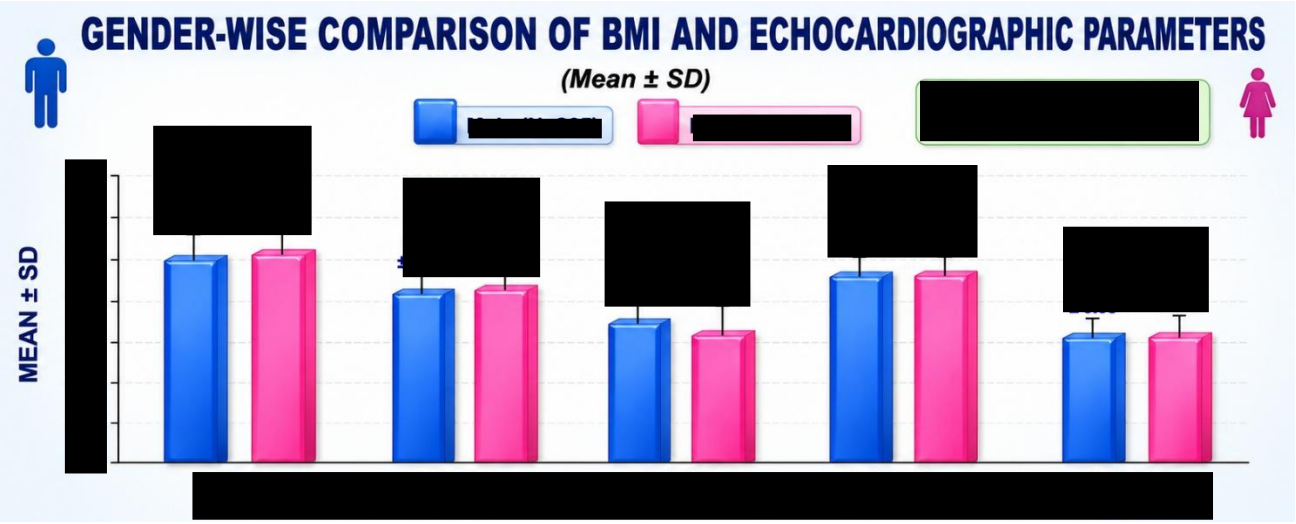


[redacted]

Table 16: Comparison of mean of BMI & ECHO data between Gender (N=502)

Parameter	Gender (Mean± SD)		P value
	Male (N=265)	Female (N=237)	
BMI (kg/m2)	[redacted]	[redacted]	[redacted]
PLAX View End Systolic	[redacted]	[redacted]	[redacted]
PLAX View End Diastolic	[redacted]	[redacted]	[redacted]
PSAX View End Systolic	[redacted]	[redacted]	[redacted]
PSAX View End Diastolic	[redacted]	[redacted]	[redacted]

Graph 15: Comparison of mean of BMI & ECHO data between Gender (N=502)



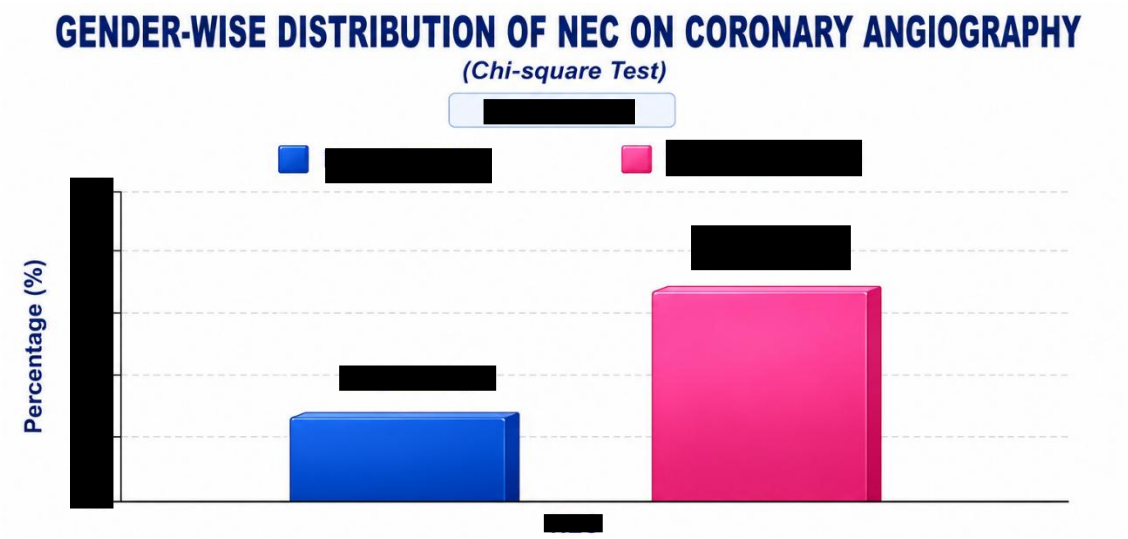
[redacted]

[redacted]

Table 17: Comparison of coronary angiography between gender (N=502)

Coronary Angiography	Gender		Chi square	P value
	Male (N=265)	Female (N=237)		
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Graph 16: Comparison of Coronary Angiography Between Gender (N=502)



[redacted]

Table 18: Comparison of Echocardiographic Parameters and LDL Across Coronary Angiography Categories (N=502)

Parameter	Coronary Angiography (Mean ±SD)	Mean Diff Reference	Tukey Post Hoc p-value
PLAX View End Systolic			
NEC (N=117)			
SVD (N=134)			
DVD (N=124)			
TVD (N=127)			
PLAX View End Diastolic			
NEC (N=117)			
SVD (N=134)			
DVD (N=124)			
TVD (N=127)			
PSAX View End Systolic			
NEC (N=117)			
SVD (N=134)			
DVD (N=124)			
TVD (N=127)			
PSAX View End Diastolic			
NEC (N=117)			
SVD (N=134)			
DVD (N=124)			
TVD (N=127)			
LDL			
NEC (N=117)			
SVD (N=134)			
DVD (N=124)			
TVD (N=127)			

[redacted]

DISCUSSION

DISCUSSION

The present study was conducted to evaluate the association between epicardial adipose tissue thickness, LDL cholesterol, and coronary artery disease among patients admitted with suspected coronary artery disease and undergoing invasive coronary angiography. [redacted]

The study also aimed to evaluate the association of epicardial adipose tissue with coronary artery disease severity, vessel involvement, metabolic risk factors, body mass index, and gender differences among patients admitted with suspected CAD.

Demographic Parameters

In the present study, the mean age of the study population was [redacted] years, with a median age of [redacted] years, indicating that coronary artery disease was predominantly observed among middle-aged and elderly individuals. [redacted]

[redacted]

Thus, the demographic characteristics of the present study are consistent with previous comparative clinical studies showing that advancing age and increased body mass index are strongly associated with epicardial adipose tissue accumulation and coronary artery disease severity.

Gender Distribution

In the present study, males constituted [redacted] of the study population, while females accounted for [redacted], indicating a slight male predominance among patients admitted with suspected coronary artery disease. [redacted]

[redacted] (2025), while evaluating determinants of early-onset coronary artery disease, also reported a higher prevalence of CAD among males, emphasizing the strong association between male gender and coronary atherosclerotic disease burden (11).

Chief Complaints

In the present study, chest pain was the most common presenting complaint, observed in [redacted] of patients, followed by dyspnoea in [redacted] of patients. [redacted] (2018) also evaluated patients with established coronary artery disease and reported that symptomatic CAD patients demonstrated increased epicardial adipose tissue thickness and adverse cardiovascular outcomes (80).

Past Medical History

In the present study, hypertension was the most common comorbidity and was observed in [redacted] of patients, while [redacted] had type 2 diabetes mellitus. [redacted]

[redacted] (2023) reported that visceral adipose tissue contributes substantially to residual cardiovascular risk and is strongly associated with hypertension, dyslipidemia, and metabolic syndrome among CAD patients (49).

Lifestyle Habits

In the present study, tobacco consumption was observed in [redacted] of patients, smoking in [redacted], combined tobacco and smoking in [redacted], while combined smoking, tobacco, and alcohol use was present in [redacted] of patients. [redacted]

[redacted] (2025) demonstrated that patients with diabetes mellitus and coronary artery disease had significantly greater epicardial adipose tissue thickness and higher burden of cardiovascular risk factors, including smoking and obesity, supporting the multifactorial cardiovascular risk profile observed in the present study (92).

Laboratory and Clinical Parameters

In the present study, the mean pulse rate was [redacted] bpm, mean systolic blood pressure was [redacted] mmHg, and mean diastolic blood pressure was [redacted] mmHg. [redacted]

[redacted] (2023) further reported that patients with increased epicardial fat thickness undergoing coronary revascularization demonstrated greater cardiovascular risk burden including elevated LDL cholesterol and triglyceride levels (10).

Diagnosis Investigations

In the present study, unstable angina was the most common diagnosis and was observed in [redacted] of patients, followed by ST-elevation myocardial infarction (STEMI) in [redacted] and non-ST elevation myocardial infarction (NSTEMI) in [redacted] of patients. [redacted] (2023), who studied patients undergoing coronary revascularization and demonstrated that symptomatic CAD patients with acute ischemic presentations had significantly increased epicardial adipose tissue thickness and greater coronary disease severity (10).

Echocardiographic Epicardial Adipose Tissue Measurements

In the present study, the mean epicardial adipose tissue thickness measured in the PLAX end systolic view was [redacted] cm, while the PLAX end diastolic view demonstrated a mean value of [redacted] cm. [redacted]

[redacted]

Their findings are consistent with the elevated epicardial adipose tissue measurements observed in the present study.

Coronary Angiography Findings

In the present study, [redacted] of patients had angiographically proven coronary artery disease (CAD), while [redacted] had normal or near-normal epicardial coronary arteries (NEC). [redacted]

[redacted](2026) reported that increased epicardial fat thickness was significantly associated with coronary artery disease severity and ischemic burden among patients undergoing cardiovascular evaluation (95).

Distribution of Coronary Artery Disease Severity on Coronary Angiography

In the present study, single vessel disease (SVD) was observed in [redacted] of patients, double vessel disease (DVD) in [redacted], and triple vessel disease (TVD) in [redacted] of patients. [redacted](2025) demonstrated that diabetic patients with angiographically significant coronary artery disease had markedly increased epicardial adipose tissue thickness, particularly among those with multivessel coronary involvement (92).

Comparison of Epicardial Adipose Tissue Between NEC and CAD

In the present study, all echocardiographic epicardial adipose tissue measurements were significantly higher in patients with CAD compared to patients with NEC. [redacted] (2025) similarly found increased EAT thickness among patients with severe CAD (96).

Comparison of BMI, Triglyceride and LDL Between NEC and CAD

In the present study, the mean BMI was significantly higher among CAD patients ([redacted] kg/m²) compared to NEC patients ([redacted] kg/m²) with a statistically significant difference ([redacted]).

(2025) reported significantly increased epicardial adipose tissue thickness among STEMI patients with severe coronary artery disease and elevated cardiovascular risk factors, including obesity and dyslipidemia (96).

Correlation Between BMI and Echocardiographic Epicardial Adipose Tissue Measurements

In the present study, BMI demonstrated a significant positive correlation with epicardial adipose tissue thickness measured in the PLAX end systolic view ( ), PSAX end systolic view ( ), and PSAX end diastolic view ( ).

[redacted]

[redacted](2025) further demonstrated that STEMI patients with severe coronary artery disease had significantly greater epicardial adipose tissue thickness and higher obesity-related cardiovascular risk, supporting the present study findings (96).

Correlation Between LDL Cholesterol and Echocardiographic Epicardial Adipose Tissue Measurements

In the present study, LDL cholesterol demonstrated a significant positive correlation with all echocardiographic epicardial adipose tissue measurements. [redacted]

[redacted](2024) further demonstrated that increased epicardial adipose tissue was associated with coronary atherosclerotic plaque burden and adverse metabolic profile, including elevated atherogenic lipid parameters (9).

Correlation Between Triglyceride Levels and Echocardiographic Epicardial Adipose Tissue Measurements

In the present study, triglyceride levels demonstrated a weak but statistically significant positive correlation with PLAX end systolic epicardial adipose tissue thickness ([redacted]), PSAX end systolic thickness ([redacted]), and PSAX end diastolic thickness ([redacted]). [redacted](2018), who demonstrated that increased echocardiographic epicardial adipose tissue thickness was associated with adverse metabolic profile and coronary artery disease severity among CAD patients (80).

Comparison of BMI and Echocardiographic Parameters Between Gender

In the present study, there was no statistically significant difference in BMI or echocardiographic epicardial adipose tissue measurements between males and females. [redacted]

[redacted] (2025), who demonstrated significantly increased epicardial adipose tissue thickness among CAD patients without major gender-based differences in echocardiographic epicardial fat measurements (92).

Comparison of Coronary Angiography Findings Between Gender

In the present study, angiographically proven coronary artery disease was significantly more common among males compared to females. [redacted] (2023), who demonstrated that male patients undergoing coronary revascularization had greater coronary disease burden and increased epicardial adipose tissue thickness compared to females (10).

Comparison of Echocardiographic Epicardial Adipose Tissue Thickness and LDL Across Coronary Artery Disease Severity

In the present study, epicardial adipose tissue thickness progressively increased with increasing severity of coronary artery disease. [redacted] (2026) demonstrated that increased epicardial fat thickness was significantly associated with greater ischemic burden and severe coronary artery disease (95).

Strengths of the Study

1. The present study included a relatively large sample size of 502 patients, improving the reliability and statistical validity of the findings.

[redacted]

[redacted]

10. The study contributes important regional data regarding epicardial adipose tissue and coronary artery disease among Indian patients admitted to a tertiary care center.

Limitations of the Study

1. The study was conducted at a single tertiary care center, which may limit the generalizability of the findings to the broader population.

[redacted]

10. Although LDL cholesterol demonstrated significant association with CAD severity, other advanced lipid parameters and lipoprotein subfractions were not assessed.

CONCLUSION

CONCLUSION

The present study demonstrated a significant association between epicardial adipose tissue thickness, LDL cholesterol, and coronary artery disease among patients admitted with suspected coronary artery disease and undergoing invasive coronary angiography. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]Epicardial adipose tissue assessment by echocardiography may serve as a useful, non-invasive, economical, and clinically applicable marker for identifying patients at increased risk of significant coronary artery disease and multivessel coronary involvement.

SUMMARY

SUMMARY

The present study titled “The Association Between Epicardial Adipose Tissue, LDL Cholesterol and Coronary Artery Disease in Patients Admitted with Suspected Coronary Artery Disease: A One Year Observational Study in a Tertiary Care Centre” was conducted among 502 patients admitted with suspected coronary artery disease and undergoing invasive coronary angiography. [redacted]

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BIBLIOGRAPHY

1. World Health Organization. Cardiovascular diseases (CVDs).
2. Shahjehan RD, Sharma S, Bhutta BS. Coronary artery disease. In: Mistake-Based Learning in Cardiology: Avoiding Medical Errors. 2024;94-119. doi:10.1016/B978-0-323-93157-1.00006-X. PubMed PMID: 33231974.

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96. El-Naggar HM, Abdel-Maseh JG, Hasan-Ali H, Khidr SS. Epicardial fat thickness predicts severe coronary artery disease and high mortality risk among ST-elevation myocardial infarction patients. Echo Res Pract. 2025;12(1):17. doi:10.1186/s44156-025-00087-y. PubMed PMID: 40685373.

ANNEXURES

ANNEXURES-I

ANNEXURES-II

MASTERCHART

Sr. No	DEMOGRAPHIC DETAILS				CHIEF COMPLAINTS					PAST HISTORY			PERSONAL HISTORY			GENERAL EXAMINATION						SYSTEMIC EXAMINATION				DIAGNOSIS	INVESTIGATIONS									ECG	ECHO				CORONARY ANGIOGRAPHY
	NAME	Age	Sex	Ip No.	Chest Pain	Dyspnoea	Syncope	Palpitations	Angina Equivalents	T2dm	HTN	Cad	Habits	Sleep	Appetite	Pulse (Bpm)	Bp mmhg	Resp Rate (Bpm)	Height (Cm)	Weight (Kg)	BMI (Kg/M2)	CVS	Respiratory	Abdomen	CNS		Hb (G/Dl)	TLC	Platelet	Urea	Creat	RBS	Total Cholesterol	TRIGLYCERIDE	HDL	LDL		PLAX VIEW		PSAX VIEW		
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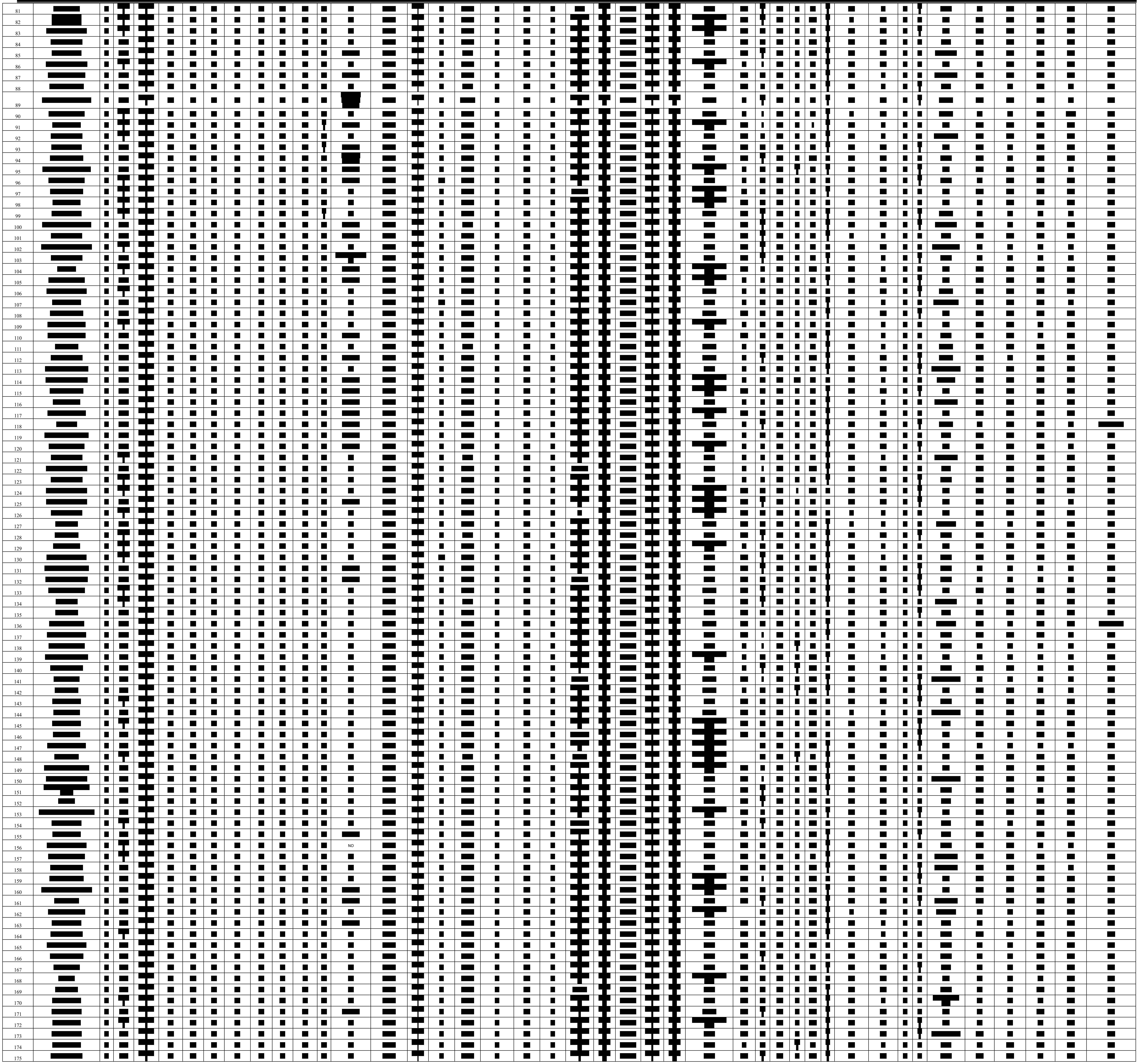
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