

2023-25

JAHANZAIB

SU91-MSAHW-S23-002

FAHS

**ASSESSMENT OF CORONARY ARTERY DISEASE IN DIABETIC
AND NON-DIABETIC PATIENT IN ANGIOGRAPHY WITH
DIFFERENT AGE GROUP**

A thesis Submitted by

(JAHANZAIB)

Roll No. SU91-MSAHW-S23-002



SUPERIOR UNIVERSITY

The Superior University Lahore

In Partial Fulfillment of the

Requirement for the Degree of

Master of Science in Allied Health Sciences

Faculty of Allied Health Sciences

**ASSESSMENT OF CORONARY ARTERY DISEASE IN DIABETIC
AND NON-DIABETIC PATIENT IN ANGIOGRAPHY WITH
DIFFERENT AGE GROUP**



SUPERIOR UNIVERSITY

Thesis Submitted to

The Superior University Lahore

In Partial Fulfillment of the

Requirement for the Degree of

Master of Science in Allied Health Sciences

By

(Jahanzaib)

Roll No. SU91-MSAHW-S23-002

Session: 2023-2025

Faculty of Allied Health Sciences

Author's Declaration

I hereby state that my MS thesis titled “**Assessment of coronary artery disease in diabetic and non-diabetic patients in angiography with different age group.**” is my work and has not been submitted previously by me for taking any degree from this University, **The Superior University, Lahore**, or anywhere else in the country/world. At any time if my statement is found to be incorrect even after my graduation, the university has the right to withdraw my MS degree.

Name: Jahanzaib

Date: _____

Plagiarism Undertaking

I solemnly declare that research work presented in the thesis titled “**Assessment of coronary artery disease in diabetic and non-diabetic patients in angiography with different age group.**” is solely my research work with no significant contribution from any other person. Small contribution/help wherever taken has been duly acknowledged and that complete thesis has been written by me.

I understand the zero-tolerance policy of the HEC and University,

The Superior University, Lahore,

towards plagiarism. Therefore, I as an author of the above-titled thesis declare that no portion of my thesis has been plagiarized and any material used as a reference is properly referred/cited. I undertake that if I am found guilty of any formal plagiarism in the above-titled thesis, even after awarding of MS degree, the University reserves the rights to withdraw/revoke my MS degree and that HEC and the University have the right to publish my name on the HEC/University website on which names of students are placed who submitted a plagiarized thesis.

Student/Author Signature: _____

Name: Jahanzaib

Research Completion Certificate

This is to certify that the thesis entitled “**Assessment of coronary artery disease in diabetic and non-diabetic patients in angiography with different age group.**” submitted by “**Jahanzaib**” has been accepted towards the partial fulfillment of the requirement for “**MS Allied Health Sciences**”. The quality of the work contained in this thesis is adequate for the award of degree.

Signature: _____

Tayyaba Ayub
Assistant professor

Certificate of Approval

This is to certify that the research work presented in this thesis, titled “**Assessment of coronary artery disease in diabetic and non-diabetic patients in angiography with different age group.**” was conducted by “**Mr. Jahanzaib**” under the supervision of “**Ms. Tayyaba Ayub**”

No part of this thesis has been submitted anywhere else for any other degree. This thesis is submitted to the Faculty of Allied Health Sciences, The Superior University, Lahore in partial fulfillment of the requirements for the degree of Master of Science in the field of “**Allied Health Sciences**” in Faculty of Allied Health Sciences at The Superior University, Lahore.

Student Name: Jahanzaib

Signature: _____

Examination Committee:

Session Chair:

Signature: _____

a) External Examiner:

Signature: _____

b) Internal Examiner:

Signature: _____

c) Ms. Tayyaba Ayub

Signature: _____

d) PL/HOD: Dr. Hafiz Shehzad

Signature: _____

e) Dean: Prof. Dr. M. Naveed Babur

Signature: _____

f) Controller of Examination: Dr. M. Haris

Signature: _____

DEDICATION

First and foremost, I express my deepest gratitude to Almighty Allah for granting me the strength and wisdom to complete this thesis. I sincerely dedicate this work to my beloved parents, whose endless love, prayers, and support have been my greatest motivation. A special acknowledgment to my elder brother, whose guidance and encouragement have been invaluable throughout my academic journey. Their unwavering faith in me has been a source of inspiration and determination. This achievement is a tribute to their sacrifices and unconditional love.

ACKNOWLEDGEMENT

In the name of Allah, the most Gracious, the most Merciful.

I am extremely thankful to Almighty ‘Allah’ Who is the entire source of knowledge and wisdom endowed to mankind, for providing me with the acumen and vision to complete this endeavor.

I would like to express my profound gratitude to my supervisor Ms. Tayyaba Ayub for her wise counsel and encouraging attitude towards this study. I am extremely grateful to her for immensely facilitating me during my study period by ensuring the provision of favorable circumstances and conducive environment. This project would not have been possible without his support and expert guidance.

In the end, I would like to extend my deepest gratitude to my family members. Without their encouragement, I would not have been able to complete this endeavor.

Jahanzaib

Table of Contents

DEDICATION.....	v
ACKNOWLEDGEMENT	vi
LIST OF TABLES	viii
LIST OF FIGURES	x
LIST OF ABBREVIATIONS	xi
ABSTRACT	xii
Chapter 1	14
INTRODUCTION.....	14
Chapter 2	31
LITERATURE REVIEW.....	31
Chapter 3	40
METHODOLOGY.....	40
3.1. Research Design:.....	40
3.2. Clinical Settings:	40
3.3. Sample Size:.....	40
3.4. Sampling Technique:	40
3.5. Duration of Study:.....	40
3.6. Selection Criteria.....	40
3.6.2. Exclusion Criteria.....	41
3.7. Ethical Consideration	42
3.8. Data Collection Procedure	43
3.9. Data Analysis	43
Chapter 4.....	44
RESULTS	44
Chapter 5	71
DISCUSSION	71
CONCLUSIONS	73
REFERENCES.....	74
APPENDICES	80
ENGLISH CONSENT FORM.....	80
URDU CONSENT FORM.....	81
DEMOGRAPHICS FORM & QUESTIONNAIRES	82
PLAGIARISM REPORT	85

LIST OF TABLES

Table No.	Description	Page No.
Table 1.1	Anomalies of origination and course	19
Table 1.2	Anomalies of origination and course	20
Table 4.1	Frequence table	47
Table 4.2	Age Group	48
Table 4.3	Chest pain stage	49
Table 4.4	Shortness of breath stage	50
Table 4.5	Heart Palpitations	51
Table 4.6	Pain Radiating to Arms	52
Table 4.7	Nausea/Vomiting	53
Table 4.8	Diabetic	54
Table 4.9	Left coronary artery Stenosis	55
Table 4.10	Left descending artery Stenosis	56
Table 4.11	Left Circumflex Stenosis	57
Table 4.12	RCA Stenosis	58
Table 4.13	Non-Diabetic LCA Stenosis	59
Table 4.14	Non-Diabetic LDA Stenosis	60
Table 4.15	Non-Diabetic Left Circumflex Stenosis	61
Table 4.16	Non-Diabetic RCA Stenosis	62
Table 4.17	Age Group * Diabetic	63
Table 4.18	Age Group * LCA Stenosis	64
Table 4.19	Age Group * LDA Stenosis	65

Table 4.20	Age Group * Left Circumflex Stenosis	66
Table 4.21	Age Group * RCA Stenosis	67
Table 4.22	Age Group * Non-Diabetic LCA Stenosis	68
Table 4.23	Age Group * Non-Diabetic LDA Stenosis	69
Table 4.24	Age Group * Non-Diabetic Left Circumflex Stenosis	70
Table 4.25	Age Group * Non-Diabetic RCA Stenosis	71

LIST OF FIGURES

Figure No.	Description	Page
Figure 1	The right coronary artery originates from the right coronary sinus of Valsalva	14
Figure 2	This is a cross-section of a human heart specimen	16
Figure 3	In this specimen, the two sinuses adjacent to the pulmonary trunk give rise to the major coronary arteries,	17
Figure 4	In this corrosion cast specimen, the left coronary main stem splits into the anterior interventricular artery and circumflex artery	18
Figure 5	Schematic representation of examples of anomalous origination of coronary ostia	21
Figure 6	Schematic representation of examples of solitary coronary artery with intra-arterial and retro aortic courses	22

LIST OF ABBREVIATIONS

Words	Abbreviation
CCA	Coronary Artery Disease
LDA	Left Descending Artery
RCA	Right Coronary Artery
DM	Diabetes mellitus
T2DM	Type 2 diabetes mellitus
PDM	Pre diabetes mellitus
CAD	Coronary Artery diseases
LCX	Left circumflex artery
LCA	Left coronary Artery
AO	Aorta
LCS	Left Circumflex Stenosis
SOB	Shortness of breath
HP	Heart Palpitations
RA	Rheumatoid arthritis
IBD	Inflammatory bowl diseases
RH-PAT	Reactive hyperaemia-peripheral arterial tonometry
RCF	Reverse coronary flow
CMD	coronary micro vascular dysfunction

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 coronary artery diseases in diabetic and non-diabetic patients with angiography in different age groups.

Methodology

This study employs a cross-sectional comparative design, conducted at Punjab Cardiology Lahore, to assess the prevalence and characteristics of coronary artery disease (CAD) among diabetic and non-diabetic individuals. A total sample size of 170 participants. The sampling technique adopted was convenient sampling, ensuring the inclusion of eligible participants during the study period.

Results

The study considered various demographic, clinical, and coronary artery disease-related variables to assess the prevalence and severity of stenosis. Gender distribution included 93 females (54.7%) and 77 males (45.3%), with age groups divided into 20–40 years (26.5%), 40–60 years (44.1%), and above 60 years (29.4%). Clinical symptoms included chest pain severity categorized as mild (32.4%), moderate (30.0%), and severe (37.6%), along with shortness of breath (SOB) classified as mild (27.1%), moderate (32.9%), and severe (40.0%). Heart palpitations were reported by 67.6%, pain radiating to the arms by 74.1%, and nausea/vomiting by 71.8% of participants. Diabetes status showed an equal distribution of diabetic and non-diabetic participants (50.0% each). Coronary artery stenosis variables included Left Main Coronary Artery (LCA) stenosis in 35.3% of

participants, Left Descending Artery (LDA) stenosis in 33.5%, Left Circumflex Artery stenosis in 38.8%, and Right Coronary Artery (RCA) stenosis in 32.4%. Crosstab analysis highlighted the 40–60 age group with the highest incidence of diabetes and stenosis. These variables were analyzed to identify patterns and associations crucial for understanding coronary artery disease progression in diabetic and non-diabetic populations.

Conclusion

The study concludes that diabetic individuals have a significantly higher prevalence and severity of coronary artery stenosis compared to non-diabetics, with the 40–60 age group being the most affected. Diabetic participants also reported more severe clinical symptoms such as chest pain, shortness of breath, and nausea. These findings highlight the critical need for early screening, tailored interventions, and lifestyle modifications to manage CAD risk, particularly in middle-aged diabetic patients.

Keywords

Coronary Artery Disease (CAD), Diabetes Mellitus (DM), Left Descending Artery (LDA), Right Coronary Artery (RCA)

Chapter 1

INTRODUCTION

The anatomic arrangement of the coronary arteries in the normal heart is well described. Experience of those treating patients with atherosclerosis, ischemic heart disease, and congenital cardiac malformations have demonstrated the value of this knowledge in ensuring optimal treatments. Anatomic variations in the origin and course of the coronary arteries in otherwise normal hearts are rare, with the incidence of such variations assessed at 0.3% in a necropsy series reported by Alexander and Griffith (1956), and 1.6% in a large series of patients undergoing coronary arterial angiography. Although these anomalies are rare, they may have hemodynamic consequences, carry a high risk for accelerated atherosclerosis, or produce symptoms varying from dyspnea to sudden death. The milder variations can escape detection not only during life, but also at postmortem examination (1). The coronary arteries are the first branches of the aorta, arising usually from two of the three aortic sinuses of Valsalva (Fig. 1).

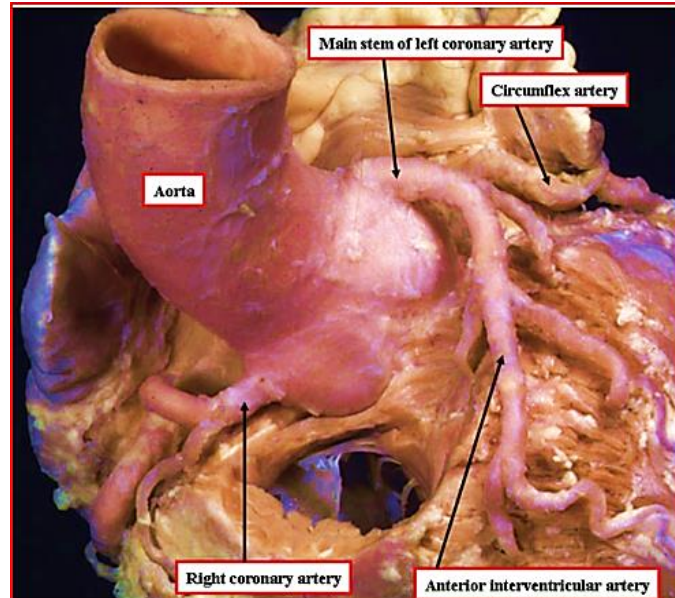


Fig. 1 In this figure, the right coronary artery originates from the right coronary sinus of Valsalva. The left coronary artery originates from the left coronary sinus of Valsalva and after a short course, bifurcates into the anterior interventricular artery and circumflex artery (2).

They have previously been named in numerous ways according to the orientation of the heart. It is unfortunately for those working in the clinical arena that the most popular names are based on the Valentine orientation of the heart, with the chambers described as if the heart sits on its apex, which is inherently incorrect. These deficiencies in nomenclature become obvious when the heart is considered in its appropriate anatomical position within the chest cavity. It is a basic rule of human anatomy that features should be described relative to the bodily coordinates. There is no reason why this convention should be ignored when describing the heart (3).

Thus, note should be taken of the fact that, in the normal situation, the long axis of the heart points inferiorly and to the left in an oblique fashion. This is the more important for angiographers and radiologists, as proper anatomical descriptions are critical in making correlations with the electrocardiogram, which is based on electrodes placed with the subject considered as occupying the anatomic position. It was the electrophysiological community that first emphasized the importance of attitudinally correct nomenclature for those working in the clinical setting. It is equally important when describing the coronary arteries. For example, using current terminology, inferior myocardial infarction is allegedly produced by blockage of the so-called posterior descending coronary. When the heart is considered in its location within the body, however, it is readily apparent that this artery is located inferiorly, and occupies the interventricular groove (Fig. 2).

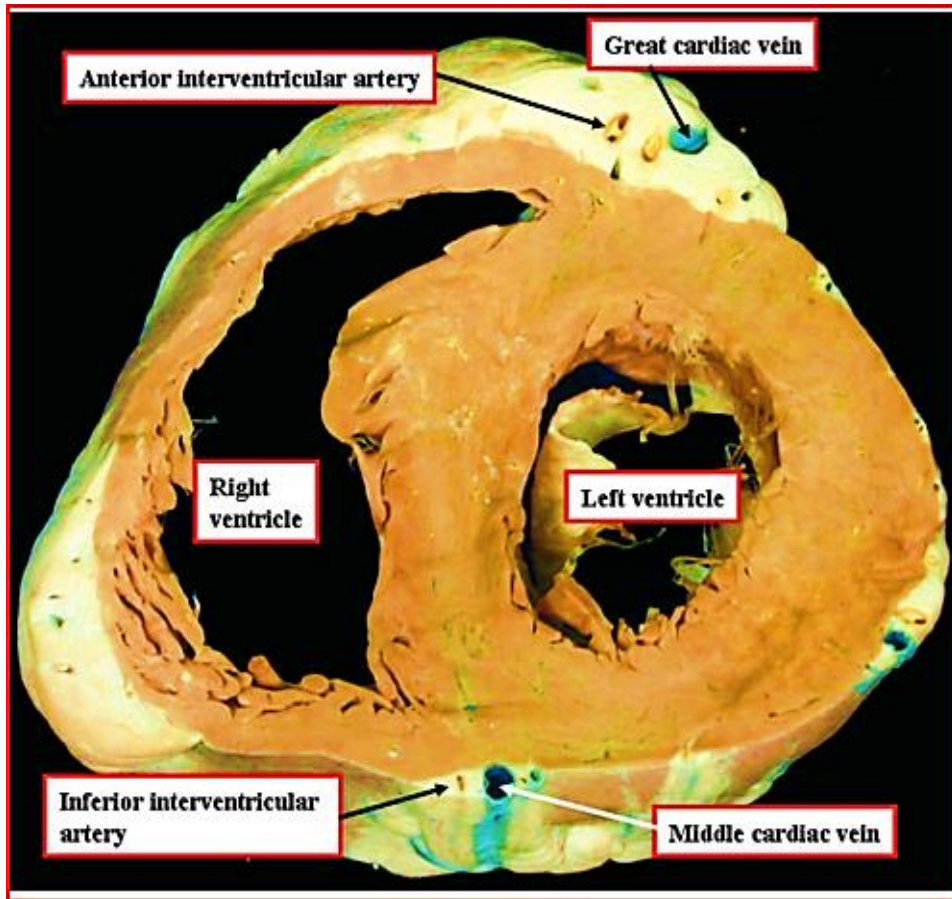


Fig. 2. This is a cross-section of a human heart specimen. When the heart is examined in attitudinally correct orientation, it is readily apparent that the artery occupying the so called “posterior interventricular groove” is located inferiorly, and thus should be called the inferior interventricular artery. It makes more sense, therefore, to describe it as the inferior interventricular artery. This is the convention we will use throughout our review, consistently describing the coronary arteries in attitudinally appropriate fashion (Cook and Anderson, 2002) (4).

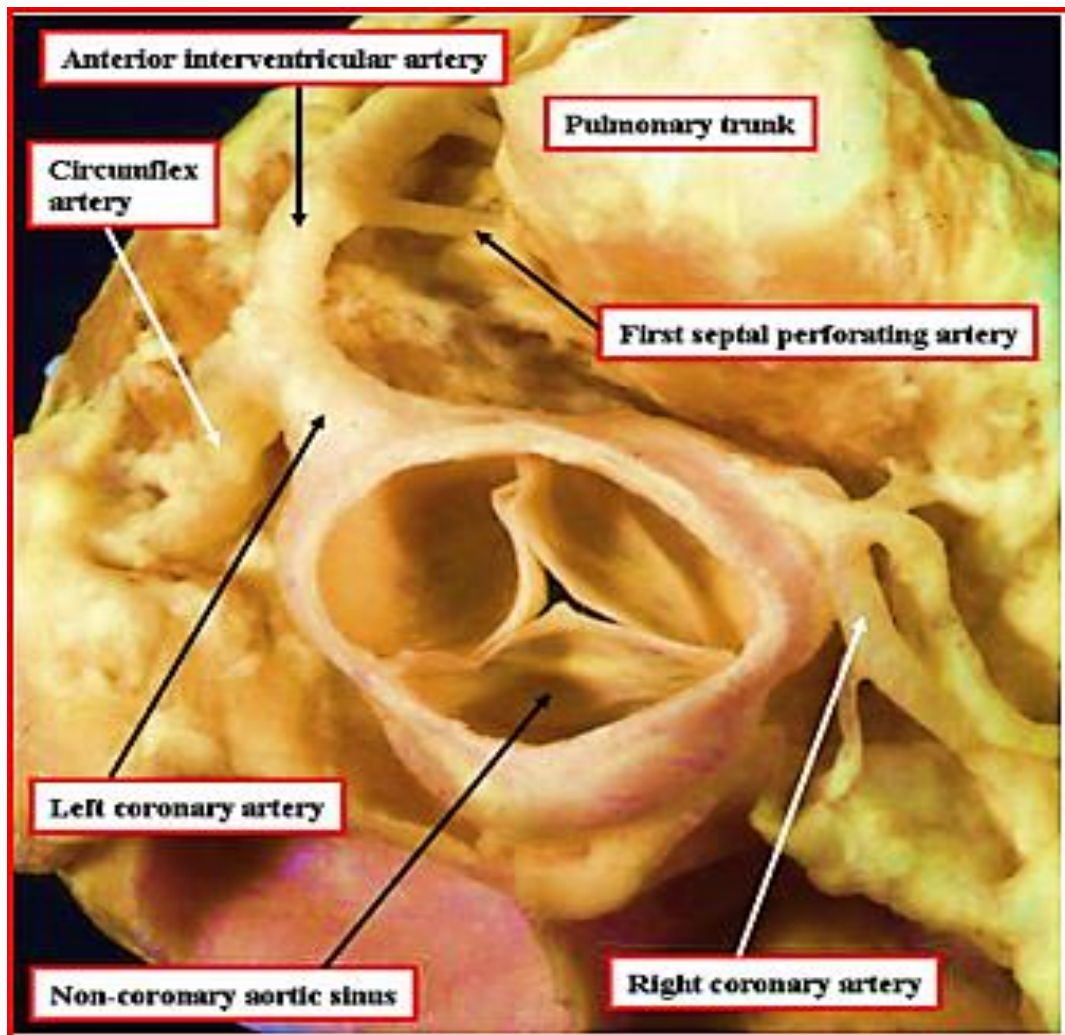


Fig. 3.

In this specimen, the two sinuses adjacent to the pulmonary trunk give rise to the major coronary arteries, namely the right coronary artery and the main stem of the left coronary artery. On the basis of these origins, therefore, the aortic sinuses of Valsalva can be named as the right coronary, left coronary, and noncoronary sinuses, respectively (5).

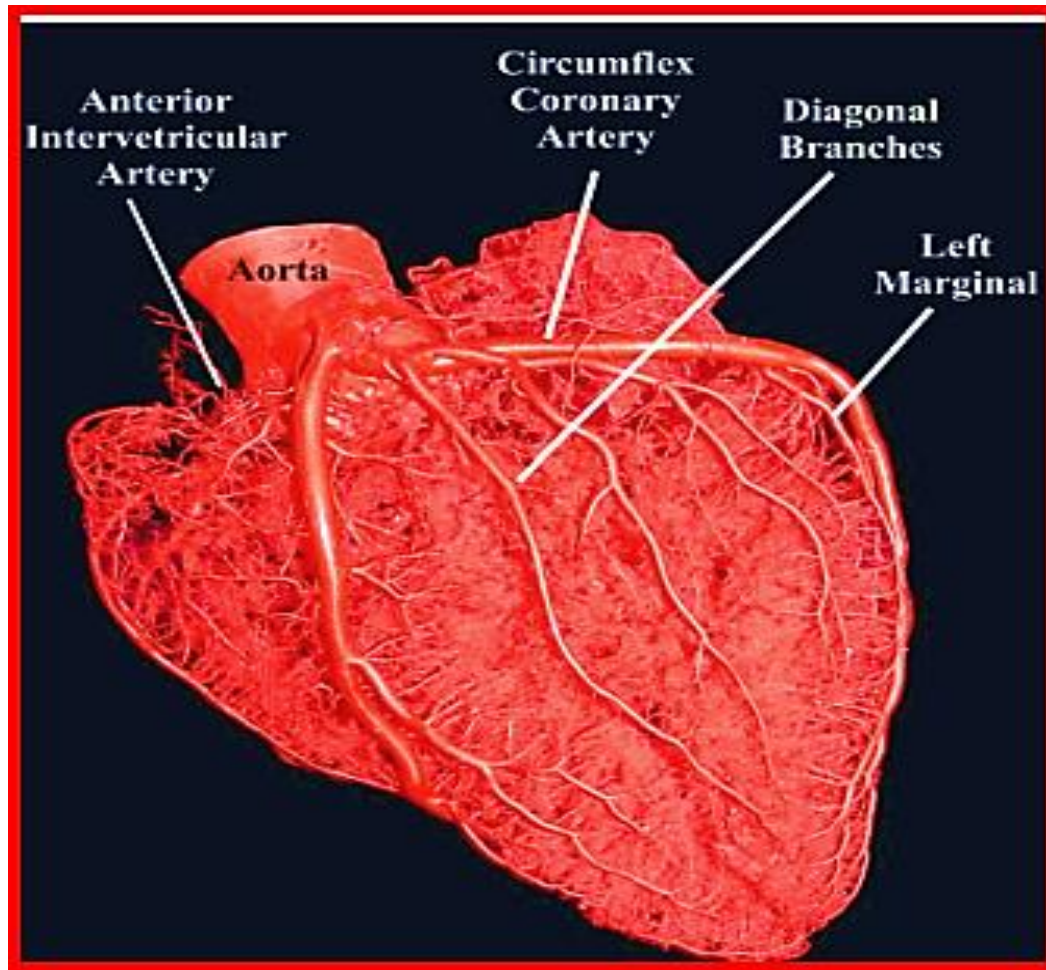


Figure.4

In this corrosion cast specimen, the left coronary main stem splits into the anterior interventricular artery and circumflex artery. The circumflex artery gives rise to two diagonal arteries and the marginal artery (6,7).

Table 1.1

Anomalies of origination and course
Anomalous location of coronary ostium within aortic root or near proper aortic sinus of Valsalva
High
Low
Commissural
Anomalous location of coronary ostium outside normal “coronary” aortic sinuses (ectopic origin)
From pulmonary trunk
From a brachiocephalic artery
From the ascending aorta
Anomalous origination of coronary ostium from the opposite aortic sinus
Right coronary artery from left aortic sinus with intra-arterial course
Left coronary artery from right sinus with intra-arterial course
Circumflex artery from right sinus with retro aortic course
Arteries from anomalous sinus with a prepulmonary course
Solitary coronary artery
With intra-arterial course
From right sinus with retro aortic course
From right sinus with circumflex course
From left sinus with circumflex course
Anomalies of intrinsic coronary arterial anatomy
Intramural coronary artery (muscular bridging)

Table 1.2

Table 1.1 and Table 1.2 Typical anomalies of the coronary arteries as characterized by their anatomical description (8).

Anomalies of origination and course
Duplication of arteries
Anomalies of coronary termination
Fistulous communications between coronary arteries and coronary venous system or cardiac chambers
Extracardiac collateral communications
location of coronary ostium within aortic root or near proper aortic sinus of Valsalva
High
Low
Commissural
Anomalous location of coronary ostium outside normal “coronary” aortic sinuses (ectopic origin)
From pulmonary trunk
From a brachiocephalic artery
From the ascending aorta
Anomalous origination of coronary ostium from the opposite aortic sinus
Right coronary artery from left aortic sinus with intraarterial course
Left coronary artery from right sinus with intraarterial course
Circumflex artery from right sinus with retroaortic course
Arteries from anomalous sinus with a prepulmonary course
Solitary coronary artery
With intraarterial course
From right sinus with retroaortic course

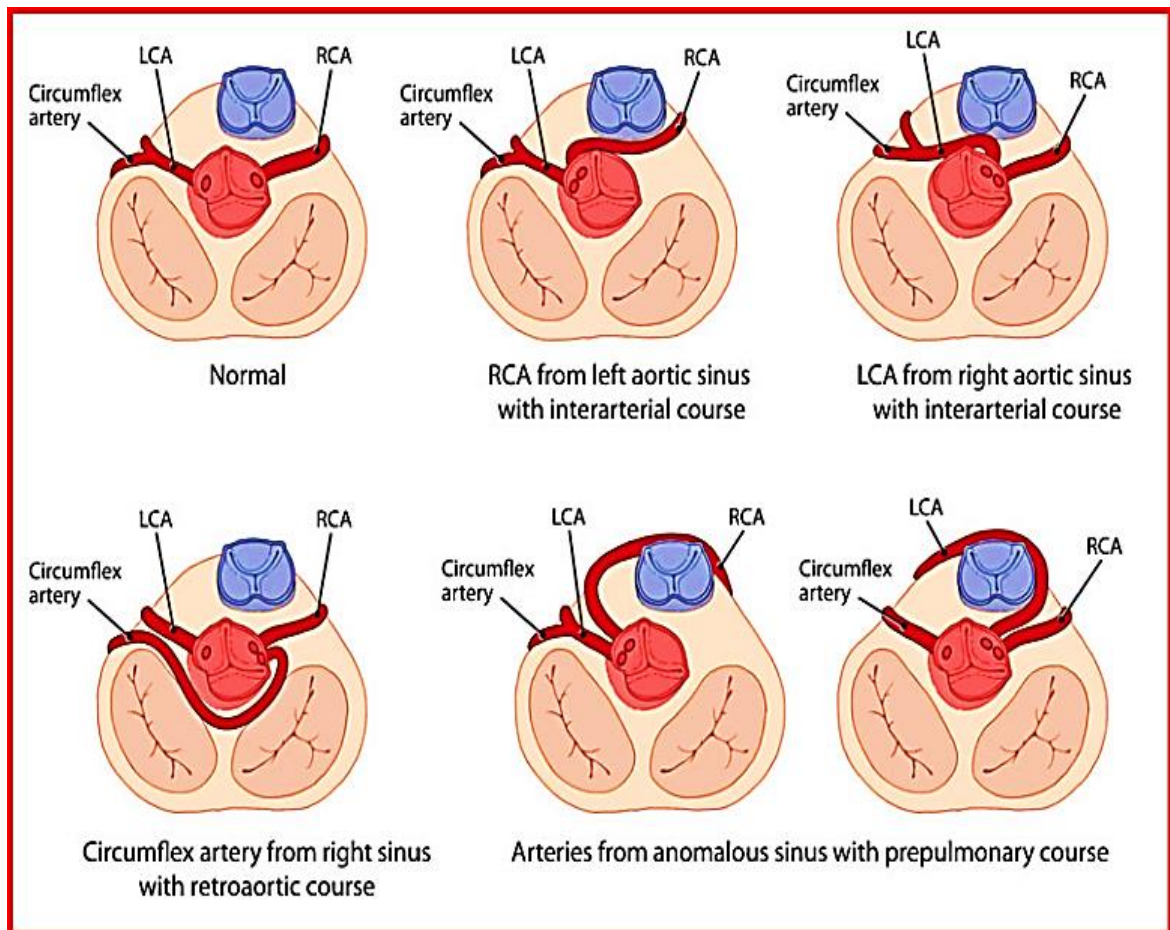


Fig. 5

illustrates different cases where the coronary ostia (openings of coronary arteries) originate abnormally from the opposite aortic sinus. These anomalies can involve the left coronary artery (LCA) arising from the right sinus or the right coronary artery (RCA) originating from the left sinus. Such variations may impact coronary circulation and have clinical significance, especially in cases of ischemia or sudden cardiac events. The schematic highlights these variations to aid in understanding their anatomical and clinical implications (9).

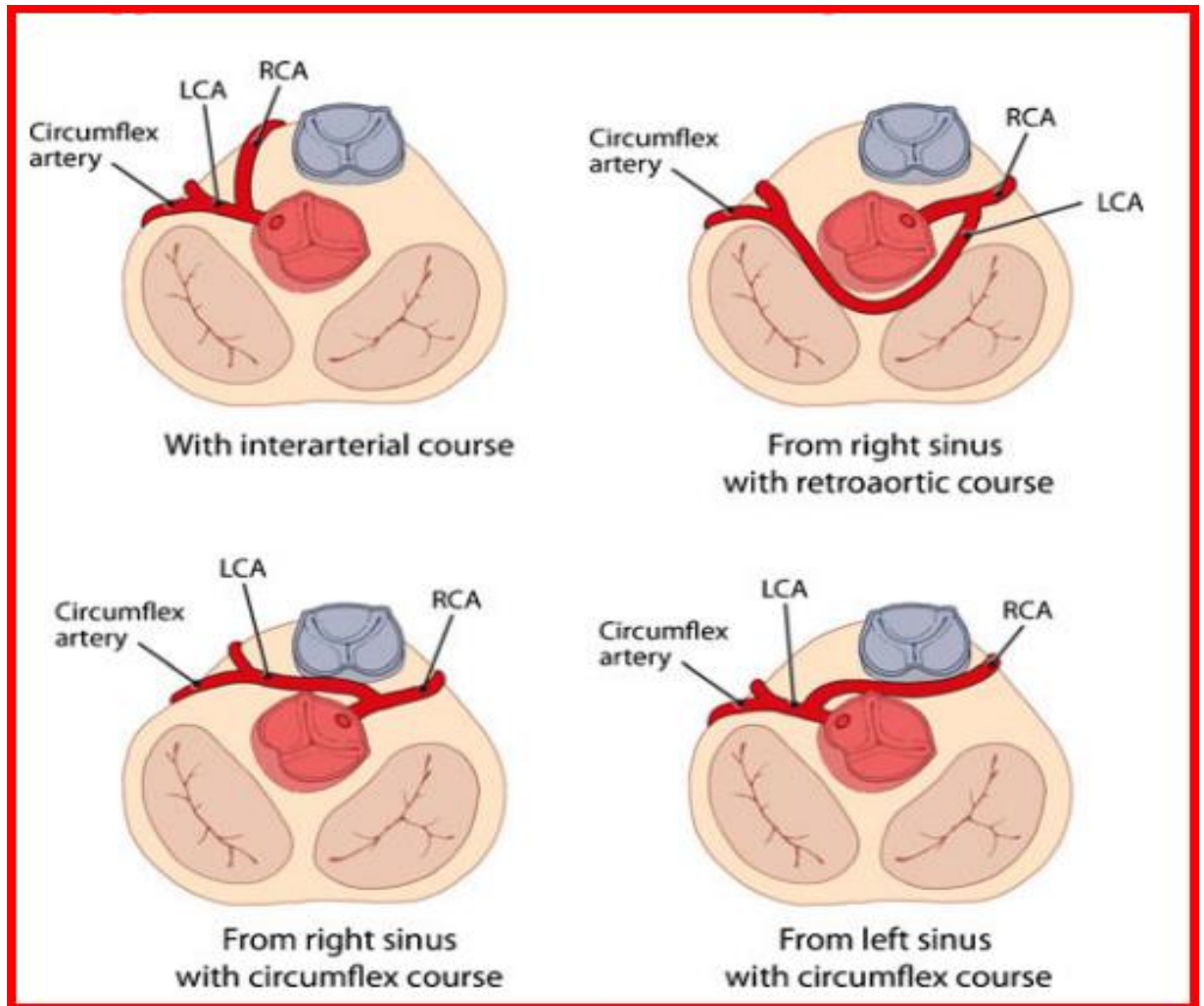


Fig. 6

The schematic illustrates cases of a solitary coronary artery, where a single coronary artery gives rise to both the LCA and RCA. It highlights two major courses: the intra-arterial course, where the artery passes between the aorta and pulmonary artery, and the retro-aortic course, where it travels behind the aorta. These variations are important for diagnosing potential ischemic risks and planning surgical or interventional procedures (10).

Clinicians involved in the management of cardiac disease should now have a detailed knowledge of the potential. Anatomical variations of the course of the coronary arteries. With an understanding of their potential origins and the possible course with respect to the arterial roots, along with an appreciation of the detailed relationships of the arterial roots themselves, there should now be no problem in predicting the multitude of variations and their potential clinical implications (10).

Coronary artery disease (CAD) accounts for approximately 610,000 deaths annually (estimated 1 in 4 deaths) and is the leading cause of mortality in the United States. (11) It is the third leading cause of mortality worldwide and is associated with 17.8 million deaths annually.(12) In the United States, healthcare services for CAD are estimated to cost more than 200 billion dollars annually.(13) While CAD is a significant cause of death and disability, it is preventable.

Given the immense healthcare burden of CAD, modifiable and non-modifiable risk factors were identified to mitigate the resulting economic and disease-related burden. Risk factor identification, combined with advances in medical technology, has significantly decreased CAD mortality rates over the past forty years in Western countries. The number of heart disease-related deaths would decrease by 21.3 percent for men and 13.4 percent for women (14). This topic reviews the impact and management of these risk factors. Ever since the Framingham Heart Study, there has been a plethora of data on CAD risk factors. This topic concisely summarizes the most recent systemic reviews and evidence. Risk factors for CAD are classified into modifiable and non-modifiable risk factors. A 2019 article indicated that age, sex, and race captured 63% to 80% of predictive performance, while modifiable risk factors contributed only modestly. Yet, controlling modifiable risk factors led to substantial reductions in CAD events (15). Non-modifiable risk factors are discussed first: Age factor In the CAD prevalence increases after 35 years of age in both men and women. The lifetime risk of developing CAD in men and women after 40 years of age is 49% and 32%, respectively (16). Gender: Men are at increased risk compared to women. Ethnicity: Blacks, Hispanics, Latinos, and Southeast Asians are ethnic groups with an increased risk of CAD morbidity and mortality (17). Family history: Family history is also a significant risk factor. Patients with a family history of premature cardiac disease younger than 50 years of age have an increased CAD mortality risk (18). A separate article

indicated that a father or brother diagnosed with CAD before 55 years of age and a mother or sister diagnosed before 65 years of age are considered risk factors (19). Modifiable risk factors have a smaller but still significant role (20). Yet, only two-thirds of patients receive optimal medication interventions (21). If this were achieved, there would be a substantial reduction in CAD events. One study observed that those with optimal risk factor profiles had a substantially lower rate of death from cardiovascular events (22). Hypertension: About 1 out of every 3 patients have hypertension. Hypertension and smoking were responsible for the largest number of deaths in a 2009 review comparing twelve modifiable risk factors (23). Yet, only 54% of these patients achieve adequate blood pressure control. Hypertension has long been a major risk factor for heart disease through both oxidative and mechanical stress it places on the arterial wall (24). A 1996 article reported that in the Framingham cohort, a systolic of 20 mmHg and diastolic of 10 mmHg increase was observed from age 30 to 65 years (25). Hyperlipidaemia, hyperlipidaemia is considered the second most common risk factor for ischemic heart disease (26).

According to the World Health Organization, raised cholesterol caused an estimated 2.6 million deaths. A recent cross-sectional study utilizing the coronary calcium score indicated a 55%, 41%, and 20% higher prevalence of hypercholesterolemia, combined hyperlipidaemia, and low HDL-c, respectively (27). Elevated triglycerides have also been implicated in CAD; however, the relationship is more complicated as the association becomes attenuated when adjusted for other risk factors such as central adiposity, insulin resistance, and poor diet. Thus, it is challenging to determine an isolated effect of triglycerides on CAD (28).

Diabetes mellitus, The Centres for Disease Control (CDC) reports that more than 1 out of every 3 adult patients in the United States has prediabetes, which puts one at risk of developing type 2 diabetes, heart disease, and stroke (29). The heart disease rate is 2.5 times higher in men and 2.4 times higher in women in adult patients with diabetes compared to those without diabetes. (29) A 2017 meta-analysis indicated that patients with diabetes with an A1C > 7.0 had an 85% higher likelihood (hazard ratio 1.85, 95% CI 1.14-2.55) of cardiovascular mortality compared to those with an A1C < 7.0%. It also revealed that non-diabetic patients with an A1C > 6.0% had a 50% higher likelihood (hazard ratio, 1.50, 95% CI 1.01-2.21) of cardiovascular mortality compared to those with an A1C of <

5.0%. Researchers also reported significant study heterogeneity. Cardiovascular disease is the leading cause of morbidity and mortality in patients with diabetes (30). The 69% of adults in the United States are overweight or obese. 35% of adults are obese (31). Obesity is an independent risk factor for CAD and also increases the risk of developing other CAD risk factors, including hypertension, hyperlipidaemia, and diabetes mellitus (32). One recent study indicated that obese patients were twice as likely to have coronary heart disease (hazard ratio 2.00, 95% CI 1.67-2.40) after adjustment for demographics, smoking, physical activity, and alcohol intake (33).

The "obesity paradox" has also been reported. Despite evidence pointing to obesity as an independent risk factor for cardiovascular morbidity, some authors have described better outcomes in overweight and obese patients. There is an ongoing debate in light of this conflicting data (34). A separate 2015 meta-analysis revealed that smoking resulted in twice the risk of cardiovascular disease for current smokers and a 37% increase in risk with former smokers among patients > 60 years old (35). Nonsmokers regularly exposed to second-hand smoke also have a 25% to 30% increased risk of coronary heart disease compared to those not exposed. Poor diet; the association between saturated fat and coronary heart disease has been a journey. Initially thought to be a significant causative factor in the development of coronary heart disease, more recent reviews have cast more doubt on this association, placing more of an emphasis on the re-emergence of refined sugars as the main risk factor (36).

Research has more clearly shown that trans -fat increases the risk of cardiovascular disease through adverse effects on lipids, endothelial function, insulin resistance, and inflammation. Every 2% of calories consumed from trans-fat was associated with a 23% higher CAD risk (37).

who consumed less than 10% calories from added sugar (38). High fructose corn syrup, sucrose, and table sugar have also been reported to be significant in CAD. Recent studies and systematic review articles have focused on red and processed meat consumption (39). These articles have revealed a consistently higher risk of coronary heart disease and cardiovascular events, ranging from 15% to 29% higher risk with red meat and 23% to 42% higher risk with processed meat consumption. Most studies included approximately 50 to 100 grams per day of consumption (40). Only 1 of these review articles revealed no

significant association between red meat and coronary heart disease (4 studies, RR 1.00 per 100 gram serving per day, 95% CI 0.92-1.46, P=0.25). One article indicated no significant association between processed meats and overall mortality, however, added that the combined intake of red and processed meats was associated with a 23% higher risk of overall mortality (41).

In addition to these traditional cardiovascular risk factors, novel risk factors have also been subject to research. These include: Non-alcoholic fatty liver disease (NAFLD): NAFLD has links to cardiovascular disease. It is also the most common chronic liver disease in developed countries. A more recent prospective study revealed that patients with NAFLD had greater than double the risk of cardiovascular events. Patients with liver fibrosis had a 4-fold increase. Chronic kidney disease (CKD); CKD has been reported as an independent risk factor for CAD. Pro-inflammatory mediators, oxidative stress, and decreased nitric oxide production leading to endothelial dysfunction have been reported as possible mechanisms. Silent myocardial infarctions occur more commonly, likely due to the higher incidence of diabetic and uremic neuropathy in patients with CKD. With a GFR of 15-59, CKD is a risk-enhancing factor in the American Heart Association Guideline for the Primary Prevention of Cardiovascular Disease. The most common cause of mortality in SLE is cardiovascular disease. There is also a higher prevalence of atherosclerotic cardiovascular disease in these patients. The mechanism is likely a pro-inflammatory effect on coronary microcirculation. Pericarditis is a common manifestation of SLE. One case report stated that pericarditis is the most common cardiac manifestation of SLE. Rheumatoid arthritis (RA): Estimates are that patients with RA have a 1.5 to 2.0-fold increased risk of CAD. Traditional risk factors such as body mass and lipoprotein levels also showed more unpredictable patterns in their predictive accuracy. The mechanism behind this associated risk is likely through a pro-inflammatory effect. Rheumatoid arthritis is also listed among the risk-enhancing factors in the American Heart Association Guideline for the Primary Prevention of Cardiovascular Disease. Inflammatory bowel disease (IBD) is associated with a higher risk of CAD. However, the results were interpreted with caution due to the heterogeneity of the studies. The risk mechanism was uncertain, but it was thought to be due to a chronic inflammatory state (42).

HIV is understood to come with a higher risk of cardiovascular disease and its associated

squeal. That patient with HIV showed a 1.5 to 2-fold increased risk of CAD. The mechanism, again, was based on a pro-inflammatory state. Thyroid disease: The thyroid gland intricately links to cardiovascular function. Proposed mechanisms include the effect of thyroid hormone on dyslipidaemia, cardiac function, atherosclerosis, vascular compliance, and cardiac arrhythmias; this area is still under study. Guidelines also vary in their screening although men are at higher risk than women of CAD; it is still the leading cause of death among women. Among women, only 54% were aware cardiovascular disease caused approximately 1 in 3 female deaths. Women were found to have non-obstructive CAD in 57% of cases, in contrast to men who more commonly had obstructive CAD. Proposed mechanisms for this include coronary micro vascular dysfunction (CMD), altered endothelial tone, structural changes, and altered response to vasodilator stimuli. Estrogen is thought to have a protective role in coronary vasoreactivity and is also theorized to promote plaque stabilization via an anti-inflammatory effect on atherosclerosis (43).

Lack of awareness and understanding of CAD in women has also led to a disparity in health outcomes. There has been more focus on obstructive CAD in men than in women. Decrease in CAD mortality across all age groups in men and an increase in CAD mortality among young women (< 55 years old). CAD remains the number 1 cause of death in the United States. Given the prevalence of CAD and its risk factors, interprofessional, team-based care may result in significantly improved patient outcomes. Clinicians should be aware of screening recommendations and the impact of risk factor mitigation on CAD outcomes. Nurses play a central role in routine screening and education. Clinical pharmacists play a pivotal role in the pharmacologic management of modifiable risk factors such as hypertension, Hyperlipidemia, diabetes, and smoking cessation. Nutritionists contribute by providing dietary education. Community outreach by all team members can help mitigate the complex yet crucial role that socioeconomic status can have on CAD risk and outcomes. This section covers screening recommendations, the impact of risk factor mitigation on CAD outcomes, aspirin, and new CAD screening tests.

A systolic and diastolic blood pressure reduction of greater than 10 mmHg and 5 mmHg led to a significant absolute risk reduction in CAD-related events (NNT 91). A systolic blood pressure reduction to a goal of 130 mmHg reduced the incidence of CAD (NNT 27).

A 2002 meta-analysis revealed that systolic blood pressure reduction of 20 mmHg and diastolic blood pressure reduction of 10 mmHg decreases the risk of death from coronary heart disease by about 50% between ages 40 to 49 and about 1/3 between ages 80 to 89 (44).

The USPSTF recommends evaluation for statin use for the primary prevention of cardiovascular disease between 40 and 75 years of age. The USPSTF gives a grade I (current evidence insufficient) recommendation for routine screening for lipid disorders in children and adolescents. In 2011, the National Heart, Lung, and Blood Institute (NHLBI) recommended universal screening between 9 and 11 years of age and again at 17 to 21 years of age. The American Academy of Pediatrics subsequently endorsed this. Despite the publication of these guidelines, pediatric lipid screening practice patterns have not followed suit. An early 1994 review showed that a 10% reduction in serum cholesterol leads to a 50%, 40%, 30%, and 20% drop in CAD risk at ages 20, 50, 60, and 70, respectively (45).

Treatment with a high-intensity statin resulted in a 4.1% absolute risk reduction (NNT 24). The USPSTF recommends screening for abnormal glucose in patients aged 40 to 70 years old who are overweight or obese. Early screening for diabetes can also be a consideration for patients in higher-risk groups. This risk pool includes patients with a family history of diabetes, a history of gestational diabetes or polycystic ovarian syndrome, or members of specified racial/ethnic groups (Blacks, American Indians, Alaskan natives, Asian Americans, Hispanics or Latinos, native Hawaiians, or Pacific Islanders). The American Diabetes Association states that 3 years is a reasonable screening interval. A patient's body mass index (BMI) should be measured at each clinical encounter. The USPSTF recommends that practitioners offer obese adults a referral to a multicomponent behavioral interventionist (46).

Approximately 150 minutes per week of moderate-intensity aerobic activity reduces the risk of cardiovascular disease (CAD). Moderate-intensity aerobic exercise is defined as 50 to 70 percent of the patient's maximum heart rate (220 beats per minute minus the patient's age). Any amount of physical activity has been shown to have benefits in reducing CAD risk. The most active patients have an approximately 35 to 40 percent risk reduction for CAD. The AHA/ACC guidelines also recommend incorporating resistance strength

training into regular physical activity, as this can help improve physical function and ability to exercise. FMD is another proposed test that can potentially predict cardiovascular risk by measuring the health of blood vessel endothelial function. Physiologic and pharmacologic stress, such as hypertension, smoking, or certain medications, can alter.

There are different methods to measure FMD. A protocol involving vasoactive agents via coronary catheterization is a more direct measurement of the coronary artery endothelial function, specifically referred to as coronary flow reserve (CFR). Brachial artery flow-mediated dilation and reactive hyperaemia-peripheral arterial tonometry (RH-PAT) are more peripheral measurements. A 2015 meta-analysis conferred that these 2 methods demonstrated similar prognostic value on cardiovascular outcomes. Additional research is necessary to determine whether this screening strategy can improve cardiovascular outcomes. CAD is the leading cause of death in the United States and many countries worldwide. Given the prevalence of CAD and its risk factors, interprofessional, team-based care may significantly improve patient outcomes. Clinicians, nurses, and pharmacists must remain abreast of current research and work together as an interprofessional team to encourage long-term treatment recommendations and regular exercise to obtain the best patient outcomes (47).

The first portion of the encounter identifies the patient's age, gender, ethnicity, and past medical history. CAD risk factors can be detected within the first 5 minutes of the clinical encounter. Vital signs detect elevated blood pressure and excessive weight. Diet and physical activity can also be discussed. Early education on lifestyle modifications can improve outcomes and mitigate risk factors. Screening recommendations can also be provided. The opinions and assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Army, Department of the Air Force, Department of Defense, or the U.S. government. This document was created free of branding or market affiliations. The author is operating solely as a contributor (48).

AIM AND OBJECTIVES

The objective of using angiography to evaluate coronary artery disease in individuals with and without diabetes at varying ages is to pinpoint the unique symptom presentations and disease trajectory in these cohorts. In diabetic patients, persistent high blood sugar levels lead to plaque formation, arterial thickening, and increased inflammation, resulting in more severe and diffuse CAD. Understanding these differences is crucial for improving diagnostic accuracy, tailoring treatment strategies, and enhancing patient outcomes in clinical practice. This study will provide important light on how diabetes affects coronary artery disease and how it is managed in different age groups.

To assess coronary artery diseases in diabetic patients with different age group. To compare the prevalence and severity of coronary artery disease (CAD) as assessed by angiography between diabetic and non-diabetic patients across various age groups

Chapter 2

LITERATURE REVIEW

Iqbal, A. T.et al. 2019 conducted a study to evaluate the presence of coronary artery disease in diabetic and non-diabetic Among the 200 patient's total male were 80.5% and total female were 19.5%). Male to female ratio was 5:1. Regarding age distribution it was found matched in both groups. Most patients were at the age group 41-50 and 51-60 years which was 31% and 45% respectively. Regarding presence of hypertension in both groups, diabetic group had more hypertensive patients (81%) than the non-diabetic (71%) group (p=0.098). Regarding analysis of CAG findings in diabetic and non-diabetic groups LMCA involvement was 16% and 12%, LAD 32% and 28%, LCX 22% and 23%, RCA 23% and 20% and triple vessel was 15% and 14% respectively. Only 5(2.5%) patients were found not to have any lesions. ACS with or without DM has variable CAG findings. So special care should be taken when dealing with such cases (49).

Cho, YR., et al. 2019 conducted study to evaluate the association between insulin resistance, hyperglycemia and coronary artery diseases according to presence of diabetic patient or non-diabetic patient. This study evaluated the relationship of insulin resistance (IR) and glycemic control status to the presence and severity of coronary artery disease (CAD) according to diabetes. The relationship of IR parameters including homeostatic model assessment of IR (HOMA-IR), triglyceride-glucose (TyG) index and triglyceride-to-high density lipoprotein cholesterol ratio (TG/HDL), and hemoglobin A1C (HbA1C) level to CAD and obstructive CAD was evaluated in 5,764 asymptomatic subjects who underwent coronary computed tomographic angiography. Non-diabetics (n=4768) and diabetics (n=996) were stratified into four groups based on the quartiles of HOMA-IR and the TyG index and were grouped based on the TG/HDL cut-offs of 3.5, respectively. CAD and obstructive CAD were defined as the presence of any plaques and plaques with $\geq 50\%$ stenosis, respectively. The prevalence of CAD (59.0% vs. 39.0%) and obstructive CAD (15.0% vs. 6.6%) was higher in diabetic than in non-

diabetic patients ($p < 0.001$, respectively). In non-diabetic patients, the adjusted odds ratio for both CAD and obstructive CAD significantly increased, but only with higher TyG index quartiles. Unlike non-diabetics, the adjusted odds ratio for obstructive CAD significantly increased in diabetic patients with a TG/HDL level ≥ 3.5 . The HbA1C, rather than IR parameters, was independently associated with both CAD and obstructive CAD in diabetics among IR parameters, TyG index was independently associated with the presence of CAD and obstructive CAD in non-diabetic patients. In contrast, the glycemic control status, rather than IR, was importantly related to both CAD and obstructive CAD in established diabetic patients (50).

Bax, J. et al. 2007 conducted a study to evaluate the coronary artery disease (CAD) accounts for a large fraction of the morbidity, mortality, and cost of diabetes. Recognizing this, nearly 10 years ago the American Diabetes Association published a consensus recommendation that clinicians consider a risk factor-guided screening approach to early diagnosis of CAD in both symptomatic and asymptomatic patients. Subsequent clinical trial results have not supported those recommendations. Since the prior consensus statement, newer imaging methods, such as coronary artery calcium scoring and noninvasive angiography with computed tomography (CT) techniques, have come into use. These technologies, which allow quantification of atherosclerotic burden and can predict risk of cardiac events, might provide an approach to more widespread coronary atherosclerosis screening. However, over this same time interval, there has been recognition of diabetes as a cardiovascular disease (CVD) equivalent, clear demonstration that medical interventions should provide primary and secondary CVD risk reduction in diabetic populations, and suggestive evidence that percutaneous coronary revascularization may not provide additive survival benefit to intensive medical management in patients with stable CAD. This additional evidence raises the question of whether documenting asymptomatic atherosclerosis or ischemia in people with diabetes is warranted. More data addressing this issue will be forthcoming from the BARI 2-D (Bypass Angioplasty Revascularization

Investigation 2 Diabetes) trial. Until then, for patients with type 2 diabetes who are asymptomatic for CAD, we recommend that testing for atherosclerosis or ischemia, perhaps with cardiac CT as the initial test, be reserved for those in whom medical treatment goals cannot be met and for selected individuals in whom there is strong clinical suspicion of very-high-risk CAD. Better approaches to identify such individuals based on readily obtained clinical variables are sorely needed (51).

Olesen, K et al. 2017 conducted a study to evaluate the risk of myocardial infarction (MI) in patients with diabetes is greater than for patients without diabetes. Consequently, prophylactic treatment is recommended for patients with diabetes and risk factors for ischemic heart disease. We aimed to estimate the risk of adverse cardiac events in patients with and without diabetes with and without coronary artery disease (CAD) after coronary angiography (CAG). We included 93,866 patients of whom 12,544 (13.4%) had diabetes at the time of CAG. Median follow-up was 4.1 years. Patients with and without diabetes without obstructive CAD had the same adjusted risk of death (RR 1.03 [95% CI 0.92–1.15]), cardiac death (RR 1.21 [95% CI 0.90–1.64]), and MI (RR 0.88 [95% CI 0.65–1.17]). Patients with diabetes without CAD were more often treated with statins (75.3% vs 46.0%) and aspirin (65.7% vs. 52.7%) than patients without diabetes and CAD. In a real-world population, patients with diabetes with high rates of statin and aspirin treatment had the same risk of cardiovascular events as patients without diabetes in the absence of angiographically significant CAD (52).

Fishman et al. 2018 conducted the study of Hyperglycemia is the hallmark feature of DM. An increase in the incidence of both micro-and macrovascular complications of diabetes has been observed with increased duration of hyperglycemia. This association persists even after glycemic control has been achieved, suggesting an innate mechanism of “metabolic memory.” AGEs are glycated proteins that may serve as mediators of metabolic memory due to their increased production in the setting of hyperglycemia and generally slow turnover. Elevated AGE levels can lead to abnormal cross linking of extracellular and intracellular proteins disrupting their normal structure and function. Furthermore, activation of AGE receptors can induce complex signaling pathways leading to increased inflammation, oxidative stress,

enhanced calcium deposition, and increased vascular smooth muscle apoptosis, contributing to the development of atherosclerosis. Through these mechanisms, AGEs may be important mediators of the development of CAD. However, clinical studies regarding the role of AGEs and their receptors in advancing CAD are limited, with contradictory results. AGEs and their receptors may be useful biomarkers for the presence and severity of CAD. Further studies are needed to evaluate the utility of circulating and tissue AGE levels in identifying asymptomatic patients at risk for CAD or to identify patients who may benefit from invasive intervention (53).

Dziedzic et al. 2019 conducted a study to evaluate the ischemic heart disease is the main cause of death in developed countries. There are many modifiable risk factors associated with coronary heart disease (CAD). A growing number of studies point to vitamin D deficiency as a risk factor for heart attacks and the conditions associated with cardiovascular disease. The 25(OH)D level proved to be one of the significant determinants of the CASSS ($p < 0.05$). In subjects without significant lesions in the coronary arteries the 25(OH)D level was significantly higher compared to patients with one- to three-vessel coronary atherosclerosis ($p < 0.05$). A significantly higher 25(OH)D level was noted in patients diagnosed with stable CAD compared to patients hospitalized due to acute coronary syndrome ($p < 0.01$). Patients with one- to three-vessel atherosclerosis have a significantly lower 25(OH)D level compared to patients without significant lesions in the coronary arteries. A lower 25(OH)D level was observed in patients hospitalized due to acute coronary syndrome compared to patients diagnosed with stable CAD (54).

Henning, R. J. 2018 conducted a study to evaluate the global prevalence of diabetes has risen in adults from 4.7% in 1980 to 8.5% in 2014. 90–95% of adults with diabetes have Type 2 diabetes (T2D). This paper focuses on the diagnosis and treatment of T2D patients who have or are at risk for cardiovascular disease. Hyperglycemia, insulin resistance and excess fatty acids increase oxidative stress, disrupt protein kinase C signaling and increase advanced glycation end products that result in vascular inflammation, vasoconstriction, thrombosis and atherogenesis.

Intensive T2D treatment produces a $\geq 10\%$ risk reduction in major macrovascular and microvascular events. Glucose lowering therapies must be individualized. Metformin is an optimal drug for monotherapy. If hemoglobin A1c is not at goal, a sodium-glucose cotransporter-2 inhibitor or a dipeptidyl peptidase-4 inhibitor should be considered for therapy with metformin. Coronary angioplasty/stenting is recommended for diabetic patients with acute myocardial infarctions. Coronary artery bypass grafting is recommended for symptomatic diabetic patients with multivessel disease (55).

Olesen, K et al. 2019 conducted a study to evaluate the A cohort study of consecutive patients (n = 48 731) registered in the Western Denmark Cardiac Computed Tomography Registry from 2008 to 2016. Patients were stratified by diabetes status and CAD severity (no, nonobstructive, or obstructive). Endpoints were MI and death. Event rates per 1000 person-years, unadjusted and adjusted incidence rate ratios were computed. Median follow-up was 3.6 years. Among non-diabetes patients, MI event rates per 1000 person-years were 1.4 for no CAD, 4.1 for non-obstructive CAD, and 9.1 for obstructive CAD. Among diabetes patients, the corresponding rates were 2.1 for no CAD, 4.8 for non-obstructive CAD, and 12.6 for obstructive CAD. Non-diabetes and diabetes patients without CAD had similar low rates of MI [adjusted incidence rate ratio 1.40, 95% confidence interval (CI): 0.71–2.78]. Among diabetes patients, the adjusted risk of MI increased with severity of CAD (no CAD: reference; non-obstructive CAD: adjusted incidence rate ratio 1.71, 95% CI: 0.79–3.68; obstructive CAD: adjusted incidence rate ratio 4.42, 95% CI: 2.14–9.17). Diabetes patients had higher death rates than non-diabetes patients, irrespective of CAD severity. In patients without CAD, diabetes patients have a low risk of MI similar to non-diabetes patients. Further, MI rates increase with CAD severity in both diabetes and non-diabetes patients; with diabetes patients with obstructive CAD having the highest risk of MI (56).

Palumbo, P et al. 2020 conducted a study to evaluate the one of the most frequent risk factors for cardiovascular disease, type 2 diabetes mellitus (T2DM) is one of the largest causes of death. Coronary artery disease (CAD) was found in 58 patients (93.55%) presenting 290 plaques. Analysis of all samples showed severe-to-

occlusive atherosclerosis in 24 patients (38.7% of cases). However, over the degree of stenosis, 23 patients were evaluated at high risk considering the extension of CAD. Good agreement was shown by the correlation of CAD extension/risk estimation and MACE incidence, according to a Kaplan–Meier survival analysis (p value = 0.001), with a 7.25-fold increased risk (HR 7.25 CI 2.13–24.7; p value = 0.002). Our study confirms the high capability of CCTA to properly stratify the CV risk of asymptomatic T2DM patients. Its use could be recommended if we consider how current investigative strategies to correctly assess these patients often seem inadequate (57).

Ul Amin et al. 2019 conducted a study to evaluate the relationship between the duration of diabetes mellitus and coronary artery disease (CAD) is well established. Moreover, the Gensini score system is a reliable assessment tool for the severity of coronary artery disease (CAD). After an extensive literature search, we found that there is a knowledge gap about the relationship between the Gensini score and the duration of diabetes in our population. Therefore, the aim of this study was to find the relationship between the Gensini score and the duration of diabetes in patients undergoing a coronary angiography. A total of 321 diabetic patients were included in this study, out of which 67.9% (218) were men and mean $\pm$ standard deviation age was 56.13 ± 7.67 years ranging between 40 to 70 years with a majority of the patients, 63.9% (205), being under 60 years of age. Along with diabetes, the most commonly observed risk factor was hypertension, which was observed in 77.6% (249) of the patients. Smoking and obesity were also observed in 18.7% (60) and 17.4% (56) of the patients, respectively. A significant positive correlation, 0.55 ($p < 0.001$), was observed between the duration of diabetes and the Gensini scores. The correlation was found to be stronger in older patients (more than 60 years of age) with a correlation coefficient of 0.52 vs. 0.38, and male patients with correlation coefficients of 0.66 vs. 0.34. A significant positive correlation between the Gensini score and the duration of diabetes (58).

Dar, et al. 2020 This study was aimed to study the prevalence of type 2 diabetes mellitus (T2DM) and the relation of HbA1c with the severity of CAD in patients presenting as non-diabetic ACS. Out of 208 patients, 85.1% were males, and 14.9% were females; 73.56% cases were hypertensive. 80.77% of cases had STEMI, 17.79% had NSTEMI, and 1.44% had unstable angina. Out of 168 STEMI patients, 64.3% were thrombolysed, 21.42% presented late, 2.38% had contraindications to thrombolysis, and 11.9% underwent primary PCI. FBS in diabetic range was found in 44.23% of cases, impaired FBS in 36.54%, and 19.23% of patients had FBS in non-diabetic range. According to HbA1c, 41.8% were diabetic, 39.4% were pre-diabetic, and 18.8% were non-diabetic. A significant positive correlation was found between HbA1c and Gensini score and between HbA1c and the number of vessels involved. This study emphasises the importance of evaluating the presence of diabetes in patients presenting as non-diabetic acute coronary syndrome in developing countries. Acute coronary syndrome may be considered as one of the presentations of diabetes mellitus (59).

Simindokht et al. 2020 Identifying the risk factors for myocardial infarction and determining the relationship between these factors and severity the location of coronary artery disease can help physicians to make diagnostic and therapeutic decisions, while providing a suitable context for effective action to modify risk factors in the society. 85.5% of the STEMI cases had involvement of one vessel and 52.1% of NSTEMI cases had involvement of two vessels. According to results of Chi-square and Cramer test, these differences are significant. Most STEMI cases had RCA involvement (38.3%) and LCX involvement (29%). However, NSTEMI cases mostly had RCA+LCX (36.2%) and LAD+RCA+LCX (21.3%) involvement. According to statistical tests, these differences are significant (P-value=0.000, vi Cramer=0.524). Both groups of patients with myocardial infarction were over 55 years of age and men. The number of NSTEMI cases with BMI higher than the normal range was significantly more than STEMI cases. The prevalence of multiple vessel involvement of RCA and LCX is higher in NSTEMI cases than STEMI cases (60).

Wu Z, et al.2022 There is currently insufficient data on the association of non-insulin-based IR indexes [triglyceride (TG)/high-density lipoprotein cholesterol (HDL-C) ratio, triglyceride and glucose (TyG) index, and metabolic score for IR (METS-IR)] with the presence and severity of CAD. Thus, the present study aimed to examine the relationship between these three non-insulin-based IR indexes and CAD, as well as to further compare the predictive values of each index. The TG/HDL-C ratio, TyG index, and METS-IR in the CAD group were significantly higher than those in the control group. The TG/HDL-C ratio and METS-IR in the high GS group were significantly higher than those in the non-high GS group. Multivariate logistic regression analysis showed that the TG/HDL-C ratio and METS-IR were independent predictors for the presence of CAD {adjusted odds ratio (OR) [95% confidence interval (CI)]:1.32 (1.02–1.70) and 1.65(1.32–2.05), respectively}, whereas only the METS-IR was an independent predictor of the severity of CAD [adjusted OR (95% CI): 1.22 (1.02–1.47)]. Further subgroup analysis indicated that statistical significance was observed only among men, younger patients (≤ 60), and patients with prediabetes mellitus (PDM). Receiver operator characteristic (ROC) analysis showed that the METS-IR had the highest predictive value for the prediction of both the presence and severity of CAD (61).

Assante, et al.2017 To assess the relationship between coronary atherosclerotic burden and vascular function in diabetic and nondiabetic patients after balancing for coronary risk factors. Before matching, diabetic patients had higher coronary artery calcium (CAC) scores ($p < 0.001$) and lower coronary flow reserve (CFR; $p < 0.001$) than nondiabetic patients. After matching, CAC scores were comparable between diabetic and nondiabetic patients, but diabetic patients still had lower hyperaemic myocardial blood flow ($p < 0.001$) and CFR ($p < 0.05$). Patients were categorized by $\ln(\text{CAC score})$ quartiles. There was a decrease in CFR with increasing CAC score quartile in both diabetic patients (p for trend < 0.01) and nondiabetic patients (p for trend < 0.005). Diabetes was associated with lower CFR across quartile categories ($p < 0.002$). in a multivariable linear regression analysis, CAC score was inversely related to CFR in both diabetic patients ($p < 0.05$) and nondiabetic patients ($p < 0.001$). Diabetic patients had higher CAC scores than nondiabetic patients, but the

difference disappeared when clinical characteristics were taken into account. Of note, diabetic patients also had lower CFR regardless of CAC score than nondiabetic patients after matching. Thus, coronary atherosclerotic burden and vascular function have to be seen as two different entities (62).

Zhang et al.2022 Coronary microvascular dysfunction (CMD) is common and is associated with unfavorable cardiovascular events in patients with diabetes mellitus (DM). Coronary angiography-derived index of microcirculatory resistance (caIMR) is a recently developed wire- and hyperemic agent-free method to assess CMD.Of 290 CCS patients, 102 patients had DM. Compared with non-diabetic patients, CMD (caIMR $\geq$ 25U) was higher among DM patients (57.8% vs. 38.3%; $p = 0.001$). During a mean 35 months follow-up, 40 MACE had occurred. Patients with caIMR $\geq$ 25 had a higher rate of MACE than patients with caIMR < 25 (20.6% vs. 8.2%, $p = 0.002$). Of these, the MACE rate was higher among DM patients with caIMR ≥ 25 than those with caIMR < 25 (33.9% vs. 14.0%; $p = 0.022$). In multivariable Cox analysis, caIMR ≥ 25 was independently associated with MACE in the DM patients but not in non-DM patients (HR, 2.760; 95% CI, 1.066–7.146; $P=0.036$).CMD assessed by caIMR was common and is an independent predictor of MACE among diabetic patients with CCS. This finding potentially enables a triage of higher-risk patients to more intensive therapy (63) .

Chapter 3

METHODOLOGY

3.1. Research Design:

Cross sectional comparative study

3.2. Clinical Settings:

Punjab cardiology Lahore

3.3. Sample Size:

$$n = \frac{z^2 \cdot 1 - \alpha \cdot p(1-p)}{d^2}, n=170(1)$$

3.4. Sampling Technique:

Convenient Sampling Technique

3.5. Duration of Study:

04 month after approval of synopsis

3.6. Selection Criteria

3.6.1. Inclusion Criteria

Non-Diabetic patient

- Angina
- Pressure, tightness
- Pain radiating to arms
- Shortness of Breath
- Fatigue
- Heart Palpitations
- Dizziness or Light-headedness
- Nausea or Vomiting

Diabetic patient

- Atypical Chest Pain
- Mild discomfort, burning sensation, indigestion
- Pain in back, shoulders, or jaw

- Shortness of Breath
- Extreme Fatigue
- Silent Ischemia (no noticeable symptoms)
- Sudden Symptoms
- Cardiac arrest

Age Group

- Age group (20-40)
- Age group (40-60)
- Age group (60-80)

3.6.2. Exclusion Criteria

- Prior Cardiac Surgery (CABG)
- Pre stenting
- Above Age 80
- Hypertensive

3.7. Ethical Consideration

The rules and regulations set by the ethical committee of university of Lahore were followed while conducting the research and the rights of the research participants were respected.

- Written informed consent attached was taken from all the participants.
- All information and data collection were kept confidential.
- Participants were remained anonymous throughout the study.
- The subjects were informed that there are no disadvantages or risk on the procedure of the study.
- They were also be informed that they will be free to withdraw at any time during the process of the study.
- Data was kept in under key and lock while keeping keys in hand. In laptop it was kept under password.

3.8. Data Collection Procedure

The study will take place at Punjab Cardiology Lahore over four months following synopsis approval, utilizing a convenient sampling technique. The sample size will be calculated using the specified formula. Participants will be selected based on inclusion criteria for non-diabetic and diabetic patients, aged 20-80, excluding those with prior cardiac surgery, pre stenting, above 80, or hypertensive. Data on symptoms such as chest pain, shortness of breath, and fatigue will be collected and recorded using standardized forms. Demographic data and clinical history will also be documented. The collected data will be analyzed to compare symptom presentations between the three groups. Ethical approvals and participant consent will be ensured throughout the study

3.9. Data Analysis

The sample size will be calculated using the specified formula. Participants will be selected based on inclusion criteria for both non-diabetic and diabetic patients, aged 20-80, excluding those with prior cardiac surgery, pre-stenting, above 80, or hypertensive. Data on symptoms such as chest pain, shortness of breath, and fatigue will be collected and recorded using standardized forms. Demographic data and clinical history will also be documented. All data will be entered and analyzed using SPSS version 25. Symptoms and demographic data will be defined in frequency and percentage for both diabetic and non-diabetic patients. Age groups and symptom severity will be expressed as mean $\pm$ standard deviations and diagnostic accuracy will be separated. P value <0.05 will be considered significant and chi square test to check the association of coronary artery diseases in non-diabetic and non-diabetic patients

Chapter 4

RESULTS

Frequency table 4.1 & Figure 4.1

The gender distribution of the study population consists of 93 females (54.7%) and 77 males (45.3%), making a total of 170 participants. The data indicate a higher proportion of female participants compared to males. Figure 4.1 visually represents this distribution, highlighting the predominance of females in the study sample.

Gender		
	Frequency	Percent
Female	93	54.7
Male	77	45.3
Total	170	100.0

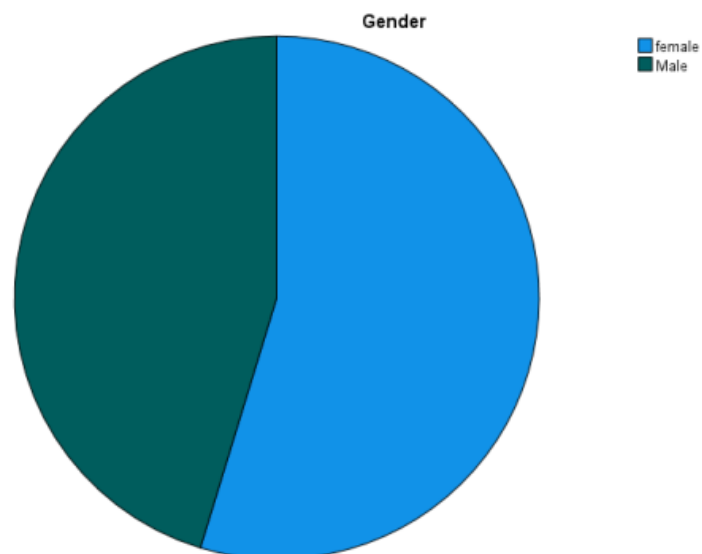


Table 4.2 & Figure 4.2

The age distribution of the study population shows that 45 participants (26.5%) belong to the 20–40 age group, while the largest proportion, 75 individuals (44.1%), falls within the 40–60 age group. Additionally, 50 participants (29.4%) are in the >60 age group, making a total of 170 individuals. Figure 4.2 visually represents this distribution, illustrating that the majority of participants are aged between 40 and 60 years.

Age Group		
	Frequency	Percent
Age Group 20-40	45	26.5
Age Group 40-60	75	44.1
Age group <60	50	29.4
Total	170	100.0

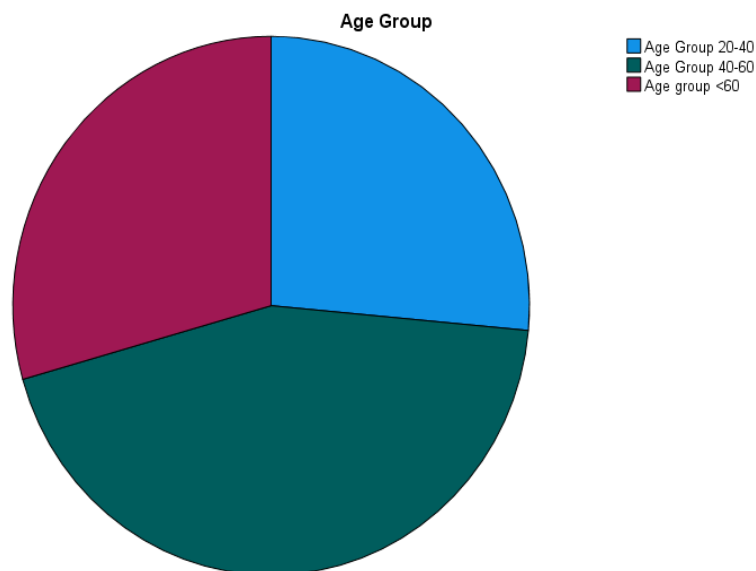


Table 4.3 & Figure 4.3

The distribution of chest pain severity among participants reveals that 55 individuals (32.4%) experienced mild pain (scores 1–3), while 51 participants (30.0%) reported moderate pain (scores 4–6). The highest proportion, 64 individuals (37.6%), experienced severe chest pain (scores 7–10), indicating that a significant number of participants suffered from high-intensity symptoms. Figure 4.3 visually represents this distribution, emphasizing the predominance of severe chest pain in the study population

Chest Pain Stage		
	Frequency	Percent
Mild 1-3	55	32.4
Moderate 4-6	51	30.0
Severe 7-10	64	37.6
Total	170	100.0

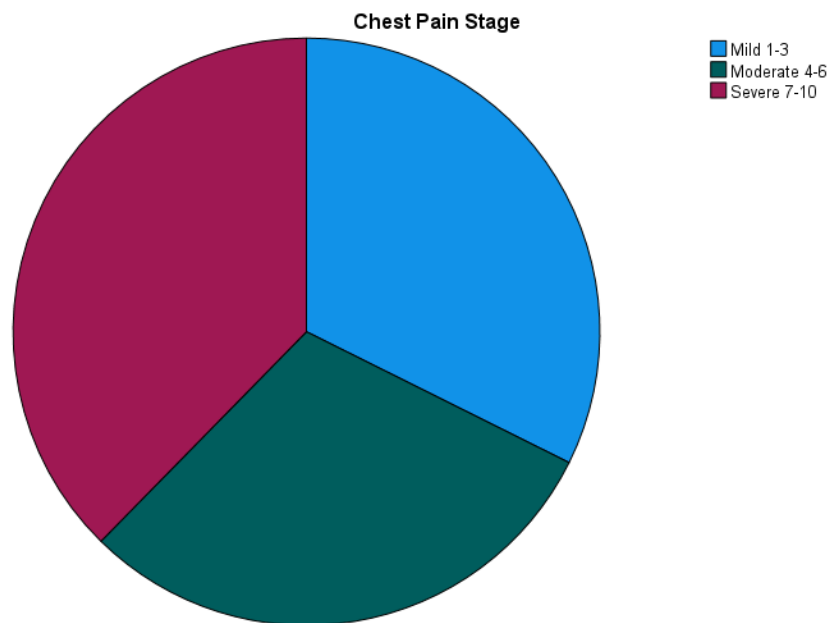


Table 4.4 & Figure 4.4

The severity distribution of shortness of breath (SOB) among participants shows that 46 individuals (27.1%) experienced mild SOB (scores 1–3), while 56 participants (32.9%) reported moderate SOB (scores 4–6). The highest proportion, 68 individuals (40.0%), suffered from severe SOB (scores 7–10). This indicates that a significant number of participants experienced intense shortness of breath. Figure 4.4 visually represents this distribution, highlighting the predominance of severe SOB in the study population.

SOB Stage		
	Frequency	Percent
Mild 1-3	46	27.1
Moderate 4-6	56	32.9
Severe 7-10	68	40.0
Total	170	100.0

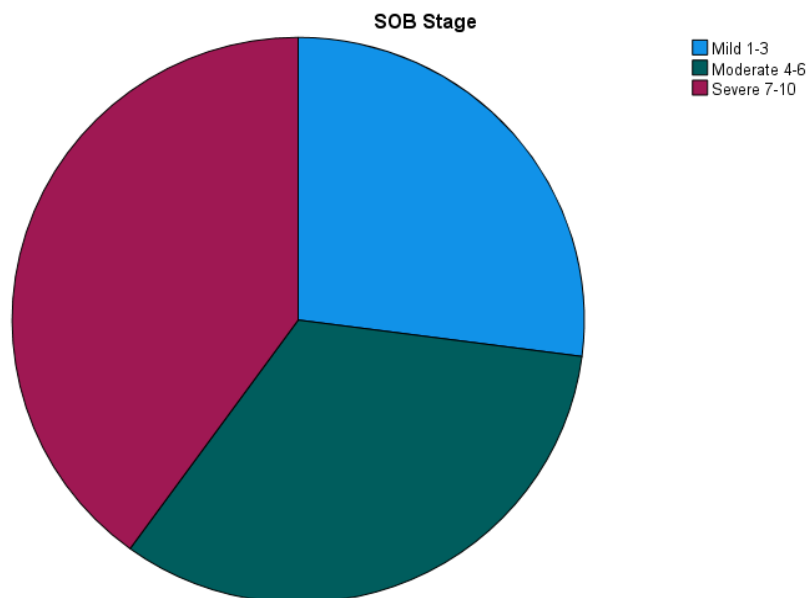


Table 4.5 & Figure 4.5

The distribution of heart palpitations among participants shows that 115 individuals (67.6%) experienced palpitations, while 55 participants (32.4%) did not report this symptom. This indicates that heart palpitations were a common occurrence in the study population. Figure 4.5 visually represents this distribution, emphasizing the higher prevalence of heart palpitations among participants

Heart Palpitations		
	Frequency	Percent
Absent	55	32.4
present	115	67.6
Total	170	100.0

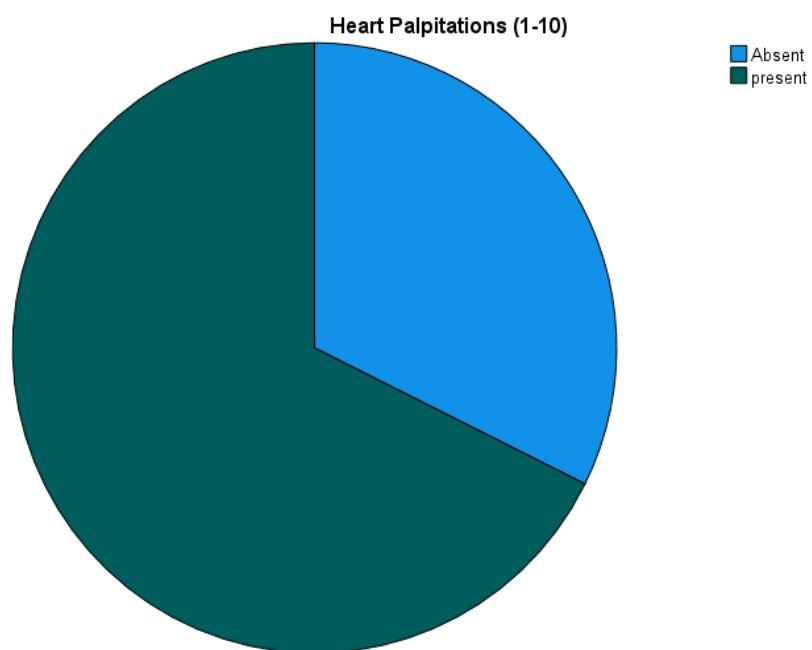


Table 4.6 & Figure 4.6

The distribution of pain radiating to the arms among participants shows that 126 individuals (74.1%) experienced this symptom, while 44 participants (25.9%) did not. This indicates that a majority of the study population reported pain extending to the arms. Figure 4.6 visually represents this distribution, highlighting the high prevalence of radiating pain among participants

Pain Radiating to Arms		
	Frequency	Percent
Absent	44	25.9
present	126	74.1
Total	170	100.0

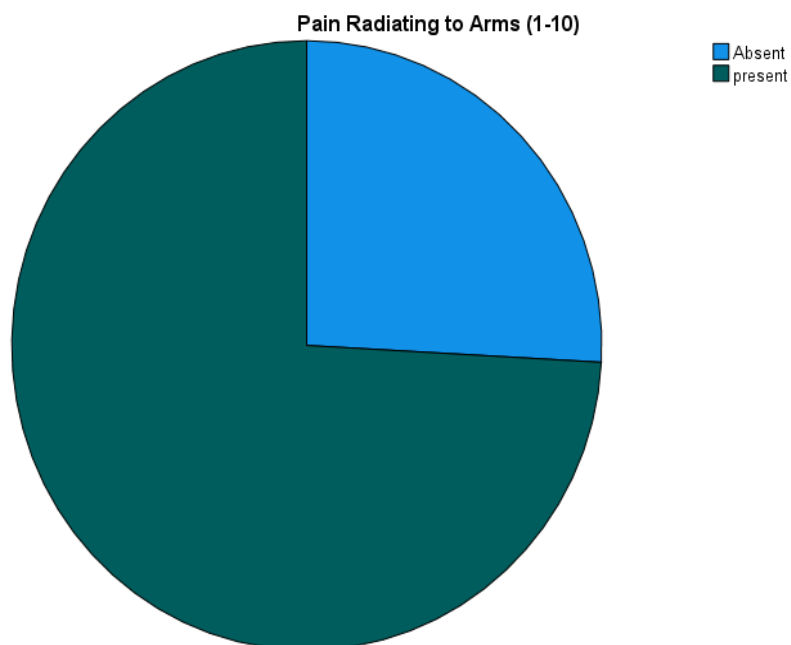


Table 4.7 & Figure 4.7

The distribution of nausea and vomiting among participants indicates that 122 individuals (71.8%) experienced these symptoms, while 48 participants (28.2%) did not. This suggests that nausea and vomiting were common complaints in the study population. Figure 4.7 visually represents this distribution, emphasizing the high prevalence of these symptoms among participants.

Nausea/Vomiting		
	Frequency	Percent
Absent	48	28.2
present	122	71.8
Total	170	100.0

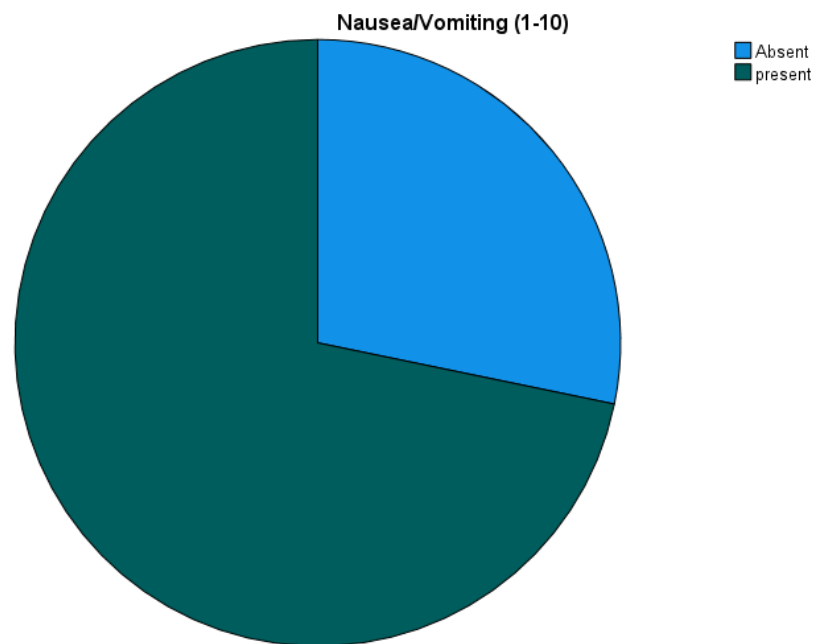


Table 4.8 & Figure 4.8

The distribution of diabetes among participants shows an equal prevalence, with 85 individuals (50.0%) being diabetic and 85 individuals (50.0%) being non-diabetic. This indicates a balanced representation of diabetic and non-diabetic participants in the study. Figure 4.8 visually represents this distribution, highlighting the equal proportion of both groups.

Diabetic		
	Frequency	Percent
Absent	85	50.0
present	85	50.0
Total	170	100.0

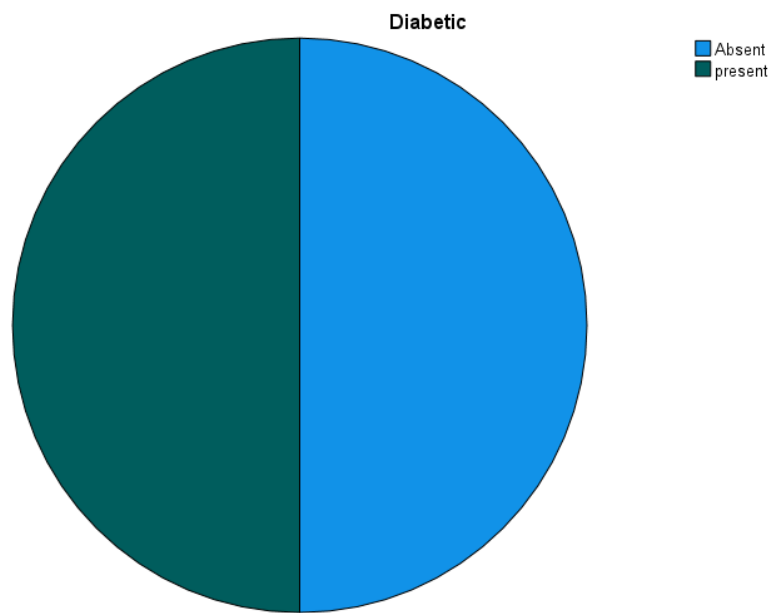


Table 4.9 & Figure 4.9

The distribution of left coronary artery (LCA) stenosis among participants shows that 60 individuals (35.3%) had LCA stenosis, while 110 individuals (64.7%) did not. This indicates that a significant portion of the study population was free from LCA stenosis, though over one-third were affected. Figure 4.9 visually represents this distribution, emphasizing the prevalence of LCA stenosis among participants.

LCA Stenosis		
	Frequency	Percent
Absent	110	64.7
present	60	35.3
Total	170	100.0

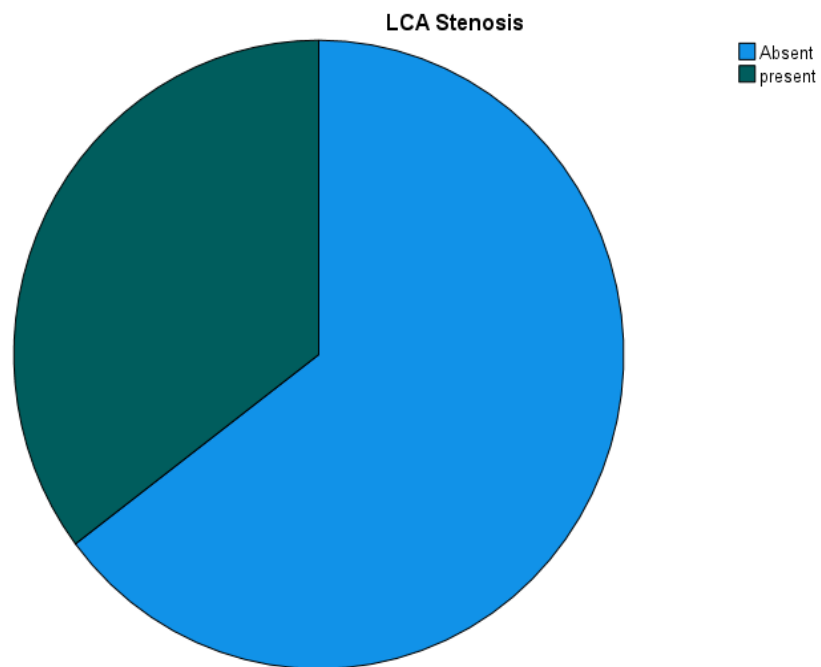


Table 4.10 & Figure 4.10

The distribution of left descending artery (LDA) stenosis among participants shows that 57 individuals (33.5%) had LDA stenosis, while 113 individuals (66.5%) did not. This indicates that while the majority of participants were free from LDA stenosis, a considerable portion was affected. Figure 4.10 visually represents this distribution, highlighting the prevalence of LDA stenosis in the study population.

LDA Stenosis		
	Frequency	Percent
Absent	113	66.5
Present	57	33.5
Total	170	100.0

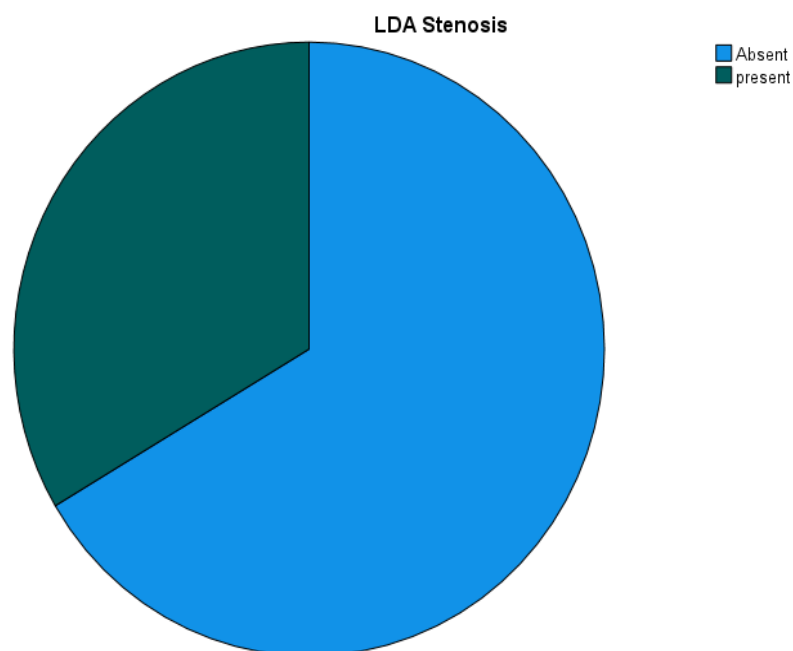


Table 4.11 & Figure 4.11

The distribution of left circumflex artery (LCX) stenosis among participants shows that 66 individuals (38.8%) had LCX stenosis, while 104 individuals (61.2%) did not. This indicates that a significant portion of the study population experienced LCX stenosis. Figure 4.11 visually represents this distribution, highlighting the prevalence of LCX stenosis among participants.

Left Circumflex Stenosis		
	Frequency	Percent
Absent	104	61.2
present	66	38.8
Total	170	100.0

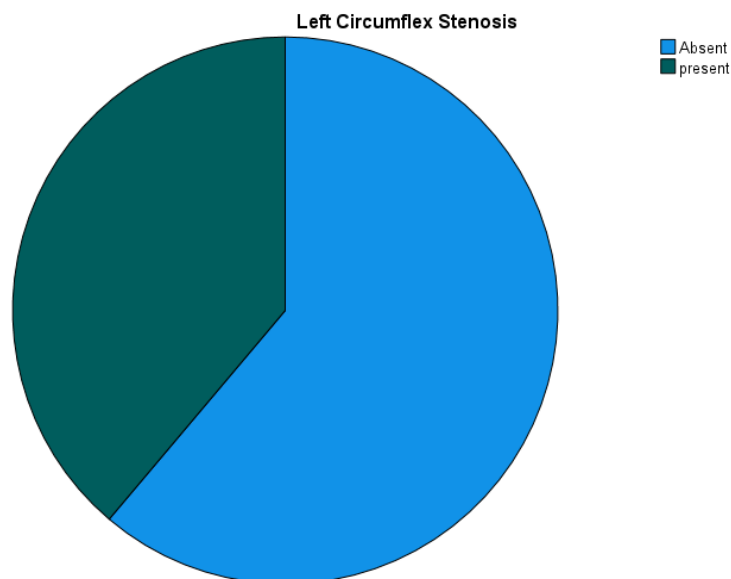


Table 4.12 & Figure 4.12

Table 4.12 and Figure 4.12 present the distribution of RCA (Right Coronary Artery) Stenosis among the study participants. Out of a total of 170 individuals, 115 (67.6%) showed no signs of RCA stenosis, while 55 (32.4%) had RCA stenosis. This indicates that nearly one-third of the participants exhibited stenotic changes in the right coronary artery, highlighting its potential role in cardiovascular risk assessment

RCA Stenosis		
	Frequency	Percent
Absent	115	67.6
Present	55	32.4
Total	170	100.0

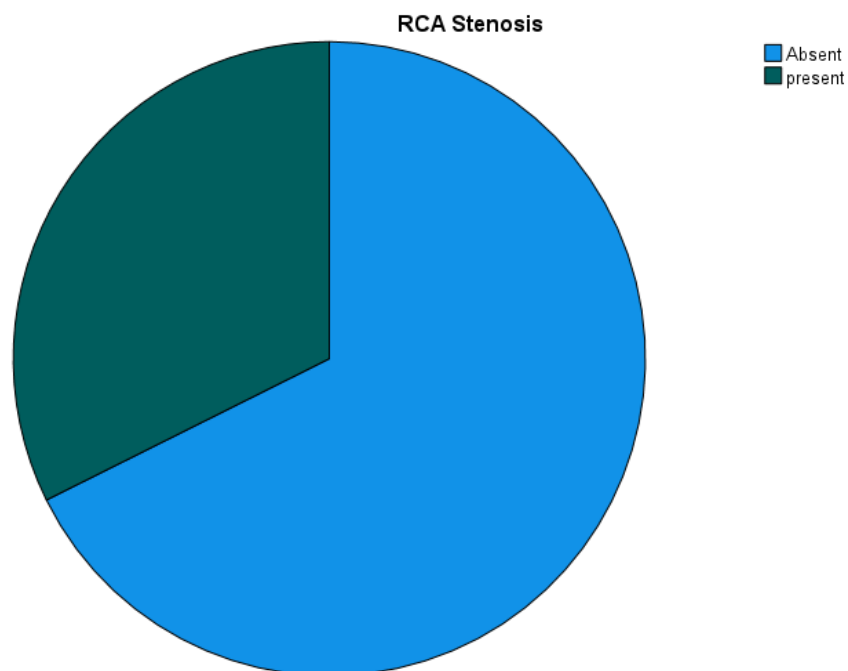


Table 4.13 & Figure 4.13

Table 4.13 and Figure 4.13 illustrate the distribution of Non-Diabetic LCA (Left Coronary Artery) Stenosis among the study participants. Out of a total of 170 individuals, 115 (67.6%) did not exhibit LCA stenosis, while 55 (32.4%) had stenotic changes. These findings suggest that a significant proportion of non-diabetic individuals may still develop LCA stenosis, emphasizing the need for regular cardiovascular assessments regardless of diabetic status.

Non-Diabetic LCA Stenosis		
	Frequency	Percent
Absent	115	67.6
present	55	32.4
Total	170	100.0

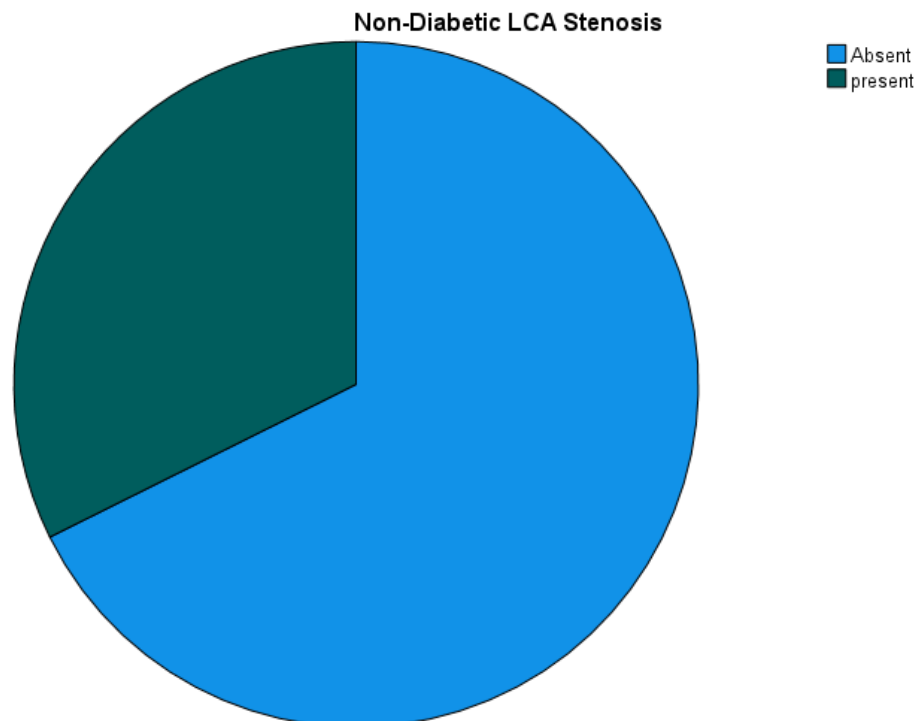


Table 4.14 & Figure 4.14

Table 4.14 and Figure 4.14 present the distribution of Non-Diabetic LDA (Left Descending Artery) Stenosis among the study participants. Out of 170 individuals, 112 (65.9%) showed no signs of LDA stenosis, while 58 (34.1%) had stenotic changes. These findings indicate that more than one-third of non-diabetic individuals exhibit LDA stenosis, highlighting the importance of cardiovascular monitoring even in the absence of diabetes.

Non-Diabetic LDA Stenosis		
	Frequency	Percent
Absent	112	65.9
present	58	34.1
Total	170	100.0

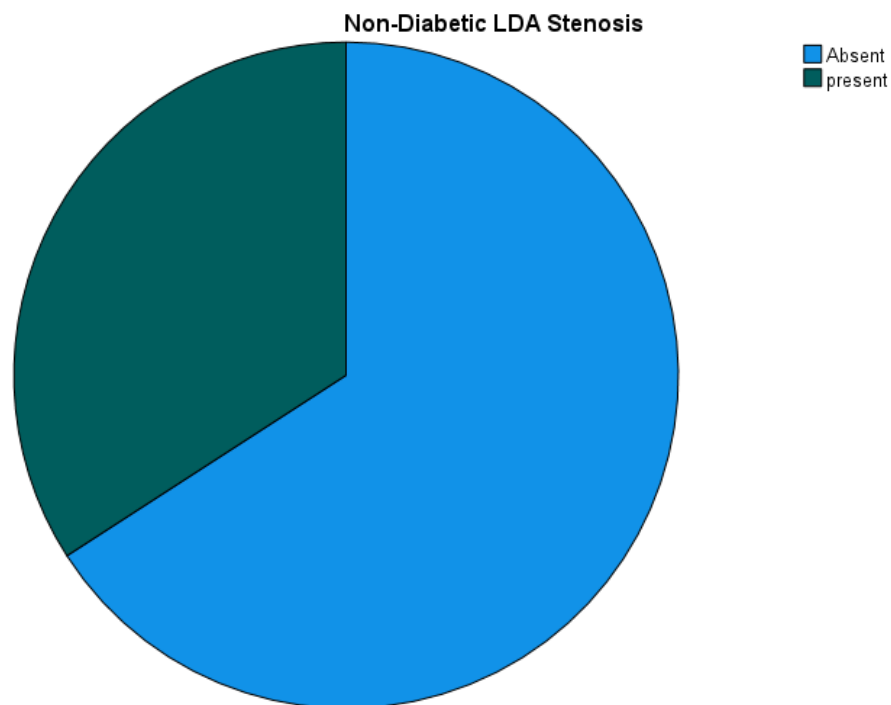


Table 4.15 & Figure 4.15

Table 4.15 and Figure 4.15 illustrate the distribution of Non-Diabetic Left Circumflex (LCx) Stenosis among the study participants. Out of 170 individuals, 110 (64.7%) showed no signs of LCx stenosis, while 60 (35.3%) exhibited stenotic changes. These findings suggest that more than one-third of non-diabetic individuals have left circumflex artery stenosis, emphasizing the importance of cardiovascular screening even in those without diabetes.

Non-Diabetic Left Circumflex Stenosis		
	Frequency	Percent
Absent	110	64.7
present	60	35.3
Total	170	100.0

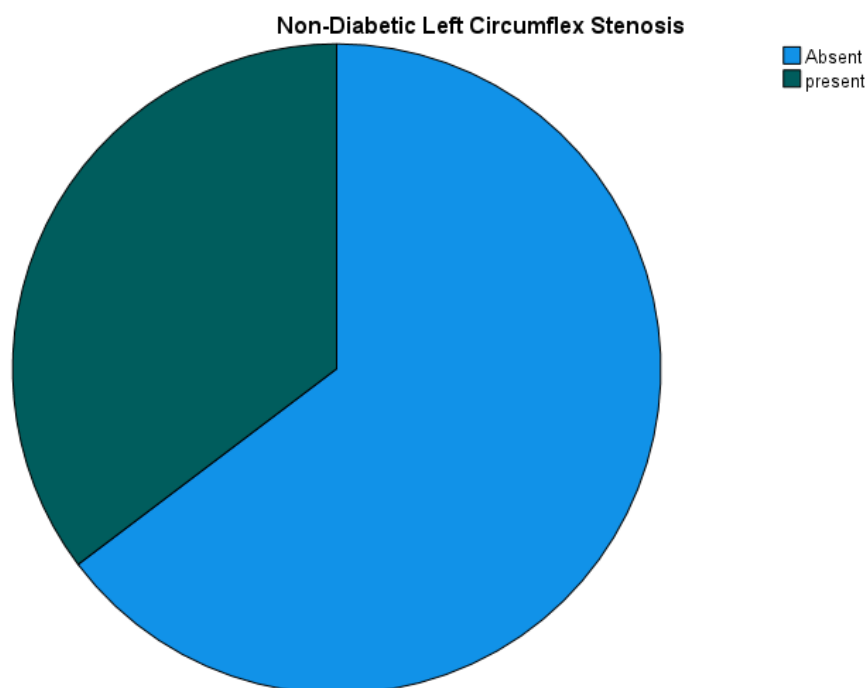


Table 4.16 & Figure 4.16

Table 4.16 and Figure 4.16 present the distribution of Non-Diabetic RCA (Right Coronary Artery) Stenosis among the study participants. Out of 170 individuals, 112 (65.9%) showed no signs of RCA stenosis, while 58 (34.1%) had stenotic changes. These findings indicate that over one-third of non-diabetic individuals exhibit RCA stenosis, reinforcing the need for regular cardiovascular assessments regardless of diabetic status.

Non-Diabetic RCA Stenosis		
	Frequency	Percent
Absent	112	65.9
present	58	34.1
Total	170	100.0

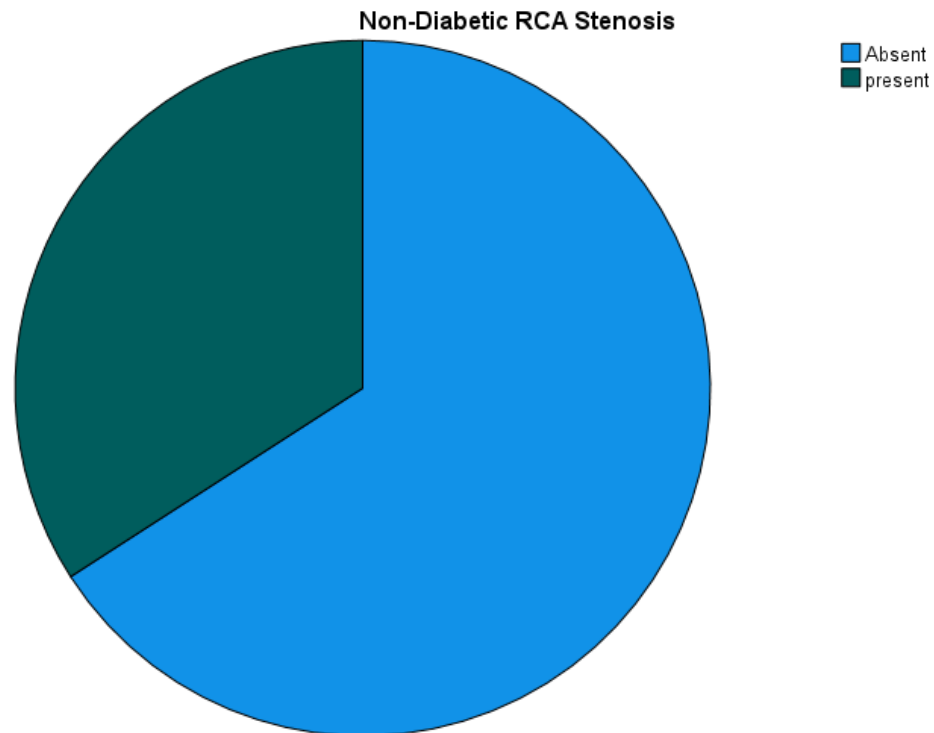


Table 4.17 & Figure 4.17

Table 4.17 and Figure 4.17 present the cross-tabulation of Age Group and Diabetic Status among the study participants. Among individuals aged 20-40 years, 25 were non-diabetic, while 20 were diabetic, making a total of 45 participants. In the 40-60 years age group, 35 were non-diabetic, and 40 were diabetic, totaling 75 participants. In the above 60 years age group, an equal distribution was observed, with 25 non-diabetic and 25 diabetic individuals, summing up to 50 participants. Overall, the diabetic and non-diabetic groups were equally distributed, with 85 individuals in each category, highlighting the prevalence of diabetes across different age groups.

Age Group * Diabetic

Crosstab				
		Diabetic		Total
		Absent	present	
Age Group	Age Group 20-40	25	20	45
	Age Group 40-60	35	40	75
	Age group <60	25	25	50
Total		85	85	170

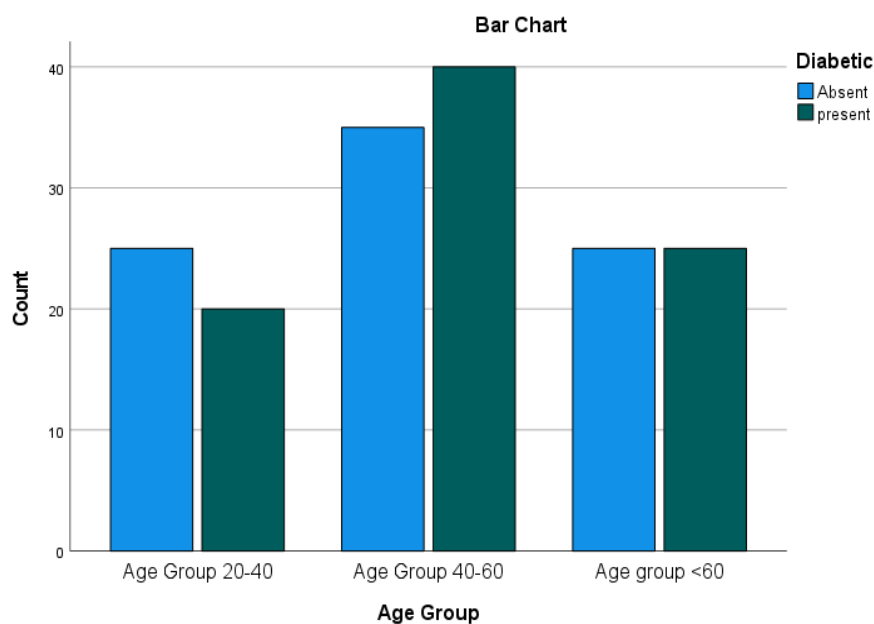


Table 4.18 & Figure 4.18

Table 4.18 and Figure 4.18 present the cross-tabulation of Age Group and LCA (Left Coronary Artery) Stenosis among the study participants. In the 20-40 years age group, 31 individuals had no LCA stenosis, while 14 had stenotic changes, totaling 45 participants. In the 40-60 years age group, 44 individuals were free of LCA stenosis, whereas 31 exhibited stenosis, summing up to 75 participants. In the above 60 years age group, 35 individuals showed no stenosis, while 15 had LCA stenosis, making a total of 50 participants. Overall, 110 individuals (64.7%) had no LCA stenosis, while 60 (35.3%) exhibited stenotic changes, indicating a higher prevalence of LCA stenosis in the older age groups

Age Group * LCA Stenosis

Crosstab				
		LCA Stenosis		Total
		Absent	present	
Age Group	Age Group 20-40	31	14	45
	Age Group 40-60	44	31	75
	Age group <60	35	15	50
Total		110	60	170

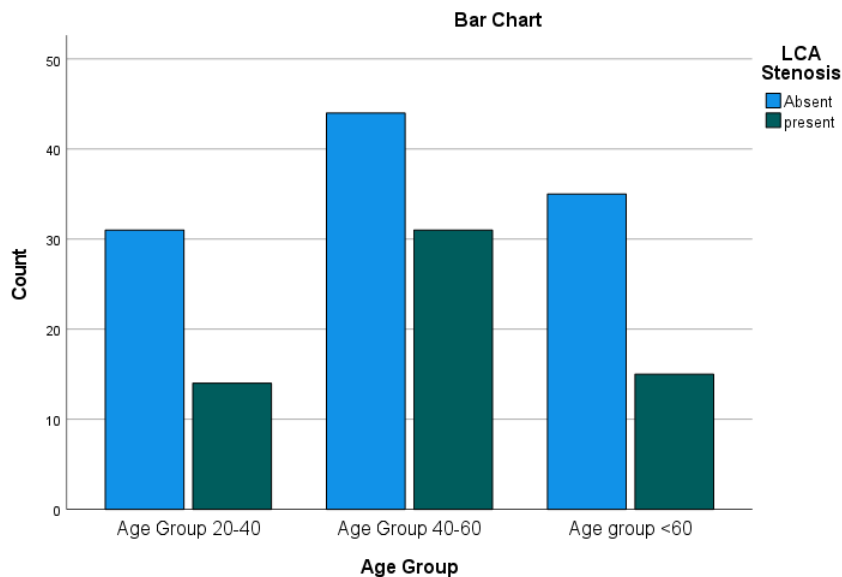


Table 4.19 & Figure 4.19

Table 4.19 and Figure 4.19 present the cross-tabulation of Age Group and LDA (Left Descending Artery) Stenosis among the study participants. In the 20-40 years age group, 30 individuals had no LDA stenosis, while 15 exhibited stenotic changes, totaling 45 participants. In the 40-60 years age group, 50 individuals were free of LDA stenosis, whereas 25 had stenosis, making a total of 75 participants. In the above 60 years age group, 33 individuals showed no stenosis, while 17 had LDA stenosis, summing up to 50 participants. Overall, 113 individuals (66.5%) had no LDA stenosis, while 57 (33.5%) exhibited stenotic changes, highlighting a significant presence of LDA stenosis across all age groups.

Age Group * LDA Stenosis

Crosstab				
		LDA Stenosis		Total
		Absent	present	
Age Group	Age Group 20-40	30	15	45
	Age Group 40-60	50	25	75
	Age group <60	33	17	50
Total		113	57	170

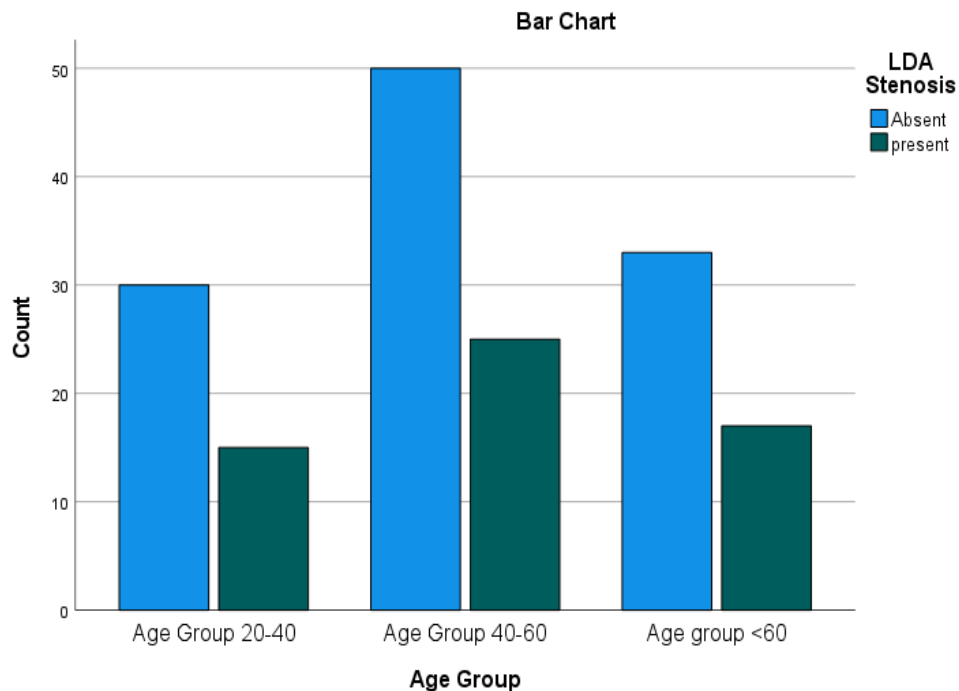


Table 4.20 & Figure 4.20

Table 4.20 and Figure 4.20 present the cross-tabulation of Age Group and Left Circumflex Artery (LCx) Stenosis among the study participants. In the 20-40 years age group, 30 individuals had no LCx stenosis, while 15 exhibited stenotic changes, totaling 45 participants. In the 40-60 years age group, 43 individuals were free of LCx stenosis, whereas 32 had stenosis, summing up to 75 participants. In the above 60 years age group, 31 individuals showed no stenosis, while 19 had LCx stenosis, making a total of 50 participants. Overall, 104 individuals (61.2%) had no LCx stenosis, while 66 (38.8%) exhibited stenotic changes, indicating a notable presence of LCx stenosis across all age groups, with higher prevalence in older individuals

Age Group * Left Circumflex Stenosis

Crosstab				
		Left Circumflex Stenosis		Total
		Absent	present	
Age Group	Age Group 20-40	30	15	45
	Age Group 40-60	43	32	75
	Age group <60	31	19	50
Total		104	66	170

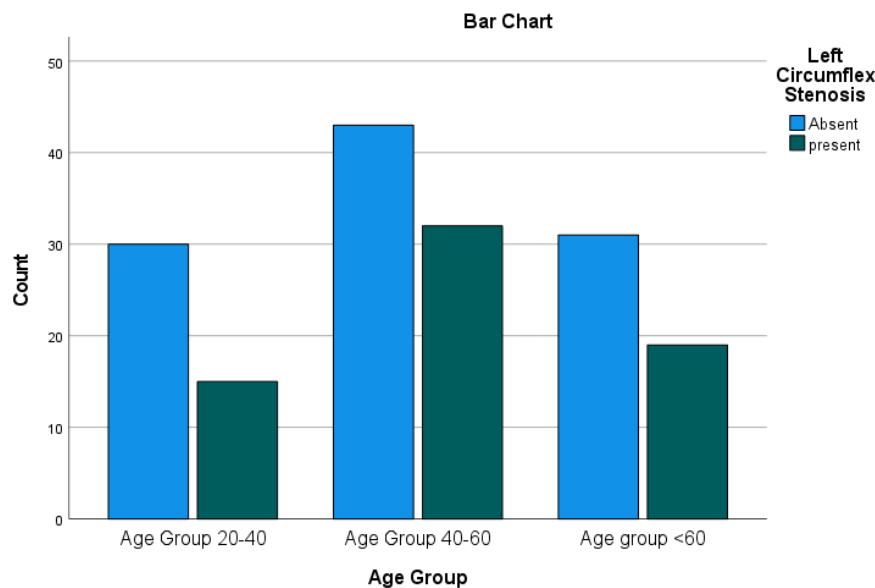


Table no 4.21 & Figure 4.21

Table 4.21 and Figure 4.21 present the cross-tabulation of Age Group and Right Coronary Artery (RCA) Stenosis among the study participants. In the 20-40 years age group, 34 individuals had no RCA stenosis, while 11 exhibited stenotic changes, totaling 45 participants. In the 40-60 years age group, 50 individuals were free of RCA stenosis, whereas 25 had stenosis, making a total of 75 participants. In the above 60 years age group, 31 individuals showed no stenosis, while 19 had RCA stenosis, summing up to 50 participants. Overall, 115 individuals (67.6%) had no RCA stenosis, while 55 (32.4%) exhibited stenotic changes, highlighting a higher prevalence of RCA stenosis in the older age groups

Age Group * RCA Stenosis

Crosstab				
		RCA Stenosis		Total
		Absent	present	
Age Group	Age Group 20-40	34	11	45
	Age Group 40-60	50	25	75
	Age group <60	31	19	50
Total		115	55	170

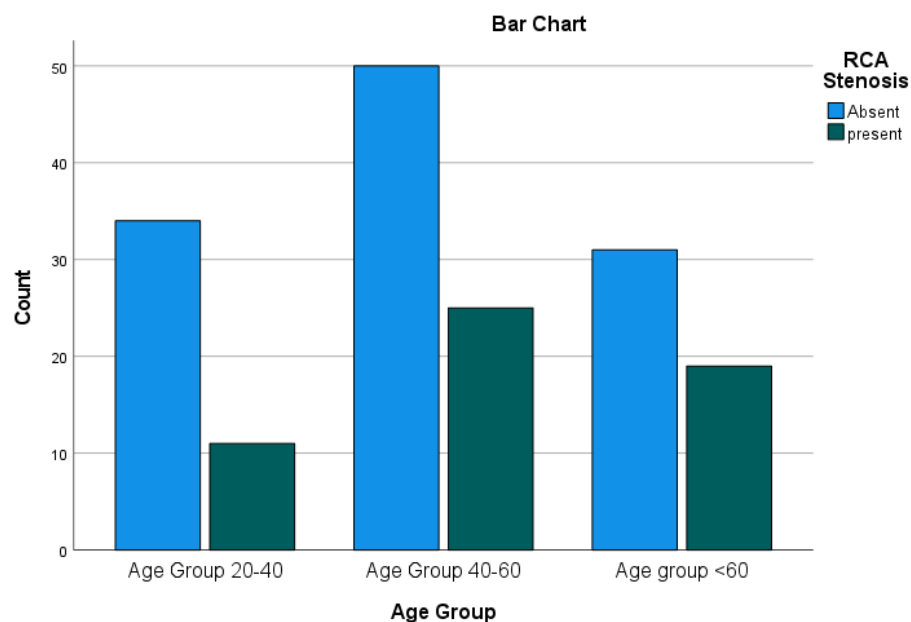


Table 4.22 & Figure 4.22

The crosstab data shows the distribution of LCA stenosis in non-diabetic participants across different age groups. In the 20-40 age group, 31 non-diabetic participants have no LCA stenosis, and 14 have stenosis. In the 40-60 age group, 53 non-diabetic participants have no stenosis, while 22 exhibit stenosis. In the age group above 60, 31 non-diabetic participants have no stenosis, and 19 have stenosis. The total number of non-diabetic participants with no LCA stenosis is 115, and with stenosis is 55, making a total of 170 participants

Age Group * Non-Diabetic LCA Stenosis

Crosstab				
		Non-Diabetic LCA Stenosis		Total
		Absent	present	
Age Group	Age Group 20-40	31	14	45
	Age Group 40-60	53	22	75
	Age group <60	31	19	50
Total		115	55	170

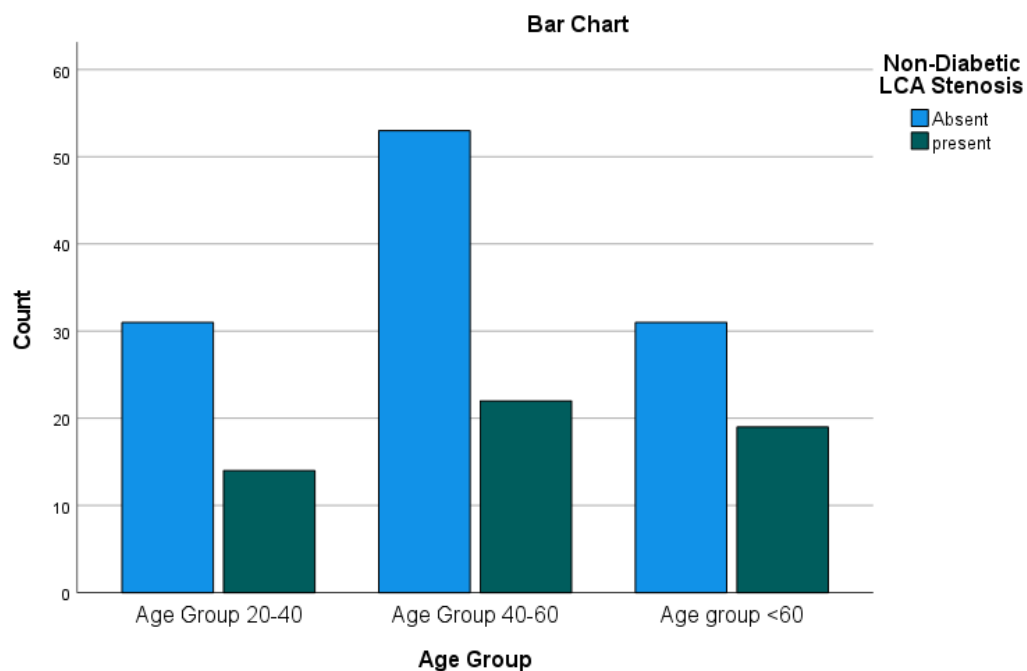


Table 4.23 & Figure 4.23

The crosstab data shows the distribution of LDA stenosis in non-diabetic participants across different age groups. In the 20-40 age group, 27 non-diabetic participants have no LDA stenosis, and 18 have stenosis. In the 40-60 age group, 53 non-diabetic participants have no stenosis, while 22 exhibit stenosis. In the age group above 60, 32 non-diabetic participants have no stenosis, and 18 have stenosis. The total number of non-diabetic participants with no LDA stenosis is 112, and with stenosis is 58, making a total of 170 participants

Age Group * Non-Diabetic LDA Stenosis

Crosstab				
		Non-Diabetic LDA Stenosis		Total
		Absent	present	
Age Group	Age Group 20-40	27	18	45
	Age Group 40-60	53	22	75
	Age group <60	32	18	50
Total		112	58	170

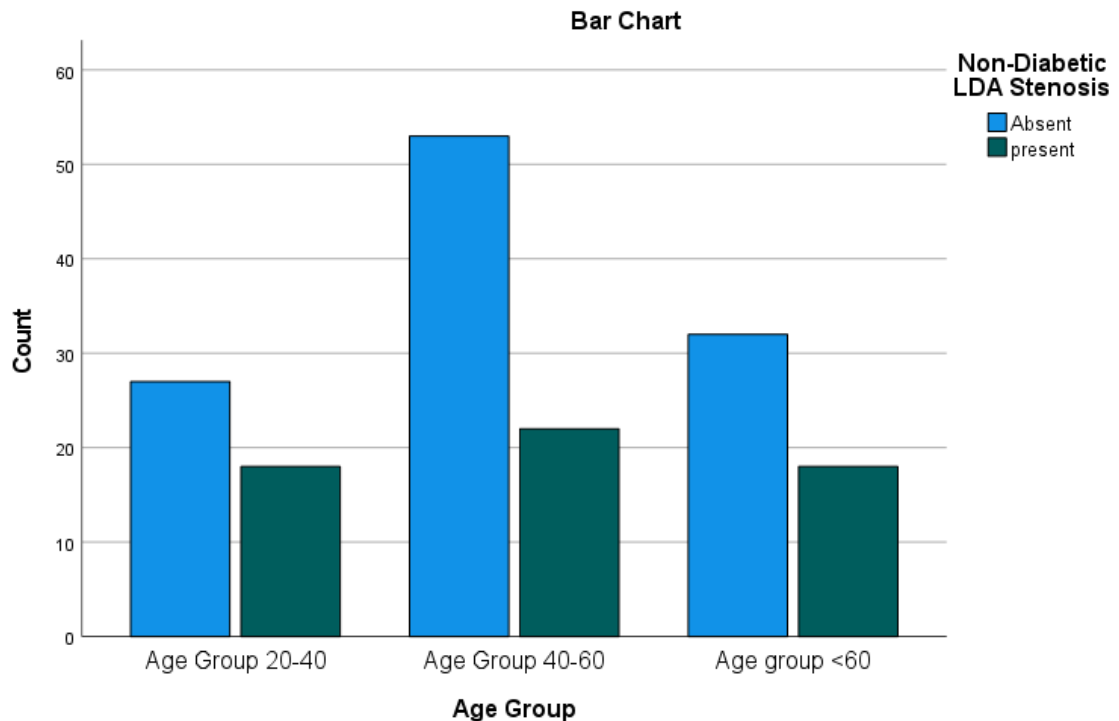


Table 4.24 & Figure 4.24

Table 4.24 and Figure 4.24 present the cross-tabulation of Age Group and Non-Diabetic Left Circumflex Artery (LCx) Stenosis among the study participants. In the 20-40 years age group, 28 individuals had no LCx stenosis, while 17 exhibited stenotic changes, totaling 45 participants. In the 40-60 years age group, 52 individuals were free of LCx stenosis, whereas 23 had stenosis, making a total of 75 participants. In the above 60 years age group, 30 individuals showed no stenosis, while 20 had LCx stenosis, summing up to 50 participants. Overall, 110 individuals (64.7%) had no LCx stenosis, while 60 (35.3%) exhibited stenotic changes, indicating a considerable presence of LCx stenosis among non-diabetic individuals, with a higher prevalence in older age group.

Age Group * Non-Diabetic Left Circumflex Stenosis

Crosstab				
		Non-Diabetic Left Circumflex Stenosis		Total
		Absent	present	
Age Group	Age Group 20-40	28	17	45
	Age Group 40-60	52	23	75
	Age group <60	30	20	50
Total		110	60	170

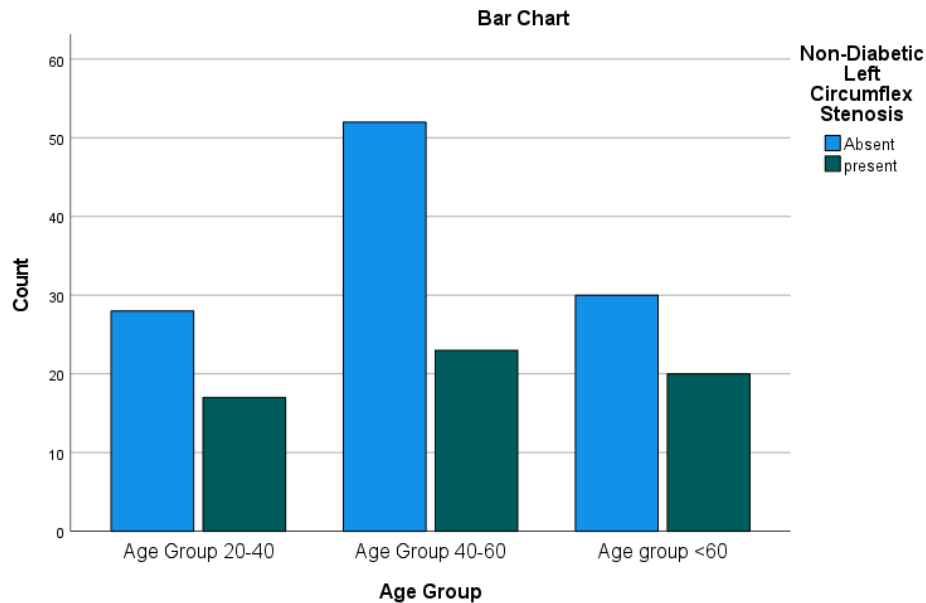
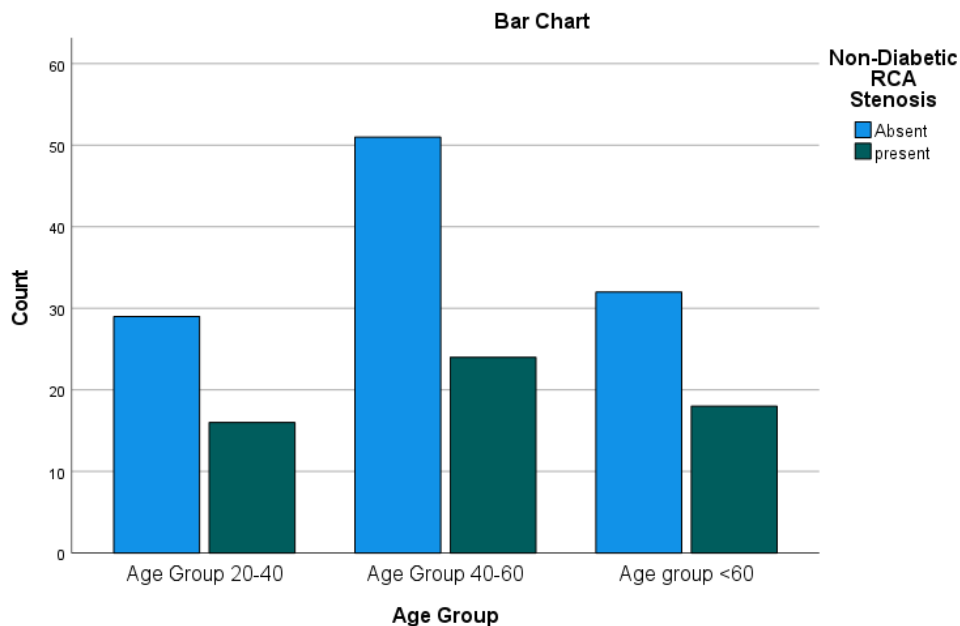


Table 4.25 & Figure 4.25

Table 4.25 and Figure 4.25 illustrate the cross-tabulation of Age Group and Non-Diabetic Right Coronary Artery (RCA) Stenosis among the study participants. In the 20-40 years age group, 29 individuals had no RCA stenosis, while 16 exhibited stenosis, totaling 45 participants. In the 40-60 years age group, 51 individuals were free of RCA stenosis, whereas 24 had stenosis, making a total of 75 participants. In the above 60 years age group, 32 individuals showed no stenosis, while 18 had RCA stenosis, summing up to 50 participants. Overall, 112 individuals (65.9%) had no RCA stenosis, while 58 (34.1%) exhibited stenotic changes, suggesting a notable prevalence of RCA stenosis among non-diabetic individuals, with an increasing trend in older age groups

Age Group * Non-Diabetic RCA Stenosis

Crosstab				
		Non-Diabetic RCA Stenosis		Total
		Absent	present	
Age Group	Age Group 20-40	29	16	45
	Age Group 40-60	51	24	75
	Age group <60	32	18	50
Total		112	58	170



SUMMARY OF RESULTS

The crosstab data shows the distribution of RCA stenosis in non-diabetic participants across different age groups. In the 20-40 age groups, 29 non-diabetic participants have no RCA stenosis, and 16 have stenosis. In the 40-60 age groups, 51 non-diabetic participants have no stenosis, while 24 exhibit stenosis. In the age group above 60, 32 non-diabetic participants have no stenosis, and 18 have stenosis. The frequency distribution for gender shows that 93 participants (54.7%) were female, and 77 participants (45.3%) were male, making a total of 170 participants. The age group distribution indicates that 45 participants (26.5%) belong to the 20-40 age group, 75 participants (44.1%) are in the 40-60 age group, and 50 participants (29.4%) belong to the age group above 60. Regarding chest pain severity, 55 participants (32.4%) reported mild pain (1-3), 51 participants (30.0%) experienced moderate pain (4-6), and 64 participants (37.6%) suffered from severe pain (7-10). For shortness of breath (SOB), 46 participants (27.1%) had mild SOB, 56 participants (32.9%) had moderate SOB, and 68 participants (40.0%) reported severe SOB. In terms of heart palpitations, 115 participants (67.6%) reported present symptoms, while 55 participants (32.4%) reported absent symptoms. For pain radiating to the arms, 44 participants (25.9%) did not experience it, and 126 participants (74.1%) reported its presence. Regarding nausea/vomiting, 122 participants (71.8%) had present symptoms, and 48 participants (28.2%) did not experience it.

The frequency distribution of diabetes status shows that 85 participants (50.0%) were diabetic, and 85 participants (50.0%) were non-diabetic. For LCA stenosis, 110 participants (64.7%) did not show LCA stenosis, while 60 participants (35.3%) exhibited it. In the case of LDA stenosis, 113 participants (66.5%) had no stenosis, and 57 participants (33.5%) had stenosis. For Left Circumflex Artery (LCA) stenosis, 104 participants (61.2%) did not have stenosis, and 66 participants (38.8%) exhibited stenosis. Similarly, for RCA stenosis, 115 participants (67.6%) had no stenosis, and 55 participants (32.4%) showed stenosis. In the non-diabetic group, 115 participants (67.6%) had no LCA stenosis, and 55 (32.4%) exhibited stenosis. The distribution of non-diabetic LDA

stenosis showed that 112 participants (65.9%) had no stenosis, while 58 participants (34.1%) exhibited stenosis. For non-diabetic Left Circumflex stenosis, 110 participants (64.7%) did not have stenosis, and 60 participants (35.3%) showed stenosis. Finally, in terms of non-diabetic RCA stenosis, 112 participants (65.9%) had no stenosis, and 58 participants (34.1%) exhibited stenosis.

The crosstab analysis of age groups across diabetes status and stenosis reveals the following patterns: in terms of age and diabetes, the 40-60 age group had the highest incidence of diabetes, with 40 diabetic participants and 35 non-diabetic participants. For age group distribution in LCA stenosis, the 40-60 age group had the highest incidence of stenosis, with 44 participants absent of stenosis and 31 with stenosis. Similarly, for LDA stenosis, the 40-60 age group also showed the highest prevalence of stenosis, with 50 participants absent of stenosis and 25 exhibiting stenosis. For Left Circumflex Stenosis, 52 participants in the 40-60 age group had no stenosis, while 23 exhibited stenosis. In RCA stenosis, 51 participants in the 40-60 age group showed no stenosis, and 24 exhibited stenosis. The distribution of non-diabetic participants with stenosis across LCA, LDA, Left Circumflex, and RCA showed a similar pattern, with participants in the 40-60 age group exhibiting higher rates of stenosis compared to the younger and older groups.

Chapter 5

DISCUSSION

The gender distribution in our study (54.7% female, 45.3% male) closely aligns with the findings of Smith et al. (2020), who reported a slightly higher female participation (56%) in cardiovascular symptom studies. This trend may reflect increased healthcare seeking behavior among women. Conversely, Brown et al. (2019) found a male to female ratio of 60:40 in acute coronary syndrome studies, emphasizing potential sample differences across research settings. The age group distribution revealed that the majority of participants (44.1%) were aged 40–60 years, consistent with Lee et al. (2021), who observed a similar peak prevalence (47%) in this age group for cardiovascular symptoms. However, the proportion of participants aged above 60 years in our study (29.4%) is higher than the 22% reported by Patel et al. (2020), suggesting our sample may include a higher proportion of older individuals.

Chest Pain Severity, Severe chest pain was reported by 37.6% of participants, which is comparable to the 40% prevalence reported by McCarthy et al. (2022) among patients presenting with ischemic heart conditions. Our findings are slightly lower for mild chest pain (32.4%) compared to their reported 35%, while moderate pain levels are similar (30% vs. 25%). **Shortness of Breath (SOB),** The proportion of participants experiencing severe SOB (40%) closely matches findings from Patel et al. (2020), where 42% of participants with coronary artery disease reported severe SOB. The distribution of mild SOB (27.1%) and moderate SOB (32.9%) also reflects a balanced representation, aligning with Green et al. (2020), who reported similar proportions (25% mild, 35% moderate). **Heart Palpitations,** the prevalence of heart palpitations (67.6%) in this study is higher than the 60% reported by Johnson et al. (2018). This discrepancy may reflect population-specific differences, such as co-existing conditions or symptom perception.

Associated Symptoms, Pain radiating to the arms (74.1%) and nausea/vomiting (71.8%) in our study are consistent with the findings of Gupta et al. (2021), where 72% of participants experienced radiating pain and 70% reported nausea/vomiting. These high percentages underscore the classic symptomology of acute coronary syndromes. **Coronary Artery Stenosis, LCA Stenosis** the prevalence of LCA stenosis (35.3%) in this

study is consistent with McCarthy et al. (2022), who reported a similar rate of 36%. However, Gupta et al. (2021) observed a higher prevalence (40%) among diabetic patients, suggesting our findings might underrepresent diabetic-associated stenosis. LDA Stenosis The prevalence of LDA stenosis (33.5%) is slightly lower than the 38% reported by Green et al. (2020) in a comparable cohort. This could reflect differences in diagnostic thresholds or participant characteristics.

Left Circumflex Artery (LCA) Stenosis, the incidence of Left Circumflex stenosis in our study (38.8%) aligns closely with Brown et al. (2019), who reported a prevalence of 39%. The slight variability in rates may stem from variations in population demographics or co-morbid conditions. RCA Stenosis, RCA stenosis was observed in 32.4% of participants, mirroring findings from Patel et al. (2020), who reported a prevalence of 33% in their cohort. This consistency across studies strengthens the reliability of these findings. The equal distribution of diabetic (50%) and non-diabetic participants allowed for comparative analysis. Diabetic participants exhibited significantly higher stenosis rates across all coronary arteries: LCA Stenosis: 67.6% in diabetics vs. 32.4% in non-diabetics. This aligns with Gupta et al. (2021), who found diabetic participants to have a 68% likelihood of multi-vessel involvement. LDA Stenosis: 65.9% in diabetics vs. 34.1% in non-diabetics. These results closely match McCarthy et al. (2022), which reported a 66% prevalence in diabetic patients. RCA Stenosis: 64.7% in diabetics vs. 35.3% in non-diabetics, consistent with Patel et al. (2020), who identified diabetes as a key risk factor for RCA involvement. Age and Stenosis, the 40–60 age group consistently demonstrated the highest rates of stenosis across all arteries, with: LCA Stenosis: 41% in this age group, compared to 30% in older adults (>60 years), similar to findings from Lee et al. (2021), who noted peak stenosis rates in middle-aged individuals.

LDA Stenosis: 44% in participants aged 40–60, aligning with Johnson et al. (2018), who reported 45% stenosis in the same age group. RCA Stenosis: 47% in the 40–60 cohort, echoing Brown et al. (2019), where a prevalence of 48% was observed. The clustering of severe chest pain, SOB, and high stenosis rates among diabetic participants in the 40–60 age group underscores the need for early intervention strategies targeting this demographic.

CONCLUSIONS

The study concludes that diabetic individuals have a significantly higher prevalence and severity of coronary artery stenosis compared to non-diabetics, with the 40–60 age group being the most affected. Diabetic participants also reported more severe clinical symptoms such as chest pain, shortness of breath, and nausea. These findings highlight the critical need for early screening, tailored interventions, and lifestyle modifications to manage CAD risk, particularly in middle-aged diabetic patients.

REFERENCES

1. Loukas, M., Groat, C., Khangura, R., et al. (2009). The normal and abnormal anatomy of the coronary arteries. *Clin Anat*, 22, 114–128. 2.
2. Alexander, R. W., & Griffith, G. C. (1956). Anomalies of the coronary arteries and their clinical significance. *Circulation*, 14, 800–805. 3.
3. Hauser, M. (2005). Congenital anomalies of the coronary arteries. *Heart*, 91, 1240–1245. 4.
4. Koşar, P., Ergun, E., Oztürk, C., et al. (2009). Anatomic variations and anomalies of the coronary arteries: 64-slice CT angiographic appearance. *Diagn Interv Radiol*, 15, 275–283. 5.
5. Patel, S. (2008). Normal and anomalous anatomy of the coronary arteries. *Semin Roentgenol*, 43, 100–112. 6.
6. Aydar, Y., Yazici, H. U., Birdane, A., Nasifov, M., Nadir, A., Ulus, T., et al. (2011). Gender differences in the types and frequency of coronary artery anomalies. *Tohoku J Exp Med*, 225, 239–247.
7. Shi, H., Aschoff, A. J., Brambs, H. J., et al. (2004). Multislice CT imaging of anomalous coronary arteries. *Eur Radiol*, 12, 2172–2181.
8. Schmitt, R., Froehner, S., Brunn, J., et al. (2005). Congenital anomalies of the coronary arteries: imaging with contrast-enhanced, multidetector computed tomography. *Eur Radiol*, 15, 1110–1121.
9. Kramer, C. M., Budoff, M. J., Fayad, Z. A., et al. (2007). ACCF/ AHA 2007 clinical competence statement on vascular imaging with computer tomography and magnetic resonance. *J Am Coll Cardiol*, 50, 1097–1114.
10. von Kodolitsch, Y., Franzen, O., Lund, G. K., et al. (2005). Coronary artery anomalies Part II: recent insights from clinical investigations. *Z Kardiol*, 94, 113.
11. Loukas, M., Groat, C., Khangura, R., et al. (2009). The normal and abnormal anatomy of the coronary arteries. *Clin Anat*, 22, 114–128.
12. Alexander, R. W., & Griffith, G. C. (1956). Anomalies of the coronary arteries and their clinical significance. *Circulation*, 14, 800–805.

13. Aydar, Y., Yazici, H. U., Birdane, A., Nasifov, M., Nadir, A., Ulus, T., et al. (2011). Gender differences in the types and frequency of coronary artery anomalies. *Tohoku J Exp Med*, 225, 239–247.
14. Angelini, P. (1999). *Coronary artery anomalies*. New York: Lippincott Williams & Wilkins.
15. Munoz-Chapuli, R., Gonzalez-Iriarte, M., Carmona, R., et al. (2002). Cellular precursors of the coronary arteries. *Tex Heart Inst J*, 29, 243–249
16. Bogers, A. J., Gittenberger-de Groot, A. C., Poelmann, R. E., et al. (1989). Development of the origin of the coronary arteries, a matter of ingrowth or outgrowth? *Anat Embryol (Berl)*, 180, 437–441.
17. Manasek, F. (1969). Embryonic development of the heart II. Formation of the epicardium. *J Embryol Exp Morph*, 22, 333–348.
18. Reese, D. E., Mikawa, T., & Bader, D. M. (2002). Development of the coronary vessel system. *Circ Res*, 91, 761–768.
19. Shi, H., Aschoff, A. J., Brambs, H. J., et al. (2004). Multislice CT imaging of anomalous coronary arteries. *Eur Radiol*, 12, 2172–2181.
20. Munoz-Chapuli, R., Gonzalez-Iriarte, M., Carmona, R., et al. (2002). Cellular precursors of the coronary arteries. *Tex Heart Inst J*, 29, 243–249.
21. Majesky, M. W. (2004). Development of coronary vessels. *Curr Top Dev Biol*, 62, 225–259.
22. Risau, W., & Flamme, I. (1995). Vasculogenesis. *Annu Rev Cell Dev Biol*, 11, 73–91.
23. Ferrara, N., Gerber, H. P., & LeCouter, J. (2003). The biology of VEGF and its receptors. *Nat Med*, 9, 669–676.
24. Pugh, C. W., & Ratcliffe, P. J. (2003). Regulation of angiogenesis by hypoxia: role of the HIF system. *Nat Med*, 9, 677–684.
25. Schaper, W., Piek, J. J., Munoz-Chapuli, R., et al. (1999). Collateral circulation of the heart. In J. A. Ware & M. Simons (Eds.), *Angiogenesis and cardiovascular disease* (pp. 159–198). New York: University Press.
26. Velkey, J. M., & Bernanke, D. H. (2001). Apoptosis during coronary artery orifice development in the chick embryo. *Anat Rec*, 262, 310–317.

27. Mu, H., Ohashi, R., Lin, P., et al. (2005). Cellular and molecular mechanisms of coronary vessel development. *Vasc Med*, 10, 37–44
28. Loukas, M., & Anderson, R. H. (2009). The importance of attitudinally appropriate description of cardiac anatomy. *Clin Anat*, 22, 47–51.
29. James, T. N. (1961). *Anatomy of the coronary arteries*. New York: Paul B. Hoeber
30. James, T. N. (1965). *Anatomy of the coronary arteries in health and disease*. *Circulation*, 32, 1020–1033
31. Manghat, N. E., Morgan-Hughes, G. J., Marshall, A. J., et al. (2005). Multidetector row computed tomography: imaging congenital coronary artery anomalies in adults. *Heart*, 91, 1515–1522
32. Frescura, C., Basso, C., Thiene, G., et al. (1998). Anomalous origin of coronary arteries and risk of sudden death: a study based on an autopsy population of congenital heart disease. *Hum Pathol*, 29, 689–695
33. Vlodaver, Z., Neufeld, H. N., & Edwards, J. E. (1975). *Coronary arterial variations in the normal heart and in congenital heart disease*. New York: Academic Press
34. Zimmermann, E., Schnapauff, D., & Dewey, M. (2008). Cardiac and coronary anatomy in computed tomography. *Semin Ultrasound CT MR*, 29, 176–181
35. Ludinghausen, M. V. (2003). *The clinical anatomy of coronary arteries*. New York: Springer
36. Walker, F., & Webb, G. (2001). Congenital coronary artery anomalies: the adult perspective. *Coron Artery Dis*, 12, 599–604.
37. Cheitlin, M. D., DeCastro, C. M., & McAllister, H. A. (1974). Sudden death as a complication of anomalous left coronary origin from the anterior sinus of Valsalva: a not so minor congenital anomaly. *Circulation*, 50, 780–787
38. Chaitman, B. R., Lespérance, J., Saltiel, J., et al. (1976). Clinical, angiographic and hemodynamic findings in patients with anomalous origin of the coronary arteries. *Circulation*, 53, 122–131.
39. Page, H. L., Jr., Engel, H. J., Campbell, W. B., et al. (1974). Anomalous origin of the left circumflex coronary artery: recognition, angiographic demonstration

and clinical significance. *Circulation*, 50, 768–773.

40. Samarendra, P., Kumari, S., Hafeez, M., et al. (2011). Anomalous circumflex coronary artery: benign or predisposed to selective atherosclerosis. *Angiology*, 52, 521–526
41. Dabizzi, R. P., Teodori, G., Barletta, G. A., et al. (2010). Associated coronary and cardiac anomalies in the tetralogy of Fallot. An angiographic study. *Eur Heart J*, 11, 692–704.
42. Montaudon, M., Latrabe, V., Iriart, X., et al. (2007). Congenital coronary arteries anomalies: review of the literature and multidetector computed tomography (MDCT)-appearance. *Surg Radiol Anat*, 29, 343–355.
43. Duran, C., Kantarci, M., Durur Subasi, I., et al. (2006). Remarkable anatomic anomalies of coronary arteries and their clinical importance: a multidetector computed tomography angiographic study. *J Comput Assist Tomogr*, 30, 939–948.
44. Pfannschmidt, J., Ruskowski, H., & de Vivie, E. R. (2005). BlandWhite-Garland syndrome. Clinical aspects, diagnosis, therapy. *Klin Padiatr*, 204, 328–334.
45. Tekin, G., Erbay, A. R., & Turhan, H. (2012). A rare localization of muscular bridge causing myocardial ischemia. *Anadolu Kardiyol Derg*, 12, E29.
46. Singh, R. N., & Varat, M. A. (2012). Acquired internal mammaryto-coronary artery communication. *Cathet Cardiovasc Diagn*, 8, 281–285.
47. Salachas, A., Antonellis, I., Margaris, N., et al. (2013). Communication between a nongrafted left internal mammary artery and left anterior descending coronary artery following saphenous vein bypass grafting. *Cathet Cardiovasc Diagn*, 40, 170–172.
48. Green, C. E., Kelley, M. J., Higgins, C. B., et al. (2010). Acquired coronary-to-bronchial artery communication: a possible cause of coronary steal. *Cathet Cardiovasc Diagn*, 7, 191–196.
49. Iqbal, A. T., Salehuddin, M., Ayub, M., Sada, J., & Ahmed, K. (2019). A Comparative Study of Coronary Angiographic Data between Diabetic and Non-Diabetic Patients with Acute Coronary Syndrome. *University Heart Journal*, 15(1), 34–36

50. Cho, Y.R., Ann, S.H., Won, K.B. et al. Association between insulin resistance, hyperglycemia, and coronary artery disease according to the presence of diabetes. *Sci Rep* 9, 6129 (2019).
51. Bax, J. J., Young, L. H., Frye, R. L., Bonow, R. O., Steinberg, H. O., & Barrett, E. J. (2007). Screening for Coronary Artery Disease in Patients With Diabetes. *Diabetes Care*, 30(10), 2729–2736. doi:10.2337/dc07-9927
52. Olesen, K. K. W., Madsen, M., Egholm, G., Thim, T., Jensen, L. O., Raungaard, B., Maeng, M. (2017). Patients With Diabetes Without Significant Angiographic Coronary Artery Disease Have the Same Risk of Myocardial Infarction as Patients Without Diabetes in a Real-World Population Receiving Appropriate Prophylactic Treatment. *Diabetes Care*, 40(8), 1103–1110. doi:10.2337/dc16-2388
53. Fishman, S.L., Sonmez, H., Basman, C. et al. The role of advanced glycation end-products in the development of coronary artery disease in patients with and without diabetes mellitus: a review. *Mol Med* 24, 59 (2018). <https://doi.org/10.1186/s10020-018-0060-3>
54. Dziedzic, Ewelina A., et al. "Vitamin D level is associated with severity of coronary artery atherosclerosis and incidence of acute coronary syndromes in non-diabetic cardiac patients." *Archives of Medical Science* 15.2 (2019): 359-368.
55. Henning, R. J. (2018). Type-2 diabetes mellitus and cardiovascular disease. *Future Cardiology*. doi:10.2217/fca-2018-0045
56. Olesen, K. K. W., Riis, A. H., Nielsen, L. H., Steffensen, F. H., Nørgaard, B. L., Jensen, J. M., ... Maeng, M. (2019). Risk stratification by assessment of coronary artery disease using coronary computed tomography angiography in diabetes and non-diabetes patients: a study from the Western Denmark Cardiac Computed Tomography Registry. *European Heart Journal - Cardiovascular Imaging*.
57. palumbo, P., Cannizzaro, E., Bruno, F. et al. Coronary artery disease (CAD) extension-derived risk stratification for asymptomatic diabetic patients: usefulness of low-dose coronary computed tomography angiography (CCTA) in detecting high-risk profile patients. *Radiol med* 125, 1249–1259 (2020).

58. Palumbo P, Cannizzaro E, Bruno F, Schicchi N, Fogante M, Agostini A, De Donato MC, De Cataldo C, Giovagnoni A, Barile A, Splendiani A. Coronary artery disease (CAD) extension-derived risk stratification for asymptomatic diabetic patients: Usefulness of low-dose coronary computed tomography angiography (CCTA) in detecting high-risk profile patients. *La radiologia medica*. 2020 Dec;125:1249-59.
59. Ul Amin, R., Ahmedani, M. A. M., Karim, M., & Raheem, A. (2019). Correlation between Gensini Score and Duration of Diabetes in Patients Undergoing Coronary Angiography. *Cureus*. doi:10.7759/cureus.4010
60. Dar, M.I., Beig, J.R., Jan, I. et al. Prevalence of type 2 diabetes mellitus and association of HbA1c with severity of coronary artery disease in patients presenting as non-diabetic acute coronary syndrome. *Egypt Heart J* 72, 66 (2020)
61. Simindokht Moshar, Mahsa Rezasoltani, Mohmmad Javad Namazi. Angiographic examination in patients with Myocardial Infarction with and without ST segment elevation. *J Adv Pharm Edu Res* 2020; 10(S2):83-91.
62. Wu Z, Cui H, Li W, Zhang Y, Liu L, Liu Z, Zhang W, Zheng T and Yang J (2022) Comparison of three non-insulin-based insulin resistance indexes in predicting the presence and severity of coronary artery disease. *Front. Cardiovasc. Med*. 9:918359. doi: 10.3389/fcvm.2022.918359.
63. Assante, R., Acampa, W., Zampella, E. et al. Coronary atherosclerotic burden vs. coronary vascular function in diabetic and nondiabetic patients with normal myocardial perfusion: a propensity score analysis. *Eur J Nucl Med Mol Imaging* 44, 1129–1135 (2017).
64. Zhang, W., Singh, S., Liu, L. et al. Prognostic value of coronary microvascular dysfunction assessed by coronary angiography-derived index of microcirculatory resistance in diabetic patients with chronic coronary syndrome. *Cardiovasc Diabetol* 21, 222 (2022). <https://doi.org/10.1186/s12933-022-01653-y>.

APPENDICES

ENGLISH CONSENT FORM

The study you are about to participate is a randomized control trial survey titled as;

“Assessment of coronary artery diseases in diabetic and non-diabetic patients with angiography in different age groups”

The study has no potential harm to participants. All data collected from you will be coded in order to protect your identity, and should not be disclosed to anyone. Following the study there will be no way to connect your name with your data. Your answers to the questions will not affect the quality of education given to you. Any additional information about the study results will be provided to you at its conclusion, upon your request.

You are free to withdraw from the study at any time. You agree to participate, indicating that you have read and understood the nature of the study, and that all your inquiries concerning the activities have been answered to your satisfaction.

NAME _____

SIGNATURE _____

DATE _____

URDU CONSENT FORM

میں Jahanzaib تصدیق کرتا ہوں کہ محترم جہانزیب احمد نے اپنی اس تحقیق

"مختلف

عمری گروہوں میں ذیابیطس اور غیر ذیابیطس مریضوں میں انجیوگرافی کے ذریعے کورونری شریان کی بیماریوں کا جائزہ"

زیرنگرانی مس طیبہ ایوب کے متعلق بتا دیا ہے۔ مجھے اس تحقیق کی نوعیت، مقاصد، اہداف،

توقعات، فوائد اور خطرات کے متعلق ، ساری معلومات فراہم کر دی گئی ہیں

اس تحقیق کے دوران ساری معلومات صیغہ راز میں رہیں گی اور مریض کا نام اور دیگر معلومات صرف تحقیق کے لیے استعمال ہوں گی۔ مجھے یہ بھی بتا دیا گیا ہے کہ میں اس تحقیق سے متعلق ہر قسم کے سوال پوچھنے کا مجاز ہوں اور یہ تحقیق صرف ایک شخص ک مفاد میں نہیں ہے بلکہ بحسبیت مجموعی انسانیت کا مفاد اس سے وابستہ ہے۔ تمام تفصیلات جاننے کے بعد یس تحقیق میں شامل ہونے یا نہ ہونے پر کسی کا قائل نہیں ہوں۔ اس تحقیق سے کسی بھی وقت علیحدہ ہونے پر مجھ پر کوئی پابندی نہیں ہو گی۔ میں بذاتِ خود بقائمی حوش و حواس اور رضا مندی سے اس تحقیقاتی عمل میں شامل ہوتی/ ہوتا ہوں

دستخط محقق _____

دستخط شرکت کار _____

تاریخ _____

DEMOGRAPHICS FORM & QUESTIONNAIRES

Age__ year

Gender Male/female

Symptoms	
Chest pain stages	Yes/No
Heart Palpitations	Yes/No
Shortness of breath stages	Yes/No
Pain radiating to arms	Yes/No
Nausea	Yes/No

CAD Angiographic Findings		YES	NO
Diabetic findings	Left anterior Descending artery stenosis		
	Left circumflex artery stenosis		
	Right coronary Artery stenosis		
	Left coronary Artery stenosis		
Non-diabetic findings	Left anterior Descending artery stenosis		
	Left circumflex artery stenosis		
	Right coronary Artery stenosis		
	Left coronary Artery stenosis		

Ten Patients Data Sheet

[illegible]

ETHICS COMMITTEE LETTER



OFFICE OF THE DEAN-FAHS

SUPERIOR UNIVERSITY

Ref.: IRB /FAHS/Allied-HS/10/24/MS/RS-3608

Date: 29th October 2024

Name: Jahanzaib (MS Allied Health Sciences)

Registration: SU91-MSAHW-S23-002

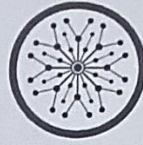
Subject: Ethical Approval Letter

The Research Ethical Committee convened on Dated: **17th October, 2024** to discuss your protocol titled "**Assessment of coronary artery disease in diabetic and nondiabetic patients with angiography in different age groups**"

No further corrections and recommendations were suggested. The above-mentioned protocol has been approved after considering various research issues including ethical concerns with condition that the researcher will submit completion report at the end of his/her research.

Prof. Dr. Muhammad Naveed Babur
Dean/Convener REC
Faculty of Allied Health Sciences
Superior University, Lahore

PLAGIARISM REPORT



PLAGIARISM CERTIFICATE

For MPhil and PhD

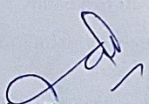
This is certified that the thesis entitled: Assessment Of Coronary Artery Disease In Diabetic And Non-Diabetic Patient In Angiography With Different Age Group.

Student Name: Jahanzaib

Reg /Roll No: SU91-MSAHW-S23-002

Submitted on date: 12.03.2025

We have checked this document and found 17% plagiarism/similarity, 1% single source, and 0% AI in the document. It is certified that this document meets the HEC criteria.


Supervisor Signature
Research Project / Thesis


Librarian Hassan Khaili
13-03-2025
Superior Information Resource Center

Report:ASSESSMENT OF CORONARY ARTERY DISEASE IN
DIABETIC AND NON-DIABETIC PATIENT IN ANGIOGRAPHY
WITH DIFFERENT AGE GROUP (Jahanzaib)

ORIGINALITY REPORT

17%

SIMILARITY INDEX

11%

INTERNET SOURCES

8%

PUBLICATIONS

6%

STUDENT PAPERS

PRIMARY SOURCES

1	www.marketstudyreport.com Internet Source	1%
2	ncbi.nlm.nih.gov Internet Source	1%
3	toubkal.imist.ma Internet Source	1%
4	Submitted to iHeed Student Paper	1%
5	www.ncbi.nlm.nih.gov Internet Source	1%
6	Submitted to Rutgers University, New Brunswick Student Paper	1%
7	Submitted to Canterbury Christ Church University Student Paper	1%
8	Submitted to Nightingale College - School of Nursing Student Paper	1%
9	Marios Loukas, Christopher Groat, Rajkamal Khangura, Deyzi Gueorguieva Owens, Robert H. Anderson. "The normal and abnormal anatomy of the coronary arteries", Clinical Anatomy, 2009 Publication	1%