PREVALENCE, ANGIOGRAPHIC FINDINGS, AND RISK FACTORS FOR PREMATURE CORONARY ARTERY DISEASE IN PATIENTS UNDERGOING CORONARY ANGIOGRAPHY IN KENYATTA NATIONAL HOSPITAL, NAIROBI, KENYA

SALAT AHMED ABDI

MASTER OF MEDICINE IN
INTERNAL MEDICINE

JOMO KENYATTA UNIVERSITY
OF
AGRICULTURE AND TECHNOLOGY

2025

Prevalence, Angiographic Findings, and Risk Factors for Premature Coronary Artery Disease in Patients Undergoing Coronary Angiography in Kenyatta National Hospital, Nairobi, Kenya

Salat Ahmed Abdi

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Medicine in Internal Medicine of the Jomo Kenyatta University of Agriculture and Technology

2025

DECLARATION

This thesis is my original work and has not been presented for a degree in any other University

Signature…….Date……

Salat Ahmed Abdi

This thesis has been submitted for examination with our approval as the University Supervisors.

Signature…….Date……

Dr. Philemon Mwella Namasaka, MBCHB, MMED

JKUAT, Kenya

Signature…….Date……

Dr. Beatrice Wangari Ndege, MBCHB, MMED

JKUAT, Kenya

DEDICATION

I dedicate this thesis to my dear wife for the support she gave me during my studies.

ACKNOWLEDGEMENT

I would like to begin by expressing my heartfelt gratitude to the Almighty God for His grace and guidance throughout the completion of this thesis. I am also deeply appreciative of Jomo Kenyatta University of Agriculture and Technology, particularly the School of Medicine, for granting me the opportunity to pursue my master's degree.

My sincere appreciation goes to my esteemed supervisors, Dr. Philemon Mwella Namasaka and Dr. Beatrice Wangari Ndege, whose unwavering support and invaluable guidance have been instrumental throughout this journey.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

ACC	American College of Cardiology
ACS	Acute Coronary Disease
AHA	American Heart Association
AMI	Acute Myocardial Infarction
CABG	Coronary Artery Bypass Grafting
CAD	Coronary Artery Disease
CA	Coronary Angiography
DASH	Dietary Approaches to Stop Hypertension
EF	Ejection Fraction
FH	Family History
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KNH	Kenyatta National Hospital
LAD	Left Anterior Descending Artery
LCX	Left Circumflex Artery
LMS	Left Main Stem
MCAD	Mature Coronary Artery Disease
MI	Myocardial Infarction

NACOSTI	National Commission of Science and Technology
NPV	Negative Predictive Value
OR	Odds Ratio
PCAD	Premature Coronary Artery Disease
PCI	Percutaneous Coronary Intervention
PPV	Positive Predictive Value
QCA	Quantitative Coronary Angiography
RA	Research Assistants
RCA	Right Coronary Artery
SCAI	Society for Cardiovascular Angiography & Interventions
SD	Standard Deviation
SDG	Sustainable Development Goals
STEMI	ST-Elevation Myocardial Infarction
TIMI	Thrombolysis in Myocardial Infarction
UA	Unstable Angina
VD	Vessel Disease

DEFINITION OF OPERATIONAL TERMS

Premature Coronary Artery Disease (PCAD): For this study, this referred to coronary artery disease (CAD) manifesting amongst males and females aged <55 years to < 65 years, respectively.

Coronary Artery Disease (CAD): This refers to a reduction of blood flow to the heart muscle due to the build-up of plaque (atherosclerosis) in the arteries of the heart.

Coronary angiography: This refers to a medical/clinical procedure involving the injection of a radiopaque contrast medium in order to visualize the coronary vessels radiographically using specialized intravascular catheters.

Risk factors: In medicine, a risk factor refers to any behavior, characteristic, or exposure that raises the likelihood of getting a disease or health problem.

Angiographic characteristics: in the context of this study, this referred to the number of blood vessels involved, the type of blood vessels, and the degree of narrowing.

Obesity: Obesity is a health condition marked by an excessive buildup of body fat that harms overall well-being, commonly identified when a person's body mass index (BMI) exceeds 30.

Hyperlipidemia: Hyperlipidemia refers to having unusually high amounts of fats, like cholesterol and triglycerides, in your bloodstream.

ABSTRACT

Coronary Artery Disease (CAD) is the leading cause of global morbidity and mortality, increasingly affecting developing countries. While CAD usually occurs after the sixth decade, some populations experience it prematurely, with premature coronary artery disease (PCAD) rising notably in developing nations. Given the absence of such studies in Kenya, this research explores the prevalence, associated cardiovascular risk factors, and angiographic characteristics of premature coronary artery disease among patients undergoing invasive coronary angiography at Kenyatta National Hospital. This study adopted a hospital-based cross-sectional design, utilizing consecutive sampling to enroll 100 adult patients. Data on socio-demographic characteristics, risk factors, and indications for coronary angiography were collected from patient records and supplemented with questionnaires for missing information. Angiographic characteristics were obtained through weekly analyses of coronary angiograms performed by hospital interventional cardiologists. Data collection spanned six months, and statistical analyses were conducted using R version 4.1.2. Descriptive statistics were reported as means and standard deviations for continuous variables, while categorical data were summarized as counts and percentages. Associations between variables were assessed using Fisher's exact tests, and a multivariable logistic regression model was fitted to identify risk factors for premature CAD after adjustment. The mean age of participants with premature CAD was 49.8 ± 8.5 years, compared to 69.9 ± 8 years for those with mature CAD. Abnormal angiographic findings were observed in 58 patients, with a premature CAD prevalence of 37.9% (95% CI: 25.8%, 51.7%). Bivariate analysis revealed that females had significantly higher odds of premature CAD compared to males (OR: 3.12, 95% CI: 1.04–9.79, p = 0.045). Males with premature CAD had a slightly lower age than that of females, though it was not statistically significant (47.2 ± 5.8 vs. 51.9 ± 10 years, p = 0.183). Smoking was significantly associated with premature CAD both before and after adjustment (OR: 0.23, 95% CI: 0.04–0.97, p = 0.045). Hypertension and diabetes mellitus were associated with lower odds of premature CAD compared to mature CAD. Most of the patients had multiple-vessel disease with severe stenosis, but no significant associations were found between risk factors and disease severity. The study concluded that premature coronary artery disease is alarmingly prevalent at Kenyatta National Hospital, with females at higher risk and smoking as a key contributing factor. Most patients in the study had severe obstructive coronary artery disease. These findings emphasize the need for targeted prevention strategies, particularly smoking cessation, to reduce the burden of PCAD in Kenya.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Coronary Artery Disease (CAD) is defined as a reduction in blood flow to the heart muscles due to the build-up of plaque (atherosclerosis) in the coronary arteries. Traditionally, Premature Coronary Artery Disease (PCAD) is defined as CAD occurring in men and women younger than 55 and 65 years, respectively, but these cut-offs tend to vary from 45 to 65 years of age, as evident in different studies (Kimeu & Kariuki, 2016; Waweru & Gatimu, 2021). Coronary artery atherosclerosis is the primary cause of morbidity and mortality in men and women globally, and it causes CAD even in developing countries (World Health Organization, 2021). An estimated 17.7 million people died from CVDs in 2015, representing 31% of all global deaths (Roth et al., 2020). Of these deaths, an estimated 7.4 million were due to coronary heart disease. Over three-quarters of CVD deaths take place in low- and middle-income countries (Wekesah et al., 2020). In Kenya, it is estimated that 25% of hospital admissions are due to CVD, and 13% of autopsies revealed CVDs as the cause of death (Chege, 2016), representing the second-highest cause of death after infectious/maternal/perinatal causes (Khoja et al., 2021).

Histological analyses have shown the presence of subclinical atheromatous plaques in earlier stages of life (Khoury et al., 2020), which may represent future substrates for the prompt onset of significant coronary stenosis. Some of the known risk factors of patients with angiographically confirmed PCAD include the presence of smoking, dyslipidemia, and a family history (Mohammad et al., 2015). Others are genetic variation, diabetes, the role of hypertension, obesity, and drug abuse that trigger factors of CAD in young patients (Osadnik et al., 2018; Shukor et al., 2023). A Kenyan study by Kamotho et al. (2004) found that hypertension, diabetes mellitus, dyslipidemia, and male gender were most strongly associated with angiographically confirmed CAD.

Coronary angiography involves the injection of a radiopaque contrast medium to visualize the coronary vessels radiographically using specialized intravascular catheters (Bahiru et al., 2018). The purpose of the procedure is to delineate the anatomy of the coronary vessels and the extent of luminal obstruction and is routinely used to verify the existence and degree of obstructive lesions and to assess the eligibility of various management options, such as percutaneous or surgical revascularization intervention (Feuchtner et al., 2021).

Although CAD is a chronic condition that often occurs after the sixth decade of life (Virani et al., 2020), some populations experience this disease prematurely (Singh et al., 2019). In the last few decades, different studies have shown an increased incidence of CAD in very young people (Meirhaeghe et al., 2020; Wu et al., 2020), especially in Asian populations (Anjum et al., 2019). In the African context, an INTERHEART study found that the mean age of myocardial infarction in Africa was 54.3 years (Steyn & Sliwa, 2016), findings that were supported by another local study (Ogeng'o et al., 2010), which found that 30% of the patients who had Acute Myocardial Infarction (AMI) were less than 50 years old. A retrospective study in a tertiary referral hospital in Nairobi by Kassam et al. (2024), found that 27.2% of patients managed for ACS were 50 years or below, and most of them had STEMI. Moreover, Wambua (2018) found that hypertension was the most frequent risk factor for angiographically confirmed CAD, with a mean age of 57 years. Similarly, in Tanzania, a study by Meda et al. (2024) showed a high prevalence of CAD among patients undergoing diagnostic CAG, with a higher frequency in males and older age. Even though they are relatively few in number, these young patients with CAD represent a significant economic and health care burden for society (Kimani et al., 2018; Page et al., 2013). Hence, focusing research efforts on proper control is a priority. While there are some studies on demographic, risk factors, and angiographic findings of all patients undergoing CAG or in the setting of ACS, there are limited documented studies focusing on investigating the prevalence and angiographic findings of patients with PCAD.

The purpose of the present study is to determine the prevalence, angiographic findings, and risk factors for PCAD amongst patients undergoing coronary angiography in Kenyatta National Hospital, Nairobi, Kenya.

1.2 Statement of the Problem

Premature Coronary Artery Disease (PCAD) is defined as CAD in males and females younger than 55 and 65 years, respectively, but these cut-offs tend to differ from 45 to 65 years of age. Coronary artery atherosclerosis is the primary cause of morbidity and mortality in men and women globally, and it causes CAD in both developing and developed countries. Premature Coronary Artery Disease (PCAD) in young populations is associated with significant morbidity and mortality, the loss of many productive life years and a growing societal and economic burden (Al-Khlaiwi et al., 2024a). PCAD prevalences of 26.5% (Sharma et al., 2022), 31% (Mohammad et al., 2015) and 5.3% (Masoudkabir et al., 2021) have been reported. The prevalence of mortality in PCAD has been reported at 4% (Al-Khlaiwi et al., 2024b) in Saudi Arabia and 27 per 100000 people globally (Hasani et al., 2023).

Various studies have been carried out to determine and establish various cardiovascular risk factors across different population contexts. However, limited studies have evaluated and documented the angiographic characteristics (vessel involvement and severity of obstruction) of patients with angiographically confirmed PCAD. A study by Maroszyńska-Dmoch & Wożakowska-Kapłon (2016) reported severe stenosis of 75.4% among the involved blood vessels in patients with PCAD. It is on this basis that the current study sought to assess and document the prevalence, angiographic findings, and risk factors of PCAD. This will provide data on the local context and may help strengthen or change the approaches used in the overall prevention of coronary artery diseases. The study setting receives various referrals of patients seeking to undergo coronary angiography procedures.

1.3 Justification

Invasive coronary angiography provides a viable platform that enables detection and confirmation of CAD; hence, it is regarded as a gold standard in matters of CAD diagnosis. PCAD remains a major cause of morbidity and mortality in the affected patients. Various previous studies have focused more on the prevalence and risk factors for cardiovascular diseases. As such, limited studies have investigated the angiographic characteristics of PCAD and its associated risk factors. Overall, information on the angiographic characteristics (vessel involvement and severity of obstruction) and associated risk factors of PCAD is scarce. The present study aims to determine the prevalence, angiographic characteristics, and risk factors associated with PCAD amongst patients undergoing a coronary angiography procedure at Kenyatta National Hospital, Nairobi, Kenya. Thus, the study will generate knowledge that may be used to inform policy on the essence of adequate prevention and control strategies of PCAD through proper management of risk factors that predispose patients to PCAD. Kenyatta National Hospital is a national referral and specialized institution, receiving a diverse patient population from across the country. This ensures a representative sample, making it an ideal site for this study.

1.4 Significance of the Study

There has been remarkable progress in the prevention and management of CVDs all around the world. However, there is a need for further efforts aimed at minimizing CVD incidences, especially in the developing world contexts. Sustainable Development Goal (SDG) number three aims to promote adequate well-being amongst populations of all ages and ensure healthy lives. Part of the specific targets for SDG 3 is to avert Non-Communicable Diseases (NCDs) and CVDs. The current study seeks to assess risk factors attributable to PCAD, which is a type of CVD that has evolved into a disease of public health concern. As such, the study is significant because it will provide insights into particular risk factors attributable to PCAD; hence, inform the development of interventions aimed at averting it. Therefore, the study will make a contribution to initiatives towards the attainment of specific targets set by SDG 3.

1.5 Research Questions

1. What is the prevalence of Premature Coronary Artery Disease among patients with angiographically confirmed coronary artery disease in Kenyatta National Hospital, Nairobi, Kenya?
2. What are the risk factors of patients with angiographically confirmed Premature Coronary Artery Disease at Kenyatta National Hospital, Nairobi, Kenya?
3. What are the angiographic characteristics of patients with angiographically confirmed Premature Coronary Artery Disease at Kenyatta National Hospital, Nairobi, Kenya?
4. What are the associations between disease severity and risk factor profiles of patients with angiographically confirmed premature coronary artery disease at Kenyatta National Hospital, Nairobi, Kenya?

1.6 Objectives of the Study

1.6.1 General Objective

To determine the prevalence, angiographic findings, and risk factors for Premature Coronary Artery Disease amongst patients undergoing coronary angiography in Kenyatta National Hospital, Nairobi, Kenya

1.6.2 Specific Objectives

1. To determine the prevalence of premature coronary artery disease among patients with angiographically confirmed coronary artery disease in Kenyatta National Hospital, Nairobi, Kenya.
2. Establish the risk factors of patients with angiographically confirmed Premature Coronary Artery Disease at Kenyatta National Hospital, Nairobi, Kenya.
3. Determine the angiographic characteristics of patients with angiographically confirmed Premature Coronary Artery Disease at Kenyatta National Hospital, Nairobi, Kenya.

4. To assess the association between disease severity and risk factor profiles among patients with angiographically confirmed premature coronary artery disease at Kenyatta National Hospital, Nairobi, Kenya.

1.7 Assumptions of the Study

The study was conducted on the assumption that the patients were from a homogenous group that was coming from the same socio-demographic and economic backgrounds in order to investigate the risk factors for PCAD.

1.8 Scope of the Study

The study focused on specific risk factors of PCAD, and data were collected from patients undergoing invasive coronary angiography in KNH, Nairobi, Kenya. Furthermore, the study relied on secondary data from medical data captured in the patient records.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

To compile this literature, we conducted an online search using Google and Google Scholar, focusing primarily on databases such as PubMed. Our search utilized key terms including coronary artery disease, premature coronary artery disease, and risk factors for PCAD.

Coronary Artery Disease (CAD) is defined as a reduction in blood flow to the heart muscle due to the build-up of plaque (atherosclerosis) in the coronary arteries. Traditionally, Premature Coronary Artery Disease (PCAD) is defined as CAD occurring in men and women younger than 55 and 65 years, respectively, but these cut-offs tend to vary from 45 to 65 years of age, as evident in different studies (Kimeu & Kariuki, 2016; Waweru & Gatimu, 2021). CAD is the leading cause of global morbidity and mortality in both men and women, with a significant and growing burden in developing countries (World Health Organization, 2021).

2.2 Prevalence of Premature Coronary Artery Disease (PCAD)

Globally, the prevalence of coronary artery disease (CAD) reported amongst very young people is 1–16%, with Acute Coronary Syndrome (ACS) being the most common clinical presentation (Trzeciak et al., 2017). In most instances, the results of the coronary angiography performed due to suspected CAD display normal coronary arteries or those without significant lesions in a large number of young patients (Raparelli et al., 2018). Coronary Artery Disease (CAD) is a chronic condition usually occurring after the sixth decade of life (Virani et al., 2020). CAD manifesting in males aged <55 years and in females aged <65 years is defined as Premature Coronary Artery Disease (PCAD). Patients with PCAD belong to a particular subgroup that needs much more attention since its impact on individuals, families, and society is devastating (Doughty et al., 2002).

Limited studies have been done on the prevalence of PCAD in Kenyan contexts. A study done in Kenyatta National Hospital, Kenya, reports that more than 30% of patients with CAD were aged below 50 years (Ogeng'o et al., 2010). Another study done in a tertiary hospital in Kenya by Wachira et al. (2014) reports that the mean age of patients with CAD was 59 years. A retrospective study in a tertiary referral hospital in Nairobi by Kassam et al. (2024) found that 27.2% of patients managed for ACS were 50 years or below and with a median age of 46.5 years. Most of this literature focused on ACS and depicts the existence of variations in the age categories of patients with CAD across the local and global contexts, with a paucity of data on the overall local prevalence of angiographically confirmed PCAD

2.3 Risk Factors of Patients with Angiographically Confirmed PCAD

Some of the risk factors of patients with angiographically confirmed PCAD include the presence of smoking, dyslipidemia, and a family history of CAD. These were associated with the presence of significant CAD in young patients. Others are genetic variation, diabetes, hypertension, obesity, and drug abuse that trigger factors of CAD in young patients (Raparelli et al., 2018). A Kenyan study by Kamotho et al. (2004) found that hypertension, diabetic mellitus, dyslipidemia, and male gender were most strongly associated with angiographically confirmed CAD. A retrospective study in a tertiary referral hospital in Nairobi by Kassam et al. (2024) found that more than half of the patients managed for ACS were smokers. The literature has focused on risk factors for all patients undergoing CAG or in the setting of ACS, and there are limited documented studies focusing on risk factors of angiographically confirmed PCAD.

2.3.1 Smoking

The influence of smoking is particularly relevant for the early appearance of coronary atherosclerosis. According to a study done in Spain, a high percentage (83.6%) of patients presenting with PCAD were smokers (Morillas et al., 2007). Smoking may increase the risk of suffering significant CAD almost threefold, even with a restricted time of tobacco

exposure in some populations, showing the relevance of tobacco in the development of early CAD (Salehi et al., 2021).

2.3.2 Dyslipidemia

In a study by Yang et al. (2020), dyslipidemia was more than half of the population affected in the case group, with higher mean total LDL-cholesterol levels and triglycerides than the values reported in different trials analyzing young populations. Dyslipidemia involves more than double the risk of CAD, even though the time of exposure to this factor may be limited due to the age restriction.

Dyslipidemia may be an underdiagnosed disease in the population ≤40 years of age, as shown in the treatment schemes on hospital admission, with only 19 (7.6%) of the cases having an active prescription of statins (Konishi et al., 2014).

2.3.3 Family History of PCAD

Genetic variations involving a family history of early CAD, together with inherited lifestyle habits (Scheffold et al., 2011), might have an impact on the early manifestation of CAD. According to Zgheib et al. (2020), the presence of a family history of early CAD increased the risk of CAD almost twofold. A local study by Kimeu & Kariuki (2016) found 8% of the patients investigated for acute myocardial infarction had a family history of PCAD. It may be necessary to carry out greater healthcare and educational control in the first-degree relatives of these patients.

2.3.4 Diabetes Mellitus

It is a heterogeneous mix of health conditions characterized by glucose dysregulation, and it has an effect on the premature onset and severity of atherosclerosis. Therefore, diabetes is one of the most prevalent risk factors for coronary artery disease in the general population older than 40 years (Virani et al., 2020); however, in young subjects with CAD,

a direct association has not been strongly described. Due to the pathophysiology of this disease, it likely requires long periods of time to induce organ damage.

2.3.5 Hypertension

Hypertension is one of the leading risk factors for coronary artery disease. The INTERHEART African study arm found that among the risk factors, hypertension played a bigger role. A local study by Kimeu & Kariuki (2016) found that among the patients under study for acute myocardial infarction, hypertension was the leading risk factor at 71.9%. Meirhaeghe et al. (2020) found that there was no difference in the prevalence of hypertension among patients with PCAD and MCAD.

2.3.6 Obesity

Obesity is a condition related to excess fat in the adipose tissue and is an independent risk factor for cardiovascular disease, according to the Framingham Heart Study, particularly in women. A national survey in Kenya by Temu et al. (2021), nearly half of the participants were obese, and women were disproportionately affected.

This study also noted the association of obesity with hypertension and dyslipidemia, which are known traditional cardiovascular risk factors.

2.3.7 Unhealthy Diet

There is an evolving relationship between cardiovascular health and diet. Lifestyle changes, including a heart-healthy diet, are the foundation of all CVD prevention guidelines (Arnett et al., 2019). Diets rich in fruits, vegetables, legumes, whole grains, and lean protein sources, with minimization/avoidance of processed foods, trans-fats, and sugar, sweetened beverages, are recommended by prevention guidelines. The Mediterranean, DASH, and plant-based diets have all proven cardioprotective benefits in varying degrees and are endorsed by professional healthcare societies. Globally, the INTERHEART Study showed that 90% of MIs were due to preventable factors, with daily

consumption of fruits and vegetables, along with regular physical activity, being associated with a 40% reduction in MI. Locally, there is a paucity of data on the role of dietary patterns on CVD.

2.3.8 Physical Inactivity

2019 ACC/AHA guidelines on prevention of CVD recommend that adults engage in at least 150 minutes per week of accumulated moderate-intensity physical activity or 75 minutes per week of vigorous-intensity physical activity. Physical inactivity is one of the modifiable risk factors for CVD. The INTERHEART Study showed that regular physical activity, along with the consumption of fruits and vegetables, is associated with a 40% reduction in MI. According to Onen et al. (2013), in Africa, men have a higher level of physical activity compared to women, and this mirrors the prevalence of obesity. Furthermore, the prevalence of physical inactivity is thought to be increasing with the rising urban population and job automation.

2.4: Pathophysiology of Coronary Artery Disease

CAD is a symptom complex resulting from an imbalance between oxygen supply and demand in the myocardium due to obstruction of the epicardial coronary arteries, usually from atherosclerosis. It primarily affects the intima and is made up of fibro-fatty plaque that contains: Lipid-containing macrophages (foam cells), Extracellular matrix & proliferating smooth muscle cells. According to a study by Jebari-Benslaiman et al. (2022), atherosclerosis is initiated by endothelial dysfunction in response to injury by one of the risk factors mentioned above. The dysfunctional endothelium becomes permeable to LDL cholesterol and monocytes. In the sub-endothelial space, the LDL is oxidized and the differentiated monocytes engulf them transforming into foam cells. The modified LDL activate the endothelial cells and the macrophages which in turn will elaborate inflammatory cytokines that will cause activation and transmigration of smooth muscle cells from the media to the intima. The intimal smooth muscle divides and promote production of extracellular matrix with resultant growth of atherosclerotic plaque. In later

stages, calcification occurs and the fibrosis continues, yielding a relatively acellular fibrous capsule that surrounds a rich lipid-core and dead and dying foam cells. In stable CAD, this causes a fixed obstruction that may or may not be symptomatic depending on the severity of the obstruction. However, in acute coronary syndrome, the plague suddenly undergoes damaging changes that expose thrombogenic matrix with resultant clot formation that further obstruct blood flow partially or completely

2.5 Invasive Coronary Angiography

According to 2021 ACC/AHA/SCAI Guideline for Coronary Artery Revascularization, Coronary angiography is the gold standard method to define coronary anatomy and characterize the severity of coronary arterial stenosis. A visually estimated diameter stenosis severity of ≥70% for non–left main disease and ≥50% for left main disease has been used to define significant stenosis and to guide revascularization strategy. According to major societal guidelines, some of the common indications for invasive coronary angiography are UA, NSTEMI or STEMI. Preparations for the procedure include signing informed consent, basic laboratory investigations, electrocardiography, assessing patients for bleeding risk and contrast-induced acute kidney injury.

KNH uses Siemens Healthineers ARTIS Angiography System for doing invasive angiographic procedures. According to Al-Shudifat et al. (2017), the procedure is performed by experienced interventional cardiologists using standard techniques. In summary, the catheter is inserted into the radial or femoral artery using a Seldinger technique, and the tip is advanced to the aortic sinus cusp. X-ray images of the transient radio-contrast distribution within the coronary arteries are carried out to visualize the arterial tree. The severity of stenosis is estimated as percentage of the arterial lumen by comparing the area of narrowing to an adjacent normal artery.

2.6 Angiographic Characteristics of Patients with PCAD

This study adopted Mosseri's classification of CAD whereby angiographic features of patients with angiographically confirmed PCAD were characterized based on vessel involvement and severity of obstruction. Thus, the angiographic findings are classified as Single-Vessel Disease (SVD), Double-Vessel Disease (DVD), and Triple-Vessel Disease (TVD) as dictated by the number of major epicardial coronary arteries involved (Alai et al., 2016). Stenosis of the coronary vessels may be considered mild when the luminal diameter is reduced by <50%, moderate (50%–70%), and significant (>70%) of the original diameter (Chen et al., 1995). Different studies examining the prevalence of different angiographic findings observe that SVD is most prevalent, followed by DVD, and then TVD (Maroszyńska-Dmoch & Wożakowska-Kapłon, 2016; Peng et al., 2018). Locally, a study by Kassam et al. (2024) on ACS found that the majority of the individuals had SVD with a predilection for LAD. Similar findings were reported from KNH by Wambua (2018) while focusing on all patients who underwent CAG. There is no local study focusing on angiographically confirmed PCAD.

2.7 Conceptual Framework

The study utilized a conceptual framework depicting the relationship between dependent and independent variables. Dependent variables were assessed on a binary scale; hence, there were two variables (Presence of PCAD Vs Absence of PCAD). The presence of PCAD was characterized based on existing angiographic findings; hence, there were three classifications: Single-Vessel Disease (SVD), Double-Vessel Disease (DVD), and Triple-Vessel Disease (TVD). The level of the vessel stenosis was also captured. Independent variables were risk factors for PCAD, which, for this study, were smoking, dyslipidemia, family history, obesity, diabetes mellitus, and hypertension. Coupled together, all these factors may affect the endothelial function of the heart; hence, increasing the likelihood of contracting PCAD, which is the dependent variable.

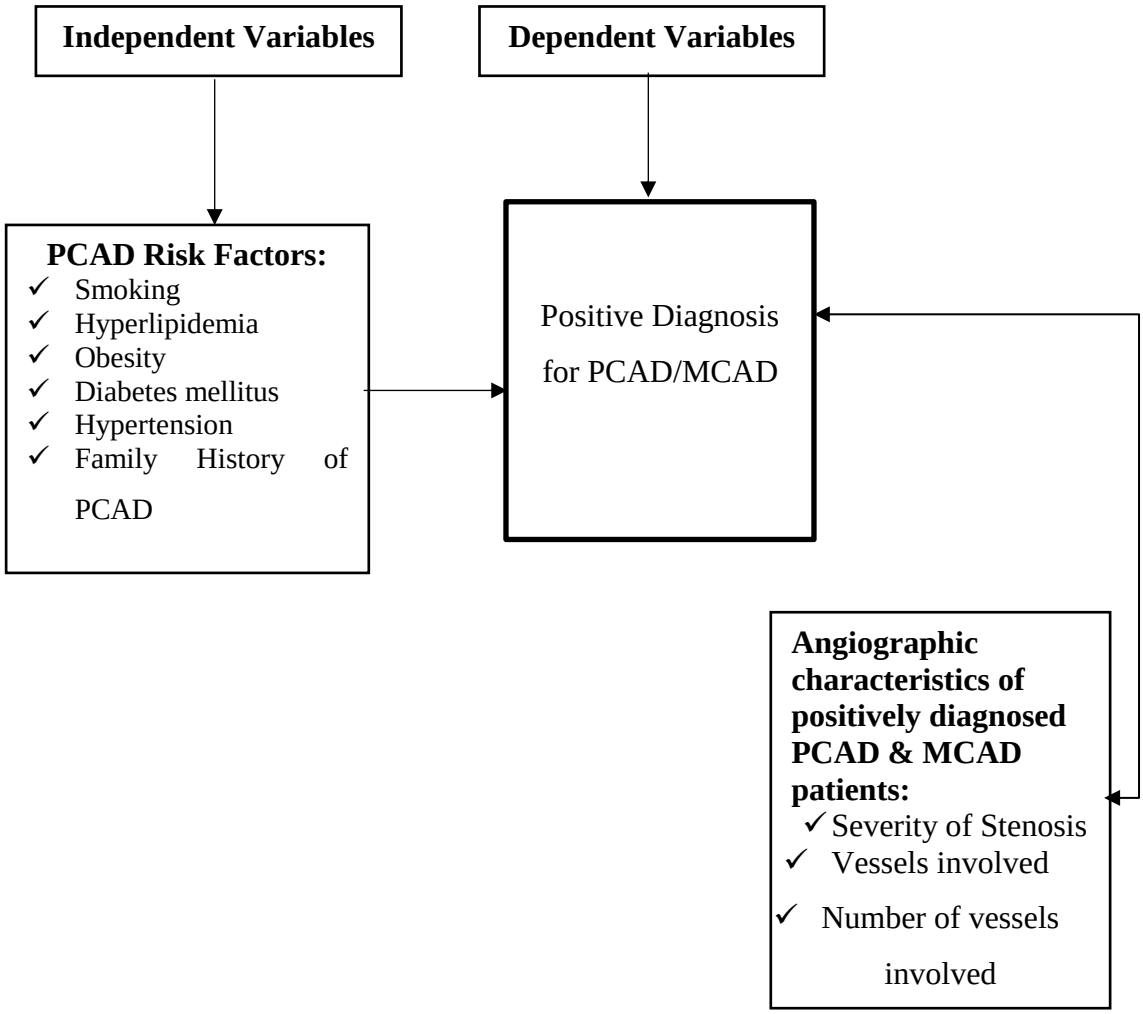

Figure 2.1: Conceptual Framework on the Relationship between Study Variables

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This section presents a description of the research methods that were employed by the study.

3.2 Study Location

The study was conducted at Kenyatta National Hospital (KNH), Nairobi, Kenya located; 01°18′04″S and 36°48′26″E (Appendix VII). KNH is the biggest and oldest national referral hospital in Kenya with a bed capacity of 2,400 and an estimated 6,000 staff. An initial review of hospital records showed that approximately two hundred cases of invasive coronary angiography are done annually and most of the patients are between thirty-five and seventy-five years old. This area was selected for the study because it has a cardiac catheterization lab; it is a national referral hospital, a center of reference for cardiology where many patients are diagnosed with CAD, hence made the setting appropriate for the study.

3.3 Study Design

This was a hospital-based cross-sectional study design.

3.4 Study Population

Study participants were adult patients aged ≥ 18 years, referred for coronary angiography at Kenyatta National Hospital, Nairobi, Kenya for period of 6 months from June 2024 to November 2024 and meeting eligibility criteria.

3.4.1 Inclusion Criteria

Inclusion criteria included all patients aged ≥18 years, who were undergoing invasive coronary angiography and who gave informed consent.

3.4.2 Exclusion Criteria

Eligible participants for whom the invasive coronary angiogram was not completed due to unforeseen complications during the procedure were excluded. In addition, eligible participants who transferred to other facilities at the time of the study were excluded.

Case Definition

Hyperlipidemia: this was defined as having either high cholesterol >5.17 **mmol/L** or high-density lipoprotein <1.03 **mmol/L** or low-density lipoprotein>2.6 **mmol/L** (Lee & Siddiqui, 2023)**.**

Obesity: was defined as a body mass index (BMI) ≥30 KGs/M^2. BMI is the weight of an individual in kilos divided by their height in metres (Purnell, 2000).

3.5 Sample Size Determination

The study sample size was computed based on the approximated study population that was accessible for enrollment into the study by the investigator during the six (6) months study period. An initial review of the records at the study setting indicated that close to five (5) patients undergo coronary angiography on a weekly basis (KNH Hospital Records, 2023); hence, 20 patients were considered eligible per month. As such, an estimated 120 would be accessible during the six (6) months study period; hence, the study sample size was computed based on sample size formula used to derive a finite sample applicable for cross-sectional studies (O'Neill, 2022).

$$\mathbf{n}=\frac{N(z2)P(1-P)}{(d2)(N-1)+(z2)P(1-P)}$$

Where;

n = the desired sample size

N = estimated number of accessible populations = 120 patients

Z = the standard normal deviation, set at 1.96, which corresponds to 95% confidence level

P = expected proportion of PCAD in patients undergoing coronary angiography 55% (Azidah et al., 2013).

d= is the desired margin of error, which is 5%

Hence, the sample size was 91 patients. The sample was adjusted by 10% (9 participants); hence a sample size of **100 patients** was arrived at.

3.6 Sampling Procedures

Consecutive sampling approach was utilized until the calculated sample size of 100 patients was realized.

3.7 Data Collection Instruments

Data was collected on the day of the procedure from both the patients and their files. Once patients who met the inclusion criteria consented and were recruited, the principal investigator, with the assistance of research assistants, administered the questionnaires. Data on risk factors and the indication for coronary angiogram were gathered from hospital records. In cases where data was missing in the hospital records, questionnaires were used to obtain the necessary information from the patients. The angiographic characteristics data was collected by analyzing images of coronary angiograms performed weekly under the supervision of the hospital's interventional cardiologists. Data on laboratory and imaging investigations was collected from inpatient or outpatient medical records.

3.8 Data Collection Procedures

The independent variables were prevalence and risk factors. The dependent variable was Premature Coronary Artery Disease (PCAD). Study variables were measured using a structured questionnaire that was used to abstract data on the study variables from the patients enrolled in the study. Regarding data collection procedures, the research recruited three (3) research assistants (RAs) who were engaged in the data collection process. The RAs three clinical officers with a diploma in clinical medicine. They were trained on study objectives, informed consent process, and data collection process. The RAs were required to sign a confidentiality agreement indicating that they would guarantee the confidentiality of the data collected.

3.9 Statistical Analysis

Statistical analyses were performed using R version 4.1.2. Descriptive statistics were reported as mean ± standard deviation (SD) for continuous variables and numbers, counts, and percentages for categorical variables. The difference in age between males and females with PCAD was analyzed using an independent sample t-test.

Binary logistic regression was used to assess for the risk factors of PCAD. Variables demonstrating significant associations on bivariate analysis and those with p values of 0.25 and below were selected for multivariable logistic regression to derive the adjusted odds ratios (ORs) to determine the level of associations. **Fisher's exact test** was used to assess associations between risk factors for PCAD and the number of vessels involved/severity of stenosis. Fisher's exact test was used because more than 20% of the cells had expected cell counts of less than 5. A p-value at $\alpha \leq 0.05$ was used as the criterion for statistical significance.

3.10 Data Quality Management

To ensure appropriate data quality management, the principal investigator checked the questionnaires daily for accuracy, consistency, and completeness and provided feedback

and corrections regarding the collected data to the research assistants. All documents related to the participants and intended for use in the study remained under the custody of the principal investigator for safekeeping and to ensure confidentiality, preventing access by any unauthorized person.

3.11 Ethical Considerations

3.11.1 Ethical Approval

Approval of the research proposal was sought from Jomo Kenyatta University of Agriculture and Technology, School of Graduate Studies. Ethical clearance was obtained from the Kenyatta National Hospital/University of Nairobi Ethical Review Committee (Approval no P311/04/2024). Permission to carry out the research was further sought from the National Commission of Science and Technology (NACOSTI). Additional administrative permission to undertake the research was sought from the Kenyatta National Hospital administration.

3.11.2 Informed Consent Process

Written informed consent was obtained from all participants after the study procedures were clearly explained to them. They were given sufficient time to review the information in the consent form, seek clarification, and decide whether to participate. The consent form detailed the ethical considerations, study procedures, confidentiality safeguards, potential benefits and risks, and emphasized that participation was voluntary, with the option to decline or withdraw at any point.

Participants were approached after being identified through medical records available at the study site. Individuals who met the inclusion criteria were informed about the study and requested to participate by signing a consent form. By signing, participants authorized the researcher to access their medical records for study purposes.

3.11.3 Risks and Discomfort

Participants in this study were likely to experience some risks during the data collection process. For instance, discomfort while interacting with the researcher, and asking questions that might be considered personal. The researcher minimized this risk through procedures to protect participants' privacy and confidentiality. In addition, the time taken by a participant in this survey may have caused some inconveniences in their schedule for the day, and there was a possibility that a participant may have found one or more of the questions asked to be upsetting or emotionally sensitive. In such a case, they did not have to respond to any question that made them feel uncomfortable. All these anticipated risks and discomforts were explained to the participants during the consent process.

3.11.4 Benefits

The researcher clarified during the consent process that there would be no direct benefit to the participants. They would not be paid, nor would they have to pay for their participation in the study. However, the study findings heightened awareness of CAD risk factors and were expected to inform policy and intervention programs.

3.11.5 Confidentiality and Data Management

All the information shared by study participants was kept confidential. Only the researcher and school supervisors had access to the information gathered during the survey. No personal details were connected to the data for analysis. Actual names were not required during the interview sessions. Filled hard-copy questionnaires were stored in a lock-and-key cabinet. This way, participants' information was protected, and all identifiable information was encrypted and stored on password-protected computers.

No individual identities were used in any reports or publications that may result from this study.

3.11.6 Dissemination of Results

The findings from this study will be disseminated through publications (journals to be selected) and presentations in conferences. The final report will also be shared with my supervisors and the university library. The results of this study will also be presented at the faculty academic rounds.

CHAPTER FOUR

RESULTS

4.1 Socio Demographic Characteristics of the Patients

A total of 100 patients were recruited in this study. Their mean age was 62.3 years, with a standard deviation of 12.8 years. The majority of the patients, 53 (53%) were aged between 40 and 64, followed by those above 64 at 43 (43%). The rest were below the age of 40 years.

Most of the patients, 60 (60%) in this study were males, while the rest were females. Out of the 100 patients, 57 (57%) came from rural areas and the rest were from urban areas. A total of 29 (29%) patients smoked cigarettes whereby 16 (55.2%) had less than or equal to ten pack years and 7 (24.1%) had between 11 and 20 pack years. The rest had more than 20 pack years. Thirty-four (34%) of the patients were consuming alcohol at the time of this study.

Out of the 100 patients, 38 (38%) of the patients were overweight with 35 (35%) being obese. A total of 43 (43%) of the patients consumed a heart-healthy diet. Forty (40%) of the patients consumed fruits daily while the rest consumed fruits occasionally.

In terms of exercise, 41 (41%) of the patients were engaged in regular exercise. Of these 41 patients, 19 (46.3%) met the recommended number of days for exercise per week while 15 (36.6%) met the recommended number of minutes of exercise per week as shown in table 4.1.

Table 4.1: Sociodemographic Characteristics of the Patients (N = 100)

Characteristic	Frequency (%)
Age in years	
Mean age ± SD = 62.3±12.8	
<40	4 (4%)
40-64	53 (53%)
≥65	43 (43%)
Gender	
Female	40 (40%)
Male	60 (60%)
Residence	
Rural	57 (57%)
Urban	43 (43%)
Smoking	
No	71 (71%)
Yes	29 (29%)
Pack years (n = 29)	
≤10	16 (55.2%)
11-20	7 (24.1%)
>20	6 (17.2%)
Alcohol consumption	
Yes	34 (34%)
No	66 (66%)
Body mass index (BMI)	
Underweight (BMI<18.5 KG/m^2)	5 (5%)
Normal (BMI = 18.5-24.9 KG/m^2)	22 (22%)
Overweight (BMI = 25 -30 KG/m^2)	38 (38%)
Obese (BMI>30 KG/m^2)	35 (35%)
Heart healthy diet	
Yes	43 (43%)
No	57 (57%)
Frequency of fruit consumption	
Daily	40 (40%)
Occasional	60 (60%)
Exercise	
Regular exercise	
Yes	41 (41%)
No	59 (59%)
Days of moderate to high-intensity exercise per week (n = 41)	
<5	22 (53.7%)
≥5	19 (46.3%)
Minutes of exercise per week (n = 41)	
<150 minutes	26 (63.4%)
≥150 minutes	15 (36.6%)

4.2 Clinical Characteristics of the Patients

Out of the 100 patients, 73 (73%) had hypertension, 35 (35%) had obesity, and 38 (38%) had diabetes Mellitus. A total of 9 (9%) of the patients had a history of premature coronary artery disease in the family, as shown in Figure 4.1.

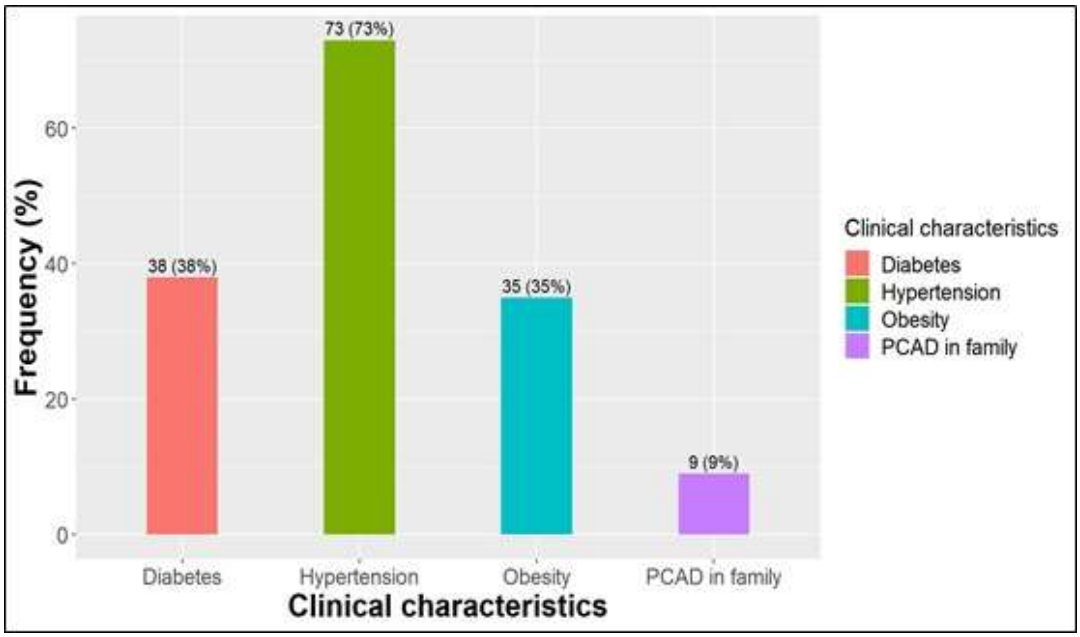

Figure 4.1: Clinical Characteristics of the Patients

4.3 Characteristics of Patients with Confirmed Coronary Artery Disease (CAD)

Out of the 58 patients with abnormal angiographic findings, 36 (62.1%) were males and 22 (37.9%) were females. Out of the 36 males, 10 (27.8%) had PCAD, and the rest had Mature Coronary Artery Disease (MCAD). The mean age of the patients with PCAD was 49.8 years with a standard deviation of 8.5 years while the mean age of the patients with MCAD was 69.9 years with a standard deviation of 8 years.

Of the 10 patients who smoked, 3 had PCAD and the rest had MCAD. A total of 19 (32.8%) with obesity had abnormal angiographic findings of which 7 (36.8%) had PCAD. Of the 44 (75.9%) patients with hypertension, 14 (31.8%) had PCAD while the rest had

MCAD. A total of 16 (27.6%) of the patients had diabetes mellitus of which 7 (43.8%) had PCAD and the rest had MCAD. Of the 30 (51.7%) patients with dyslipidemia, 13 (43.3%) had PCAD and the rest had MCAD. The rest of the information is shown in table 4.2 below.

Table 4.2: Characteristics of Patients with Confirmed Coronary Artery Disease (CAD)

	Factors		
Sociodemographic factors	**N = 58**	**Premature CAD n = 22**	**Mature CAD n = 36**
Gender			
Female	22 (37.9%)	12 (54.5%)	10 (45.5%)
Male	36 (62.1%)	10 (27.8%)	26 (72.2%)
Age in years			
Mean age ±SD	58 (100%)	49.8±8.5	69.9±8.0
Smoking	10 (17.2%)	3 (30%)	7 (70%)
Alcohol consumption	23 (39.7%)	6 (26.1%)	17 (73.9%)
No regular exercise	34 (58.6%)	13 (38.2%)	21 (61.8%)
Non-heart healthy diet	41 (70.7%)	15 (36.6%)	26 (63.4%)
Residence			
Rural	38 (65.5%)	11 (28.9%)	27 (71.1%)
Urban	20 (34.5%)	11 (55%)	9 (45%)
Clinical characteristics			
Obese	19 (32.8%)	7 (36.8%)	12 (63.2%)
Hypertensive	44 (75.9%)	14 (31.8%)	30 (68.2%)
Diabetic	16 (27.6%)	7 (43.8%)	9 (56.2%)
Dyslipidaemia	30 (51.7%)	13 (43.3%)	17 (56.7%)
Family history of PCAD	5 (8.6%)	3 (60%)	2 (20%)

4.4 Indications for Coronary Angiography for Patients with Confirmed CAD

There was a total of six indications (dilated cardiomyopathy, non-ST elevation myocardial infarction, ST-elevation myocardial infarction, stable angina, unstable angina and others i.e., left bundle branch block and left ventricular aneurysm) for coronary angiography. non-ST elevation myocardial infarction was the most common indication, accounting for 34.5%, followed by stable angina at 14 (24.1%).10 (17.2%) had dilated cardiomyopathy

and 9 (15.5%) had ST-elevation myocardial infarction. The rest of the indications are shown in figure 4.2.

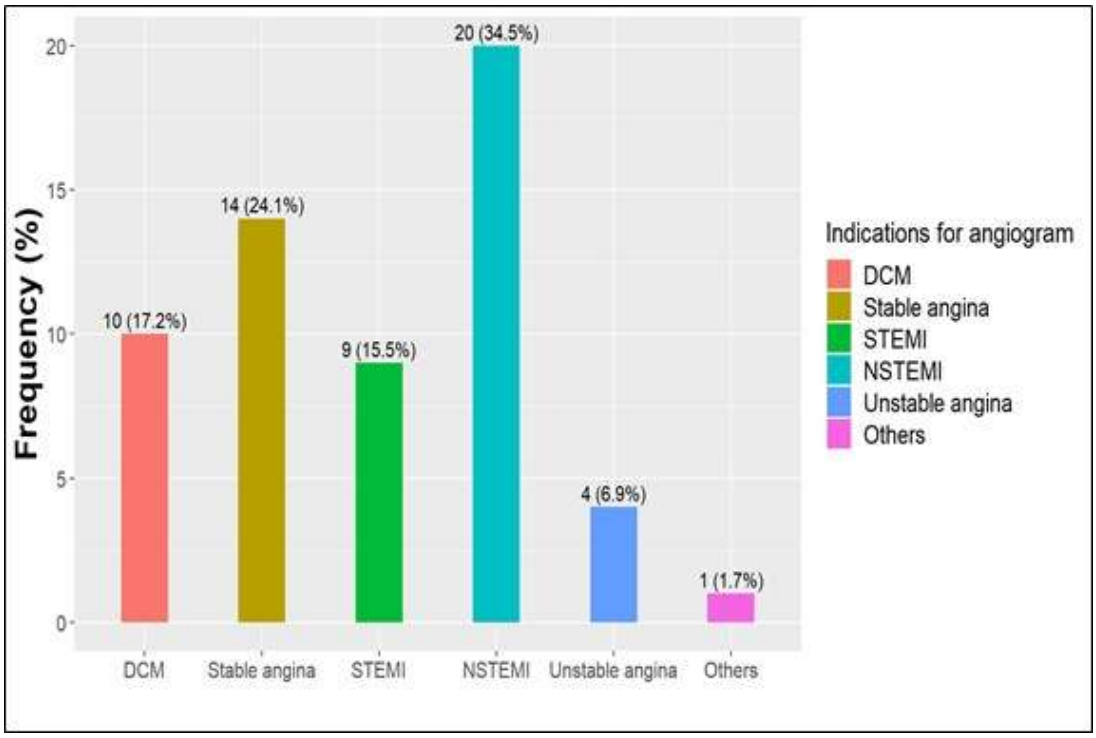

Figure 4.2: Figure Showing the Indications for Coronary Angiogram

4.5 The Proportion of Patients with Dilated Cardiomyopathy (DCM)

Among the 100 patients who underwent invasive angiography, 33 were diagnosed with dilated cardiomyopathy (DCM), with an average ejection fraction of 28.9±9.3%. Of these 33 patients, 10 (30.3%) were confirmed to have an ischemic etiology, as evidenced by obstructive lesions on their angiograms. The remaining patients had DCM of unknown etiology (Figure 4.3).

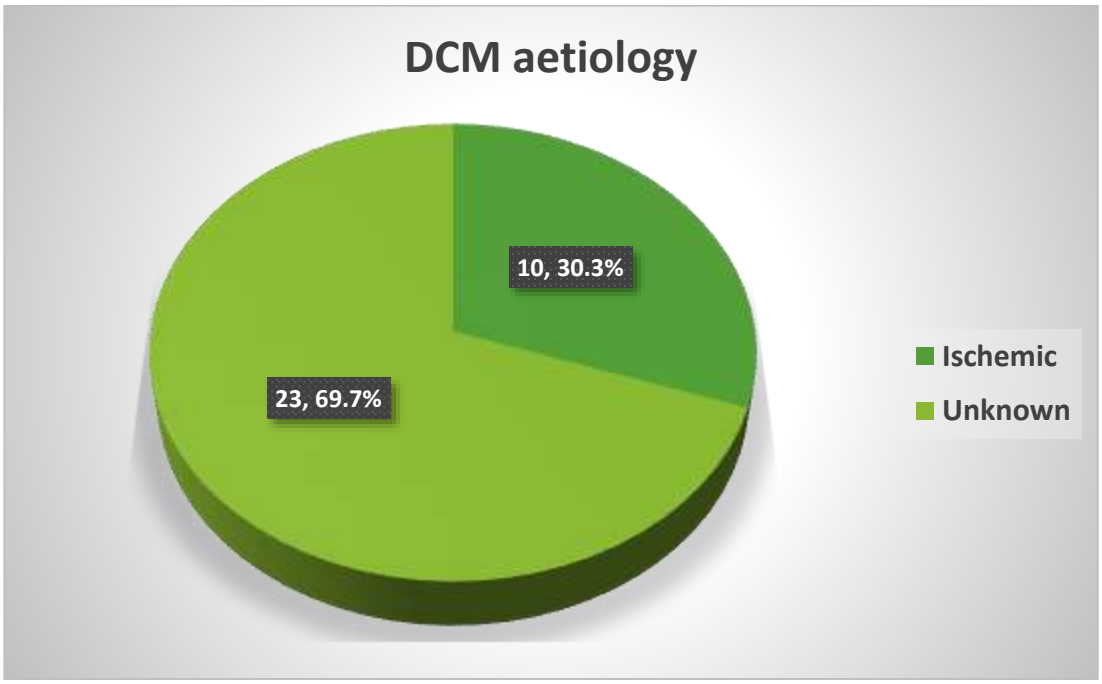

Figure 4.3: Proportion of DCM Patients with Ischemic Vs. Unknown Etiologies

4.6 Treatment approaches after diagnosis

Out of the 58 patients with abnormal angiographic findings, the majority, 36 (62.1%) were done percutaneous coronary intervention. Of these 36, 14 (38.9%) had PCAD and the rest had MCAD. Of 18 (31%) who were treated medically, 6 (33.3%) had PCAD and the rest had MCAD. A total of 4 patients (6.9%) underwent CABG, with an equal proportion from both the PCAD and MCAD groups. as shown in table 4.3.

Table 4.3: Treatment Approaches after Diagnosis (N = 58)

Treatment done or recommended	N = 58	Premature CAD n (%)	Mature CAD n (%)
Coronary artery graft bypass (CABG)	4 (6.9%)	2 (50%)	2 (50%)
Medical	18 (31%)	6 (33.3%)	12 (66.7%)
Percutaneous coronary intervention (PCI)	36 (62.1%)	14 (38.9%)	22 (61.1%)

4.7 The Prevalence of Premature Coronary Artery Disease among Patients with Angiographically Confirmed Coronary Artery Disease

The overall prevalence of confirmed CAD was 58%. Out of the 58 patients with abnormal angiographic findings, a total of 22 patients had premature coronary artery disease (PCAD) while 36 had MCAD. The prevalence of the patients with PCAD among the patients with confirmed CAD was 37.9% (95% CI 25.8%, 51.7%) (Figure 4.4).

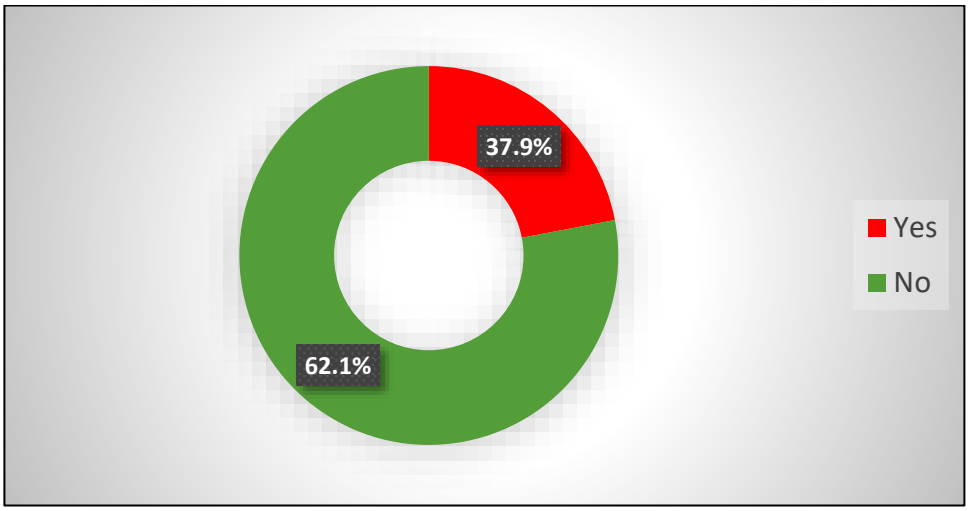

Figure 4.4: Proportion of Patients with PCAD vs. MCAD

4.8 The Risk Factors of Patients with Angiographically Confirmed Premature Coronary Artery Disease

Three factors (gender, age and smoking) were associated with the type of coronary artery disease under bivariate analysis (p-value <0.05) at 5% significance level. The results showed that female patients were 3.12 times more likely to get PCAD compared to MCAD, OR 3.12 (95% CI 1.04, 9.79). Smoking had lower odds for PCAD compared to MCAD, with smoking having 82% lower odds for PCAD when compared to MCAD, OR 0.18 (95% CI 0.04, 0.63). This means that patients who smoked were more likely to have MCAD compared to MCAD. Smoking remained a significant predictor of the type of

coronary artery disease after adjustment, with 77% lower odds for PCAD compared to MCAD, OR 0.23 (95% CI 0.04, 0.97) as shown in table 4.4.

Table 4.4: The Risk Factors of Patients with Angiographically Confirmed Premature Coronary Artery Disease

Factors Sociodemographic factors	Premature CAD n = 22	Mature CAD n = 36	Crude OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
Gender						
Female	12	10	3.12 (1.04, 9.79)	**0.045**	1.72 (0.49, 6.12)	0.392
Age in years						
Mean age ±SD	49.8±8.5	69.9±8.0	0.56 (0.32, 0.74)	**0.003**		
Smoking	3	17	0.18 (0.04, 0.63)	**0.014**	0.23 (0.04, 0.97)	**0.045**
Alcohol consumption	6	17	0.42 (0.13, 1.27)	0.136		
No regular exercise	13	21	1.03 (0.35, 3.09)	0.955		
Non-heart healthy diet	15	26	0.82 (0.26, 2.69)	0.743		
Clinical characteristics						
Obese	7	12	0.93 (0.29, 2.87)	0.905		
Hypertensive	14	30	0.35 (0.10, 1.19)	0.095		
Diabetic	7	9	0.42 (0.13, 1.24)	0.123		
Family history of PCAD	3	2	2.68 (0.41, 21.77)	0.302		
Dyslipidemia	13	17	0.76 (0.04, 13.41)	0.854		

4.9 Angiographic Characteristics among Patients with Confirmed CAD

Out of the 100 patients, 58 (58%) had abnormal coronary angiographic findings. Regarding blood vessel involvement, the left anterior descending artery (LAD) was the most involved 51 (87.9%) of the patients having stenosis. Of the 51 patients with LAD stenosis, 18 (35.3%) had PCAD while the rest had MCAD. The right coronary artery (RCA) was the second most affected occurring in 40 out of the 58 patients. Out of these 40 patients, 14 (35%) had PCAD while the rest had MCAD.

Of the 58 patients, 18 (31%) had a single vessel disease of which the majority, 10 (55.6%) had PCAD and the rest had MCAD. Twenty-one patients had triple vessel disease. Of these 21 patients, the majority 14 (66.7%) had MCAD and the rest had PCAD. In terms

of percentage stenosis, 81 (66.9%) of the involved vessels had severe stenosis of which the majority, 52 (64.2%) had MCAD and the rest had PCAD. The overall mean stenosis was 69.3% with a standard deviation of 25.1%. Patients with PCAD had a higher mean stenosis of 74.7%±29.1 compared to those with MCAD who had a mean stenosis of 63.8%±21.0 as shown in table 4.5.

Table 4.5: Patients with Abnormal Angiographic Findings

Angiography findings	**N (%)**	**Premature CAD n (%)**	**Mature CAD n (%)**
Abnormal	58 (%)	22 (37.9%)	36 (62.1%)
Vessels involved			
LAD	51 (87.9%)	18 (35.3%)	33 (64.7%)
LCX	32 (55.2%)	11 (34.4%)	21 (65.6%)
RCA	40 (69%)	14 (35%)	26 (65%)
LMCA	4 (6.9%)	2 (50%)	2 (50%)
Number of vessels involved			
Single vessel disease	18 (31%)	10 (55.6%)	8 (44.4%)
Double vessel disease	16 (27.6%)	3 (18.8%)	13 (81.2%)
Triple vessel disease	21 (36.2%)	7 (33.3%)	14 (66.7%)
Left main coronary artery disease	3 (5.2%)	2 (66.7%)	1 (33.3%)
Severity of Stenosis (n = 121)			
Mild (<50%)	28 (23.1%)	12 (42.9%)	16 (57.1%)
Moderate (50-70%)	12 (9.9%)	4 (33.3%)	8 (66.7%)
Severe (>70%)	81 (66.9%)	29 (35.8%)	52 (64.2%)
Mean stenosis	69.3%±25.1%	**74.7%±29.1**	**63.8%±21.0**

4.10 The Association between Risk Factors and Disease Severity among Patients with Angiographically Confirmed Premature Coronary Artery Disease

4.10.1 Association between risk factors and the number of vessels involved

In this section, we looked at the number of risk factors and a set of specific risk factors to see whether they were associated with the number of vessels involved.

These factors were: hypertension, diabetes, obesity, gender, smoking and dyslipidemia. From Fisher's exact test, neither the number of risk factors nor the specific factors were

associated with the number of vessels involved among patients with PCAD (P values>0.05) as shown in table 4.6.

Table 4.6: Association between the Risk Factors and the Number of Vessels Involved

		Number of vessels involved			
Risk factor	**N**	**Single vessel**	**Double vessel**	**Tripple vessel**	**P-value**
Number of risk factors					
0-2	12	4 (33.3%)	2 (16.7%)	6 (50%)	0.509[f]
≥3	10	6 (60%)	1 (10%)	3 (30%)	
Hypertension					
Yes	14	7	2	5	0.835[f]
No	8	3	1	4	
Diabetes					
Yes	7	2	1	4	0.586[f]
No	15	8	2	5	
Obesity					
Ye	8	4	1	3	0.823[f]
No	15	6	2	7	
Smoking					
Ye	3	2	0	1	1.00[f]
No	19	8	3	8	
Gender					
Female	12	7	2	3	0.308[f]
Male	10	3	1	6	
Dyslipidaemia					
Ye	13	6	2	5	1.00[f]
No	1	1	0	0	

[F]Fisher's exact test

4.10.2 Association between Risk Factors and Severity of Stenosis

In this section, we looked at the number of risk factors and a set of specific risk factors to see whether they were associated with the severity of stenosis. These factors were: hypertension, diabetes, obesity, gender, smoking and dyslipidemia. From Fisher's exact

test, neither the number of risk factors nor the specific factors were associated with the severity of stenosis among patients with PCAD (p values>0.05) as shown in table 4.7.

Table 4.7: Association between Risk Factors and the Severity of Stenosis

		Severity of stenosis			
Risk factor	**N**	**<50%**	**50 to 70%**	**>70%**	**P-value**
Number of risk factors					
0-2	27	6 (22.2%)	1 (3.7%)	20 (74.1%)	0.159[f]
≥3	18	6 (33.3%)	3 (16.7%)	9 (50%)	
Hypertension					
Yes	18	5	0	13	0.590[f]
No	24	7	4	16	
Diabetes					
Yes	28	6	1	21	0.0997[f]
No	18	6	3	8	
Obesity					
Ye	12	3	0	9	0.669[f]
No	23	9	4	20	
Smoking					
Ye	6	1	0	5	0.808[f]
No	39	11	4	24	
Gender					
Female	20	6	1	13	0.808[f]
Male	25	6	3	16	
Dyslipidaemia					
Ye	27	7	2	18	1.000[f]
No	1	0	0	1	

[F]Fisher's exact test

4.10.3 Comparison of PCAD Risk between Male and Female

We compared several risk factors of PCAD between males and females. Of the risk factors, there was a significant difference in age between males and females (P<0.05) at 5% significance level. The mean age of the male patients with PCAD was not significantly lower than that of females; 47.2±5.8 years compared to 51.9±10 years, respectively

(independent t-test p = 0.183). None of the other factors was significantly associated with gender in patients with PCAD, as shown in table 4.8.

Table 4.8: Comparison of PCAD Risk between Male and Female

Risk factor	N = 22	Males = 10	Females = 12	P value
Age in years	49.8±8.5	47.2±5.8	51.9±10	0.183[t-test]
Hypertension				
Yes	14	5	9	0.378[f]
No	8	5	3	
Diabetes				
Yes	7	2	5	0.378[f]
No	15	8	7	
Obesity				
Yes	7	1	6	0.078[f]
No	15	9	6	
Smoking				
Yes	3	3	0	0.078[f]
No	19	7	12	
Dyslipidaemia				
Ye	13	6	7	1.000[f]
No	1	0	1	

[f]Fisher's exact test

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 Introduction

Premature Coronary Heart Disease (CHD) occurs at a notably high rate in many countries. Understanding the true extent of this disease is essential for enhancing risk assessment and preventive strategies, ultimately providing the best care for those with or at risk of CHD (Sadeghi et al., 2013).

5.2 Discussion

The overall prevalence of coronary artery disease was high at 58% (95% CI 47.7%, 67.7%). In 2022, coronary artery disease (CAD) affected 315 million people worldwide, with the highest prevalence observed in Central Europe, Eastern Europe, and Central Asia, while South Asia had the lowest prevalence. A CAD prevalence of 90% has been reported in the urban populations of the United States (Stark et al., 2024). This shows that coronary artery disease is prevalent, especially among the at-risk population. The possible reason for the high prevalence of coronary artery disease in the current study is due to the nature of the patients. All the patients sampled had cardiovascular issues.

The prevalence of premature coronary artery disease among the patients with confirmed CAD in this study was high at 37.9% with a 95% confidence interval of between 25.8% and 51.7%. Similar findings have been reported by (Mohammad et al., 2015b) in a study conducted in Kurdistan in Northern Iraq. The two studies had similar age distribution between patients with PCAD and those with CAD hence comparable. A similar study conducted in India also had similar findings to the current study (Sharma et al., 2022b). Nazli et al. (2024) also reported a similar prevalence of PCAD among females <65 years and males below 55 years.

The current study revealed that females had significantly higher odds of premature coronary artery disease compared to males. These results were significant before adjusting for other factors. Though studies comparing differences in PCAD between men and women were not found, literature shows that there are notable differences between men and women concerning coronary artery disease. Importantly, this serious condition causes more deaths in women than in men each year and is the leading cause of death for both genders. Men and women exhibit distinct risk profiles when diagnosed with coronary artery disease, and their outcomes differ significantly after experiencing a myocardial infarction or undergoing coronary artery bypass grafting (Lawton, 2011). A study by Nazli et al. (2024) found significantly higher odds of PCAD among female patients compared to males despite males being more prevalent in the study. This finding is consistent with the current study. The lack of significance after adjustment in our study could be due to the small sample size.

Our study revealed that patients who smoked had lower odds of PCAD before and after adjustment and that smoking was significantly associated with lower odds of PCAD. Contrary to our findings, Nazli et al. (2024) reported that patients who smoked had higher odds of PCAD compared to those who did not smoke. This finding could be due to differences in the distribution characteristics of study participants between the two studies. Mohammad et al. (2015) has also reported contrary to our findings where smoking was a significant risk factor for PCAD compared to MCAD. The number of cigarettes smoked and years of smoking could also bring about differences in these two studies.

In the current study, patients who presented with diabetes mellitus and hypertension had lower odds of PCAD compared to MCAD though the results were not significant. Nazli et al. (2024) reported significantly lower odds of PCAD among patients with diabetes mellitus and hypertension. These findings are consistent with the current study. Contrary to our finding that obesity and abnormal levels of low-density lipoproteins reduced the odds of PCAD compared to MCAD, Mohammad et al. (2015) and Nazli et al. (2024) reported significantly higher odds of PCAD among obese patients and those with hyperlipidemia. This difference could have been influenced by participants'

characteristics considering that the current study had more patients outside the age that met criteria for PCAD compared to those that met the criteria for MCAD. Obesity has also been reported to increase with age which may support our current finding (Mkuu et al., 2021).

The current study revealed that family history of PCAD increased the risk of getting PCAD among the study participants though the results were not statistically significant. Mohammad et al. (2015) and Nazli et al. (2024) found higher odds of PCAD among the patients with a positive family history of PCAD compared with those without a positive family history of PCAD. The reported findings are consistent with those of the current study. The insignificant association in the current study is probably due to a smaller sample size. Similar findings have been reported by Rubin & Borden (2012) and Bajaj et al. (2011).

Premature coronary artery disease (P-CAD) has a complex aetiology involving multiple factors, likely a blend of genetic predispositions and environmental influences. A well-established association exists between a family history of P-CAD in first-degree relatives and an elevated risk of developing atherosclerosis-related diseases (Lloyd-Jones et al., 2004; Sivapalaratnam et al., 2010). A notably strong factor impacting offspring is the occurrence of myocardial infarction (MI) in men before age 55 and in women before age 65 (Sivapalaratnam et al., 2010). The age-adjusted odds ratio for cardiovascular events is estimated to be about 2.5 times higher in individuals with a family history of P-CAD (Lloyd-Jones et al., 2004), with an additional 10-fold increase if the first-degree relative was diagnosed before the age of 45 (Mulders et al., 2012).

The most affected artery in the current study was the left anterior coronary artery followed by the right coronary artery. Similar findings have been reported by Mohammad et al. (2015) in Iraq where the two arteries were the most affected in that respective order. According to literature, the largest coronary arteries are the first to be affected in coronary artery disease and this is in line with our findings (National Heart, Lung, and Blood Institute, 2023). More than half of the patients in the current study had more than one

vessel disease. The majority of those with more than one vessel disease had triple vessel disease. Meda et al. (2024) in Tanzania reported a high prevalence of multiple vessel disease among patients with obstructed coronary artery disease which is consistent with the current study. Contrary to our findings, Mohammad et al. (2015) reported that most of the patients who had PCAD presented with a single-vessel disease. This disparity in the number of vessels involved could be a result of differences in habits such as smoking and lifestyle.

Of the patients with PCAD in the current study, the majority had significant stenosis of more than 70%. Similar findings have been reported by Meda et al. (2024) and is consistent with our study. The mean degree of stenosis of the coronary arteries in our study was high at 74.7%. Similar findings have been reported by Maroszyńska-Dmoch & Wożakowska-Kapłon (2016) at 75.4%.

Our study did not show any association between risk factors and risk profile for coronary artery disease and the number of vessels involved or the severity of stenosis. However, a study by Wambua (2018) found a significant association between risk profile and the number of vessels involved. Wambua's study also found patients with more than three risk factors to have more severe stenosis compared to those with 0-1 risk factors. There were limited studies on the effect of risk profile on vessel involvement and severity of stenosis. Hypertension was also reported to be a significant risk for atherosclerotic plaques.

Diabetes has been linked to the number of vessels involved in coronary artery disease. According to Morgan et al. (2004) patients with diabetes mellitus are highly predisposed to coronary artery disease. More than 50% of diabetic patients succumb to coronary disease, and they represent over 20% of the cases undergoing percutaneous coronary intervention (PCI) revascularization procedures (Morgan et al., 2004).

There were limited studies on the effect of risk profile on vessel involvement and severity of stenosis. Theoretically, risk factors such as hypertension, diabetes, obesity and high

cholesterol contribute significantly to the severity of coronary artery disease through vessel involvement and obstruction (Brown et al., 2023).

5.3 Strengths and Limitations

Strengths

This is one of the first studies focusing on the risk factors for premature coronary artery disease (PCAD) and will therefore act as a precursor to other great studies in this field. This study will also aid in distinguishing risk factors for PCAD from MCAD and will therefore help physicians deal better with patients at risk for PCAD.

Limitations

Being a single-centre study, the findings of this study cannot be generalized to other centers. The consecutive sampling method employed in this study is non-probabilistic and therefore impedes generalization of the results.

The relatively smaller sample size could have affected the findings of this study. this may have lowered the power of the study

5.4 Conclusion

The prevalence of premature coronary artery disease among patients seen at Kenyatta National Hospital was high as per the findings of this study

Smoking was the only factor associated with PCAD before and after adjustment. Patients with hypertension and diabetes mellitus had lower odds of PCAD compared to MCAD.

Most of the patients in this study had multiple vessel disease with the majority having significant stenosis.

We did not find a significant association between risk factors for coronary artery disease and the number of vessels involved and the severity of stenosis among patients with premature coronary artery disease.

5.5 Recommendations

1. We recommend multiple center studies to allow the generalization of such findings to a larger population. Larger similar studies are recommended to enhance the power of the study
2. We recommend controlling cardiovascular risk factors, screening vulnerable populations, and expanding coronary interventional services to reduce the prevalence and impact of premature coronary artery disease (PCAD).
3. It is worthwhile to further investigate gender differences in coronary artery disease, including variations in risk factors and outcomes, as this study found higher odds of PCAD in females. Developing gender-specific preventive strategies and treatment plans could improve patient outcomes.
4. Smoking was a significant risk factor for CAD; hence, campaigns to cease or reduce smoking should be continued to reduce the burden of cardiovascular diseases

REFERENCES

Abdul Kadir, Azidah. (2013). Premature Coronary Artery Disease among Angiographically Proven Atherosclerotic Coronary Artery Disease in North East of Peninsular Malaysia. International Journal of Collaborative Research on Internal Medicine & Public Health. 5. 507 516.

Alai, M. S., Beig, J. R., Kumar, S., Yaqoob, I., Hafeez, I., Lone, A. A., Dar, M. I., & Rather, H. A. (2016). Prevalence and characterization of coronary artery disease in patients with symptomatic bradyarrhythmias requiring pacemaker implantation. *Indian Heart Journal*, *68*, S21–S25. https://doi.org/10.1016/j.ihj.2016.06.013

Al-Shudifat, A. E., Johannessen, A., Azab, M., Al-Shdaifat, A., AbuMweis, S. S., Agraib, L. M., & Tayyem, R. F. (2017). Risk factors for coronary artery disease in patients undergoing elective coronary angiography in Jordan. *BMC cardiovascular disorders*, *17*, 1-5. https://10.0.4.162/s12872-017-0620-4

Anjum, M., Zaman, M., & Ullah, F. (2019). Are Their Young Coronaries Old Enough? Angiographic Findings in Young Patients with Acute Myocardial Infarction. *Journal of Ayub Medical College, Abbottabad : JAMC*, *31*(2), 151–155. Retrieved from https://pubmed.ncbi.nlm.nih.gov/31094106/

Arnett, D. K., Blumenthal, R. S., Albert, M. A., Buroker, A. B., Goldberger, Z. D., Hahn, E. J., ... & Ziaeian, B. (2019). 2019 ACC/AHA guideline on the primary prevention of cardiovascular disease: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation*, *140*(11), e563-e595. https://doi.org/10.1161/CIR.000 0000000 000678

Bahiru, E., Temu, T., Gitura, B., Farquhar, C., Huffman, M. D., & Bukachi, F. (2018). Presentation, management and outcomes of acute coronary syndrome: a registry study

from Kenyatta National Hospital in Nairobi, Kenya. *Cardiovascular Journal of Africa*, *29*(4), 225–230. https://doi.org/10.5830/CVJA-2018-017

Bajaj, S., Shamoon, F., Gupta, N., Parikh, R., Parikh, N., Debari, V. A., Hamdan, A., & Bikkina, M. (2011). Acute ST-segment elevation myocardial infarction in young adults: Who is at risk? *Coronary Artery Disease*, *22*(4), 238–244. https://doi.org/10.1097/MCA.0b013e3283452e7f

Brown, J. C., Gerhardt, T. E., & Kwon, E. (2023). Risk Factors for Coronary Artery Disease. In *StatPearls [Internet]*. StatPearls Publishing. Retrieved from https://www.ncbi.nlm.nih.gov books/NBK554410/

Chege, P. (2016). Multiple cardiovascular disease risk factors in rural Kenya: evidence from a health and demographic surveillance system using the WHO STEP-wise approach to chronic disease risk factor surveillance. *South African Family Practice*, *58*(2), 54–61. https://doi.org/10.1080/20786190.2015.1114703

Chen, L., Chester, M. R., Redwood, S., Huang, J., Leatham, E., & Kaski, J. C. (1995). Angiographic Stenosis Progression and Coronary Events in Patients with 'Stabilized' Unstable Angina. *Circulation*, *91*(9), 2319–2324. https://doi.org/10.1161/01.CIR.91.9.2319

Doughty, M., Mehta, R., Bruckman, D., Das, S., Karavite, D., Tsai, T., & Eagle, K. (2002). Acute myocardial infarction in the young— The University of Michigan experience. *American Heart Journal*, *143*(1), 56–62. https://doi.org/10.1067/mhj.2002.120300

Feuchtner, G. M., Beyer, C., Langer, C., Bleckwenn, S., Senoner, T., Barbieri, F., Luger, A., Spitaler, P., Widmann, G., Adukauskaite, A., Dichtl, W., Friedrich, G., & Plank, F. (2021). The Atherosclerotic Profile of a Young Symptomatic Population between 19 and 49 Years: Coronary Computed Tomography Angiography or Coronary Artery Calcium Score? *Journal of Cardiovascular Development and Disease*, *8*(11), 157. https://doi.org/10.3390/jcdd8110157

Hubert, H. B., Feinleib, M., McNamara, P. M., & Castelli, W. P. (1983). Obesity as an independent risk factor for cardiovascular disease: a 26-year follow-up of participants in the Framingham Heart Study. *Circulation*, *67*(5), 968-977. https://doi.org/10.1161/01.CIR.67.5.968

Jebari-Benslaiman, S., Galicia-García, U., Larrea-Sebal, A., Olaetxea, J. R., Alloza, I., Vandenbroeck, K., …& Martín, C. (2022). Pathophysiology of atherosclerosis. *International journal of molecular sciences*, *23*(6), 3346. https://doi.org/ 10.3390 /ijms23063346

Kamotho, C., Ogola, E. O., Joshi, M., & Gikonyo, D. (2004). Cardiovascular risk factor profile of black Africans undergoing coronary angiography. *East African medical journal*, *81*(2), 82-86. https://doi.org/10.4314/eamj.v81i2.9130

Kassam, N., Ngunga, M., Varwani, M., Msunza, M., & Jeilan, M. (2024). Acute coronary syndrome patterns in the Young: risk factor profile and in-hospital outcomes in a tertiary referral hospital in Kenya. *BMC Cardiovascular Disorders*, *24*(1), 192. https://doi.org/ 10.1186/s12872-024-03832-z

Khoja, A., Andraweera, P. H., Lassi, Z. S., Zheng, M., Pathirana, M. M., Ali, A., Aldridge, E., Wittwer, M. R., Chaudhuri, D. D., Tavella, R., & Arstall, M. A. (2021). Risk factors for premature coronary artery disease (PCAD) in adults: a systematic review protocol. *F1000Research*, *10*, 1228. https://doi.org/10.12688/f1000research.74926.1

Khoury, S., Soleman, M., Margolis, G., Barashi, R., Rozenbaum, Z., Keren, G., & Shacham, Y. (2020). Incidence, characteristics and outcomes in very young patients with ST segment elevation myocardial infarction. *Coronary Artery Disease*, *31*(2), 103–108. https://doi.org/ 10.1097/MCA.0000000000000779

Kimani, K. N., Murray, S. A., & Grant, L. (2018). Multidimensional needs of patients living and dying with heart failure in Kenya: a serial interview study. *BMC Palliative Care*, *17*(1), 28. https://doi.org/10.1186/s12904-018-0284-6

Kimeu, R., & Kariuki, C. (2016). Assessment of the management of acute myocardial infarction patients and their outcomes at the Nairobi Hospital from January 2007 to June 2009. *Cardiovascular Journal of Africa*, *27*(4), 218–221. https://doi.org/10.5830/CVJA-2015-091

Konishi, H., Miyauchi, K., Kasai, T., Tsuboi, S., Ogita, M., Naito, R., Katoh, Y., Okai, I., Tamura, H., Okazaki, S., & Daida, H. (2014). Long-term prognosis and clinical characteristics of young adults (≤40 years old) who underwent percutaneous coronary intervention. *Journal of Cardiology*, *64*(3), 171–174. https://doi.org/10.1016/j.jjcc.2013.12.005

Lawton, J. S. (2011). Sex and Gender Differences in Coronary Artery Disease. *Seminars in Thoracic and Cardiovascular Surgery*, *23*(2), 126–130. https://doi.org/10.1053/j.semtcvs.2011.07.006

Lee, Y., & Siddiqui, W. J. (2023). Cholesterol Levels. In *StatPearls* [Internet]. StatPearls Publishing. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK542294

Lloyd-Jones, D. M., Nam, B.-H., D'Agostino, S., Ralph B., Levy, D., Murabito, J. M., Wang, T. J., Wilson, P. W. F., & O'Donnell, C. J. (2004). Parental Cardiovascular Disease as a Risk Factor for Cardiovascular Disease in Middle-aged Adults. A Prospective Study of Parents and Offspring. *JAMA*, *291*(18), 2204–2211. https://doi.org/10.1001/jama.291.18.2204

Maroszyńska-Dmoch, E. M., & Wożakowska-Kapłon, B. (2016). Clinical and angiographic characteristics of coronary artery disease in young adults: a single centre study. *Kardiologia Polska*, *74*(4), 314–321. https://doi.org/10.5603/KP.a2015.0178

Meda, J. R., Kusima, H. L., & Magitta, N. F. (2024). Angiographic characteristics of coronary artery disease in patients undergoing diagnostic coronary angiography at a tertiary hospital in Tanzania. *BMC Cardiovascular Disorders*, *24*, 125. https://doi.org/10.1186/s12872-024-03773-7

Meirhaeghe, A., Montaye, M., Biasch, K., Huo Yung Kai, S., Moitry, M., Amouyel, P., Ferrières, J., & Dallongeville, J. (2020). Coronary heart disease incidence still decreased between 2006 and 2014 in France, except in young age groups: Results from the French MONICA registries. *European Journal of Preventive Cardiology*, *27*(11), 1178–1186. https://doi.org/10.1177/2047487319899193

Mkuu, R., Barry, A., Yonga, G., Nafukho, F., Wernz, C., Gilreath, T., Chowdhury, M. A. B., & Shevon Harvey, I. (2021). Prevalence and factors associated with overweight and obesity in Kenya. *Preventive Medicine Reports*, *22*, 101340. https://doi.org/10.1016/j.pmedr.2021.101340

Mohammad, A. M., Jehangeer, H. I., & Shaikhow, S. K. (2015). Prevalence and risk factors of premature coronary artery disease in patients undergoing coronary angiography in Kurdistan, Iraq. *BMC Cardiovascular Disorders*, *15*, 155. https://doi.org/10.1186/s12872-015-0145-7

Morgan, K. P., Kapur, A., & Beatt, K. J. (2004). Anatomy of coronary disease in diabetic patients: An explanation for poorer outcomes after percutaneous coronary intervention and potential target for intervention. *Heart, 90*(7), 732. https://doi.org/10.1136/ hrt.2003.021014

Morillas, P., Bertomeu, V., Pabón, P., Ancillo, P., Bermejo, J., Fernández, C., & Arós, F. (2007). Characteristics and Outcome of Acute Myocardial Infarction in Young Patients. *Cardiology*, *107*(4), 217–225. https://doi.org/10.1159/000095421

Mulders, T. A., Sivapalaratnam, S., Stroes, E. S. G., Kastelein, J. J. P., Guerci, A. D., & Pinto, -Sietsma Sara-Joan. (2012). Asymptomatic Individuals With a Positive Family History for Premature Coronary Artery Disease and Elevated Coronary Calcium Scores Benefit From Statin Treatment. *JACC: Cardiovascular Imaging, 5*(3), 252–260. https://doi.org/10.1016/ j.jcmg.2011.11.014

National Heart, Lung, and Blood Institute. (2023, December 20). Coronary heart disease - What is coronary heart disease? Retrieved from https://www.nhlbi.nih.gov/health/coronary-heart-disease

Nazli, S. A., Rosman, A., Mohd Kasim, N. A., Al-Khateeb, A., Ul-Saufie, A. Z., Md Radzi, A. B., Ibrahim, K. S., Kasim, S. S., & Nawawi, H. (2024). Coronary risk factor profiles according to different age categories in premature coronary artery disease patients who have undergone percutaneous coronary intervention. *Scientific Reports*, *14*(1), 15326. https://doi.org/10.1038/s41598-024-53539-6

O'Neill, B. (2022). Sample size determination with a pilot study. *PloS One*, *17*(2), e0262804. https://doi.org/10.1371/journal.pone.0262804

Ogeng'o, J. A., Olabu, B. O., Ong'era, D., & Sinkeet, S. R. (2010). Pattern of acute myocardial infarction in an African country. *Acta Cardiologica*, *65*(6), 613–618. https://doi.org/10.2143/AC.65.6.2059856

Onen, C. L. (2013). Epidemiology of ischaemic heart disease in sub-Saharan Africa. *Cardiovascular journal of Africa*, *24*(2), 34-42. https://doi.org/10.5830/cvja-2012-071

Osadnik, T., Pawlas, N., Lonnie, M., Osadnik, K., Lejawa, M., Wądołowska, L., Bujak, K., Fronczek, M., Reguła, R., Gawlita, M., Strzelczyk, J., Góral, M., Gierlotka, M., Poloński, L., & Gąsior, M. (2018). Family History of Premature Coronary Artery Disease (P-CAD)—A Non-Modifiable Risk Factor? Dietary Patterns of Young Healthy Offspring of P-CAD Patients: A Case-Control Study (MAGNETIC Project). *Nutrients*, *10*(10), 1488. https://doi.org/10.3390/nu10101488

Page, R. L., Ghushchyan, V., Gifford, B., Read, R. A., Raut, M., Crivera, C., Naim, A. B., Damaraju, C. V., & Nair, K. v. (2013). The Economic Burden of Acute Coronary Syndromes for Employees and Their Dependents. *Journal of Occupational & Environmental Medicine*, *55*(7), 761–767. https://doi.org/10.1097/JOM.0b013e318297323a

Peng, L., Guo, X., Gao, Y., Guo, Q., Zhang, J., Fang, B., & Yan, B. (2018). Impact of right coronary dominance on triple-vessel coronary artery disease: A cross-sectional study. *Medicine*, *97*(32), e11685. https://doi.org/10.1097/MD.0000000000011685

Purnell, J. Q. (2000). Definitions, Classification, and Epidemiology of Obesity. In K. R. Feingold, B. Anawalt, M. R. Blackman, A. Boyce, G. Chrousos, E. Corpas, W. W. de Herder, K. Dhatariya, K. Dungan, J. Hofland, S. Kalra, G. Kaltsas, N. Kapoor, C. Koch, P. Kopp, M. Korbonits, C. S. Kovacs, W. Kuohung, B. Laferrère, … D. P. Wilson (Eds.), Endotext. MDText.com, Inc. Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK279167/

Raparelli, V., Elharram, M., Shimony, A., Eisenberg, M. J., Cheema, A. N., & Pilote, L. (2018). Myocardial Infarction with No Obstructive Coronary Artery Disease: Angiographic and Clinical Insights in Patients with Premature Presentation. *The Canadian Journal of Cardiology*, *34*(4), 468–476. https://doi.org/10.1016/j.cjca.2018.01.004

Rodríguez-Muñoz, P. M., Carmona-Torres, J. M., Rivera-Picón, C., Morales-Cané, I., Fabbian, F., Manfredini, R., Rodríguez-Borrego, M. A., & López-Soto, P. J. (2021). Risky Behaviours of Spanish University Students: Association with Mediterranean Diet, Sexual Attitude and Chronotype. *Nutrients*, *13*(11), 4042. https://doi.org/10.3390/nu13114042

Roth, G. A., Mensah, G. A., Johnson, C. O., Addolorato, G., Ammirati, E., Baddour, L. M., Barengo, N. C., Beaton, A. Z., Benjamin, E. J., Benziger, C. P., Bonny, A., Brauer, M., Brodmann, M., Cahill, T. J., Carapetis, J., Catapano, A. L., Chugh, S. S., Cooper, L. T., Coresh, J., & Fuster, V. (2020). Global Burden of Cardiovascular Diseases and Risk Factors, 1990–2019. *Journal of the American College of Cardiology*, *76*(25), 2982–3021. https://doi.org/10.1016/j.jacc.2020.11.010

Rubin, J. B., & Borden, W. B. (2012). Coronary heart disease in young adults. Current Atherosclerosis Reports, 14(2), 140–149. https://doi.org/10.1007/s11883-012-0226-3

Sadeghi, R., Adnani, N., Erfanifar, A., Gachkar, L., & Maghsoomi, Z. (2013). Premature Coronary Heart Disease and Traditional Risk Factors-Can We Do Better? *International Cardiovascular Research Journal*, *7*(2), 46.

Salehi, N., Janjani, P., Tadbiri, H., Rozbahani, M., & Jalilian, M. (2021). Effect of cigarette smoking on coronary arteries and pattern and severity of coronary artery disease: a review. *The Journal of International Medical Research*, *49*(12), 3000605211059893. https://doi.org/10.1177/03000605211059893

Scheffold, T., Kullmann, S., Huge, A., Binner, P., Ochs, H. R., Schöls, W., Thale, J., Motz, W., Hegge, F. J., Stellbrink, C., Dorsel, T., Gülker, H., Heuer, H., Dinh, W., Stoll, M., Haltern, G., & Forschungsverbund Herz-Kreislauf in NRW (Research Consortium Heart and Circulation in North Rhine-Westphalia). (2011). Six sequence variants on chromosome 9p21.3 are associated with a positive family history of myocardial infarction: a multicenter registry. *BMC Cardiovascular Disorders*, *11*, 9. https://doi.org/10.1186/1471-2261-11-9

Sharma, S. K., Makkar, J. S., Bana, A., Sharma, K., Kasliwal, A., Sidana, S. K., Degawat, P. R., Bhagat, K. K., Chaurasia, A. K., Natani, V., Sharma, S. K., & Gupta, R. (2022). Premature coronary artery disease, risk factors, clinical presentation, angiography and interventions: Hospital based registry. *Indian Heart Journal*, *74*(5), 391–397. https://doi.org/10.1016/j.ihj.2022.08.003

Shukor, M. F. A., Musthafa, Q. A., Mohd Yusof, Y. A., Wan Ngah, W. Z., & Ismail, N. A. S. (2023). Biomarkers for Premature Coronary Artery Disease (PCAD): A Case Control Study. *Diagnostics*, *13*(2), 188. https://doi.org/10.3390/diagnostics13020188

Singh, B., Singh, A., Goyal, A., Chhabra, S., Tandon, R., Aslam, N., Mohan, B., & Wander, G. S. (2019). The Prevalence, Clinical Spectrum and the Long-Term Outcome of ST-segment Elevation Myocardial Infarction in Young - A Prospective Observational Study. *Cardiovascular Revascularization Medicine*, *20*(5), 387–391. https://doi.org/10.1016/j.carrev.2018.07.020

Sivapalaratnam, S., Boekholdt, S. M., Trip, M. D., Sandhu, M. S., Luben, R., Kastelein, J. J., ... & Khaw, K. T. (2010). Family history of premature coronary heart disease and risk prediction in the EPIC-Norfolk prospective population study. *Heart*, *96*(24), 1985-1989.

Stark, B., Johnson, C., & Roth, G. A. (2024). Global prevalence of coronary artery disease: An update from the global burden of disease study. *Journal of the American College of Cardiology*, *83*(13_Supplement), 2320–2320. https://doi.org/10.1016/S0735-1097 (24)04 310-9

Steyn, K., & Sliwa, K. (2016). The African Interheart study. In *The Heart of Africa* (pp. 89–95). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781119097136.ch5

Temu, T. M., Macharia, P., Mtui, J., Mwangi, M., Ngungi, P. W., Wanjalla, C., ... & Kibachio, J. (2021). Obesity and risk for hypertension and diabetes among Kenyan adults: Results from a national survey. *Medicine*, *100*(40), e27484. https://doi.org/10.1097%2FMD. 00000 000 00027484

Trzeciak, P., Gierlotka, M., Poloński, L., & Gąsior, M. (2017). Treatment and outcomes of patients under 40 years of age with acute myocardial infarction in Poland in 2009-2013 (analysis from PL-ACS Registry). *Polish Archives of Internal Medicine*. https://doi.org/ 10.20452/pamw.4092

Virani, S. S., Alonso, A., Benjamin, E. J., Bittencourt, M. S., Callaway, C. W., Carson, A. P., Chamberlain, A. M., Chang, A. R., Cheng, S., Delling, F. N., Djousse, L., Elkind, M. S. v, Ferguson, J. F., Fornage, M., Khan, S. S., Kissela, B. M., Knutson, K. L., Kwan, T. W., Lackland, D. T., … American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee. (2020). Heart Disease and Stroke Statistics-2020 Update: A Report from the American Heart Association. *Circulation*, *141*(9), e139–e596. https://doi.org/10.1161/CIR.0000000000000757

Wachira, B. W., Owuor, A. O., & Otieno, H. A. (2014). Acute management of ST-elevation myocardial infarction in a tertiary hospital in Kenya: Are we complying with practice

guidelines? *African Journal of Emergency Medicine*, *4*(3), 104–108. https://doi.org/10.1016/j.afjem.2013.12.003

Wambua, P. (2018). Clinical profiles and angiographic patterns of patients undergoing coronary angiograms in two hospitals in Nairobi (Doctoral dissertation, University of Nairobi). University of Nairobi Repository

Waweru, P., & Gatimu, S. M. (2021). Stroke Epidemiology, Care, and Outcomes in Kenya: A Scoping Review. *Frontiers in Neurology*, *12*. https://doi.org/10.3389/fneur.2021.785607

Wekesah, F. M., Klipstein-Grobusch, K., Grobbee, D. E., Kadengye, D., Asiki, G., & Kyobutungi, C. K. (2020). Determinants of Mortality from Cardiovascular Disease in the Slums of Nairobi, Kenya. *Global Heart*, *15*(1), 33. https://doi.org/10.5334/gh.787

World Health Organization. (2021). *Cardiovascular diseases (CVDs)*. Retrieved from https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)

Writing Committee Members, Lawton, J. S., Tamis-Holland, J. E., Bangalore, S., Bates, E. R., Beckie, T. M., ... & Zwischenberger, B. A. (2022). 2021 ACC/AHA/SCAI guideline for coronary artery revascularization: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Journal of the American College of Cardiology*, *79*(2), e21-e129. Retrieved from https://www.jacc.org/doi/full/10.1016/j.jacc.2021.09.006

Wu, W. Y., Berman, A. N., Biery, D. W., & Blankstein, R. (2020). Recent trends in acute myocardial infarction among the young. *Current Opinion in Cardiology*, *35*(5), 524–530. https://doi.org/10.1097/HCO.0000000000000781

Yang, J., Biery, D. W., Singh, A., Divakaran, S., DeFilippis, E. M., Wu, W. Y., Klein, J., Hainer, J., Ramsis, M., Natarajan, P., Januzzi, J. L., Nasir, K., Bhatt, D. L., di Carli, M. F., & Blankstein, R. (2020). Risk Factors and Outcomes of Very Young Adults Who Experience

Myocardial Infarction: The Partners YOUNG-MI Registry. *The American Journal of Medicine, 133*(5), 605-612.e1. https://doi.org/10.1016/j.amjmed.2019.10.020

Yusuf, S., Hawken, S., Ôunpuu, S., Dans, T., Avezum, A., Lanas, F., ... & Lisheng, L. (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *The lancet*, *364*(9438), 937-952. https://doi.org/10.1016/S0140-6736(04)17018-9

Zgheib, H., al Souky, N., el Majzoub, I., Wakil, C., Sweidan, K., Kaddoura, R., al Hariri, M., & Chebel, R. B. (2020). Comparison of outcomes in ST-elevation myocardial infarction according to age. *The American Journal of Emergency Medicine*, *38*(3), 485–490. https://doi.org/10.1016/j.ajem.2019.05.023

APPENDICES

Appendix I: Consent to Participate in Research

Consent Form Section A: Study Information

Study Title: To determine the angiographic findings and risk factors for premature coronary artery disease in patients undergoing coronary angiography in Kenyatta National Hospital, Nairobi, Kenya

Statement of the Researcher

We request you to participate in a research study. The information in this form explains what participation in the study entails. Please, listen carefully as I read this form. You are free to ask questions about what we will ask you to do, the risks involved, the benefits, your rights as a volunteer or anything in this form that may not be clear to you. In a process known as informed consent you decide whether or not you would like to participate in the study. If you agree to take part in the study after we have described it to you and having answered any questions you have to your satisfaction, we will give you a signed copy of this form for your records.

Purpose of the Study

The purpose of this study is to determine the angiographic findings and risk factors for premature coronary artery disease in patients undergoing coronary angiography in Kenyatta National Hospital (KNH), Nairobi, Kenya. The finding from this study will help government policy makers and other stakeholders to elicit the risk factors for premature coronary artery disease in order to find ways of addressing them.

Study Procedure

The study will be carried out in KNH in Nairobi. We shall engage cardiologists to work with you so as to determine the angiographic findings and risk factors for premature

coronary artery disease. If you agree to participate in the study, we will interview you at the hospital and obtain some of your information from hospital records. The interview will take about 20 to 30 minutes.

Risks, Stress and Discomforts

This study will not put you to any risk. However, answering the questionnaire will take about 20 to 30 minutes.

Benefits of Participating in the Study

Your participation will help us determine the angiographic findings and risk factors for premature coronary artery disease at Kenyatta National Hospital, Nairobi, Kenya.

Volunteerism and other Information

Your participation in this study is absolutely voluntary and you may decide to withdraw your participation before or during the interview without any consequences. It is still possible to decline to participate even after signing this consent form. Information generated from this study will be used for the purpose described in this consent form. We would like to reassure you that the data and any publication from this study will not contain information that will reveal your identity as a participant. Only the investigator and study staff will have access to information that link your name on the consent form you have signed or put your mark on and your study number. We will keep information you give confidential. Should you have any question about the study, please feel free to get in touch with the researcher.

Salat Ahmed Abdi

_____ _____ _____

Name of Researcher Signature Date

Consent Form Section B: Statement of the Participant

In signing this form, I give my consent to participate in a study titled, "**Angiographic findings and risk factors for premature coronary artery disease in patients undergoing coronary angiography in Kenyatta National Hospital, Nairobi, Kenya**". The purpose of this study has been clearly explained to me. I consent to participate in this study. I have been accorded the opportunity to ask questions. I understand that my participation in this research will expose me to no risk. I understand that my identity will be kept confidential. Data will be coded such that my identity will not be compromised at any time nor will any key with participant names be available to anyone other than the investigator of this research and the academic supervisors. I understand that if I need additional information or have further questions, I will reach the investigator of this research study, Salat Ahmed Abdi, Master of Science (MSc) Internal Medicine candidate, Department of Internal Medicine, School of Medicine, Jomo Kenyatta University of Agriculture and Technology, Kenya, at the following address:

Kenyatta National Hospital, Nairobi, Kenya
P.O. Box 20723 - 00202, Nairobi.

Name of Participant: …… Signature: …… Date: ……

Contact information

In case of any issues or challenges related to this study, please contact me on +254 729494326, my Supervisor Dr.Namasaka on +254721689085 or KNH/UON ERC Secretariat on uonknherc@uonbi.ac.ke or +254 721 257746, (020) 318262 Ext.28250.

Thank you for sparing your precious time dedicated to participating in this study exercise.

Appendix II: Idhini ya Kushiriki katika Utafiti

Fomu ya Ridhaa Sehemu A: Taarifa za Utafiti

Kichwa cha Utafiti: Kuamua matokeo ya angiografia na sababu za hatari kwa ugonjwa wa ateri ya moyo kabla ya wakati kwa wagonjwa wanaopitia angiografia ya moyo katika Hospitali ya Kitaifa ya Kenyatta, Nairobi, Kenya.

Kauli ya Mtafiti

Tunakuomba ushiriki katika utafiti wa huu. Taarifa katika fomu hii inaeleza ushiriki katika utafiti unahusu nini. Tafadhali, sikiliza kwa makini ninaposoma fomu hii. Uko huru kuuliza maswali kuhusu kile ambacho tutakuuliza ufanye, hatari zinazohusika, manufaa, haki zako kama mtu wa kujitolea au kitu chochote katika fomu hii ambacho huenda usiwe wazi kwako. Katika mchakato unaojulikana kama idhini iliyoarifiwa unaamua kama ungependa kushiriki katika utafiti au la. Ukikubali kushiriki katika utafiti baada ya kukueleza na kujibu maswali yoyote uliyo nayo kwa kuridhika kwako, tutakupa nakala iliyotiwa sahihi ya fomu hii kwa rekodi zako.

Madhumuni ya Utafiti

Madhumuni ya utafiti huu ni kubainisha matokeo ya angiografia na sababu za hatari kwa ugonjwa wa ateri ya moyo kabla ya wakati kwa wagonjwa wanaopitia angiografia ya moyo katika Hospitali ya Kitaifa ya Kenyatta (KNH), Nairobi, Kenya. Matokeo kutoka kwa utafiti huu yatasaidia watunga sera wa serikali na washikadau wengine kuibua sababu za hatari za ugonjwa wa ateri ya moyo kabla ya wakati ili kutafuta njia za kukabiliana nazo.

Utaratibu wa Masomo

Utafiti huo utafanywa KNH jijini Nairobi. Tutawashirikisha wataalamu wa magonjwa ya moyo kufanya kazi nawe ili kubaini matokeo ya angiografia na sababu za hatari za

ugonjwa wa ateri ya moyo kabla ya wakati. Ukikubali kushiriki katika utafiti, tutakuhoji hospitalini na kupata baadhi ya taarifa zako kutoka kwa rekodi za hospitali. Mahojiano yatachukua kama dakika 20 hadi 30.

Hatari, Dhiki na Masumbuko

Utafiti huu hautakuweka kwenye hatari yoyote. Hata hivyo, kujibu dodoso itachukua kama dakika 20 hadi 30.

Faida za Kushiriki katika Utafiti

Kushiriki kwako kutatusaidia kubainisha matokeo ya angiografia na sababu za hatari kwa ugonjwa wa ateri ya moyo kabla ya wakati katika Hospitali ya Kitaifa ya Kenyatta, Nairobi, Kenya.

Kujitolea na Habari Nyingine

Kushiriki kwako katika utafiti huu ni kwa hiari kabisa na unaweza kuamua kuondoa ushiriki wako kabla au wakati wa mahojiano bila matokeo yoyote. Bado inawezekana kukataa kushiriki hata baada ya kusaini fomu hii ya idhini. Taarifa zinazotokana na utafiti huu zitatumika kwa madhumuni yaliyoelezwa katika fomu hii ya idhini. Tungependa kukuhakikishia kuwa data na uchapishaji wowote kutoka kwa utafiti huu hautakuwa na taarifa ambayo itafichua utambulisho wako kama mshiriki. Mpelelezi na wafanyakazi wa utafiti pekee ndio watapata taarifa zinazounganisha jina lako kwenye fomu ya idhini uliyotia saini au kuweka alama yako na nambari yako ya utafiti. Tutaweka habari utakazotoa kwa siri. Iwapo una swali lolote kuhusu utafiti, tafadhali jisikie huru kuwasiliana na mtafiti.

Salat Ahmed Abdi

_____	_____	_____
Jina la Mtafiti	Tarehe ya	Sahihi

Fomu ya Ridhaa Sehemu B: Taarifa ya Mshiriki

Katika kutia saini fomu hii, natoa idhini yangu ya kushiriki katika utafiti unaoitwa, **"Matokeo ya Angiografia na sababu za hatari kwa ugonjwa wa ateri ya moyo kabla ya wakati kwa wagonjwa wanaopitia angiografia ya moyo katika Hospitali ya Kitaifa ya Kenyatta, Nairobi, Kenya".** Madhumuni ya utafiti huu yameelezwa wazi kwangu. Ninakubali kushiriki katika utafiti huu. Nimepewa nafasi ya kuuliza maswali. Ninaelewa kuwa ushiriki wangu katika utafiti huu hautaniweka katika hatari yoyote. Ninaelewa kuwa utambulisho wangu utawekwa siri. Data itawekwa msimbo ili kwamba utambulisho wangu hautaathiriwa wakati wowote wala ufunguo wowote wenye majina ya washiriki hautapatikana kwa mtu mwingine yeyote isipokuwa mpelelezi wa utafiti huu na wasimamizi wa masomo. Ninaelewa kwamba nikihitaji maelezo ya ziada au nikiwa na maswali zaidi, nitawasiliana na mpelelezi wa utafiti huu, Salat Ahmed Abdi, Mtahiniwa wa Udaktari wa Uzamili wa Sayansi (MSc), Idara ya Tiba ya Ndani, Shule ya Tiba, Chuo Kikuu cha Jomo Kenyatta cha Kilimo na Teknolojia, Kenya, kwa anwani ifuatayo:

Hospitali ya Kitaifa ya Kenyatta, Nairobi, Kenya

P.O. Box 20723 - 00202, Nairobi.

Jina la Mshiriki: …… Sahihi: …… Tarehe: ……

Maelezo ya mawasiliano

Iwapo kuna masuala au changamoto zinazohusiana na utafiti huu, tafadhali wasiliana nami kwa +254 729494326, Msimamizi wangu Dr.Namasaka kwa +254721689085 KNH-UoN Sekretarieti ya ERC kwa uonknherc@uonbi.ac.ke au +254 721 257746, (020) 318262 Ext.28250.

Asante kwa kuhifadhi muda wako wa thamani uliojitolea kushiriki katika zoezi hili la utafiti

Appendix III: Data Collection Tools

PREVALENCE, ANGIOGRAPHIC FINDINGS AND RISK FACTORS FOR PREMATURE CORONARY ARTERY DISEASE IN PATIENTS UNDERGOING CORONARY ANGIOGRAPHY IN Kenyatta National Hospital, Nairobi, Kenya

Questionnaire No: …… Date…….

Participants/Patients Name: …….....

INSTRUCTIONS

i. Consent before proceeding with the questions.
ii. Tick as appropriate

PART I: RESPONDENTS DEMOGRAPHIC CHARACTERISTICS			
	Questions	**Coding category**	**Skip pattern**
1.1	What is your age?	……..	
1.2	What is your gender?	Male [1] Female [2]	
1.4	What is your area of residence?	Urban [1] Rural [2]	

PART II: RISK FACTORS FOR PREMATURE CORONARY ARTERY DISEASE			
	Questions	**Coding category**	**Skip pattern**
2.1	Have you ever smoked cigarette or tobacco?	Yes [1] No [2]	If 2, skip to Q.2.3
2.2	How many cigarettes per day? How many years of smoking?	……. …….	
2.3	**Dyslipidemia status**: are you prescribed on any lipid lowering medications? LDL levels (mmol/L): ……	Yes [1] No [2]	

	HDL levels (mmol/L): …… Total blood cholesterol (mmol/L): ……		
2.4	Family history of PCAD?	Yes [1] No [2]	
2.5	Diabetic Status?	Diabetic [1] Non-Diabetic [2]	
2.6	Hypertension	Hypertension [1] Non-Hypertension [2]	
2.7	Do you consume alcohol?	Yes [1] No [2]	
2.8	Nutritional status:	Weight…….. Height…….	
2.9	Do you regularly exercise?	Yes [1] If 1, skip to Q.3.2 No [2]	
3.1	How many days of the week of moderate to high intensity exercise?	No. of days per week….... Total minutes per week……	
3.2	How frequent do you take fruits and vegetable?	Daily [1] occasional [2]	
3.3	Do you regularly take fruit, vegetables, nuts, legumes, fish, chicken and whole-fat dairy?	Yes [1] No [2] If 2, skip to Q 3.5	
3.4	If no to above, which type of food do you often take?	……	

PART III: ANGIOGRAPHIC FINDINGS			
	Questions	**Coding category**	**Skip pattern**
3.5	Date when angiogram was done:……		
3.6	Indication for coronary angiogram?	Stable Angina [1] Unstable Angina [2] NSTEMI [3] STEMI [4] DCM [5] Other (specify) [6]	

3.7	If DCM, what is the ejection fraction	……	
3.8	Angiography diagnosis?	Normal [1] Abnormal [2]	
3.9	If abnormal, which vessel is involved?	□LMCA □LCX □LAD □RCA □Other (name……)	
4.0	Percentage (%) Stenosis?	□ If LMCA,site & % Stenosis? …… …… …….. □ If LCX, site & % Stenosis? …… …… …….. □ If LAD, site & % Stenosis? …… …… …….. □ If RCA, site & % Stenosis? …… …… …….. □If other, site & % Stenosis? …… …… ……..	
4.1	Other angiographic findings? Please specify.	……..	
4.2	Treatment done or recommended	□Medical □PCI □CABG	

PART IV: ANGIOGRAPHY OUTCOME			
	Questions	**Coding category**	**Skip pattern**
4.3	Presence of PCAD?	Yes [1] No [2]	

Appendix IV: Dummy Table

Dummy Tables

Table 1: Demographic Characteristics

	Frequency	Percentage
Demographic factors		
Age (Mean± SD)	xx	xx
Gender	xx	xx
Marital status	xx	xx
Education level	xx	xx
Nature of occupation	xx	xx
Residence	xx	xx

Table 2: Prevalence of Risk Factors for Angiographically Confirmed PCAD

	Frequency	Percentage
Demographic factors		
Smoking	xx	xx
Dyslipidemia	xx	xx
History of PCAD	xx	xx
Diabetic	xx	xx
Hypertension	xx	xx
Obesity	xx	xx
Physical Inactivity	xx	xx
Unhealthy Diet	xx	xx

Table 3. Involved coronary artery branches by Risk factors (Based on Chi-square Test)

CVS Risk Factors	**LAD**			**LCX**			**RCA**			**LMS**		
	No	**%**	***P* value**	**No**	**%**	***P* value**	**No**	**%**	***P* value**	**No**	**%**	***P* value**
T2DM	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Hypertension	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Dyslipidemia	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Smoking	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Obesity	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Physical Inactivity	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx

CVS Risk Factors	LAD			LCX			RCA			LMS		
	No	**%**	***P* value**	**No**	**%**	***P* value**	**No**	**%**	***P* value**	**No**	**%**	***P* value**
Unhealthy Diet	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx

Table 4: Number of affected vessels by risk factors (Based on Chi-square Test)

CVD Risk Factors	Normal		Non-significant		SVD		DVD		TVD		Total		*P*-values
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	
T2DM	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Hypertension	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Dyslipidaemia	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Smoking	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Obesity	xx	xx	xx	xx	xx	xxxx	xx	xx	xx	xx	xx	xx	xx
Physical Inactivity	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
Unhealthy Diet	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx

Table 4: Logistic regression model of CAD risk factors in premature CAD

CAD risk factors	Odds Ratio	Confidence Interval	P-value
T2DM	xx	xx	xx
hypertension	xx	xx	xx
Dyslipidemia	xx	xx	xx
smoking	xx	xx	xx
Obesity	xx	xx	xx
Physical Inactivity	xx	xx	xx
Unhealthy Diet	xx	xx	xx

Appendix VI: Map of Study Area

Appendix VII: Kenyatta National Hospital/University of Nairobi ERC Approval Letter

UNIVERSITY OF NAIROBI

UNIVERSITY OF NAIROBI
FACULTY OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
(254-020) 2726300

KNH-UoN ERC
Email: uonknh_erc@uonbi.ac.ke
Website: http://www.erc.uonbi.ac.ke
Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC1

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9 Ext 44355, 44102
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/216

12th June, 2024

Dr. Ahmed Abdi Salat
Reg. No. HSM 352-0116/2022
Dept. of Internal Medicine
School of Medicine
J.K.U.A.T

APPROVED
12 JUN 2024

Dear Dr. Salat,

ETHICAL APPROVAL-RESEARCH PROPOSAL: PREVALENCE, ANGIOGRAPHIC FINDINGS AND RISK FACTORS FOR PREMATURE CORONARY ARTERY DISEASE IN PATIENTS UNDERGOING CORONARY ANGIOGRAPHY IN KENYATTA NATIONAL HOSPITAL, NAIROBI, KENYA (P311/04/2024)

This is to inform you that KNH-UoN ERC has reviewed and approved your above research proposal. Your application approval number is **P311/04/2024** The approval period is 12th June 2024 – 11th June 2025.

This approval is subject to compliance with the following requirements:

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by KNH-UoN ERC.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to KNH-UoN ERC 72 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH-UoN ERC within 72 hours.
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to KNH-UoN ERC.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://research-portal.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

PROF. ANGELA AMAYO
CHAIR, KNH- UON ERC

c.c. The Dean, Faculty of Health Sciences, UoN
The Senior Director, CS, KNH
The Assistant Director, Health Information Dept., KNH
The Chair, Dept. of Internal Medicine, J.K.U.A.T
Supervisors: Dr. Namasaka Philemon, School of Medicine, J.K.U.A.T
Dr. Wangari Ndege Beatrice, School of Medicine, J.K.U.A.T