RISK FACTORS ASSOCIATED WITH CARDIOVASCULAR DISEASES AMONG PATIENTS ATTENDING NYERI COUNTY REFERRAL HOSPITAL, CENTRAL KENYA

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DECLARATION AND APPROVAL

Declaration by Candidate:

This thesis is my original work and has not been presented for a degree in any other university or any other award.

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DEDICATION

This work is dedicated to my daughter, Naima Wanjiku Chebet, my parents Dr. Titus Kahiga and Dr. Millicent Muhu, my brothers Roy Muhu and James Kahiga for their unwavering patience, support and prayers.

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ABBREVIATIONS AND ACRONYMS

AMIU - Amref International University

AMPATH - Academic Model Providing Access to Healthcare.

ASCVD - Cardiovascular disease that specifically affects blood vessels by build-up of cholesterol plaques

BMI - Body Mass Index.

BP - Blood Pressure

CHD - Congenital heart disease.

CVDs - Cardiovascular Diseases.

DASH - Dietary Approaches to Stop Hypertension.

DBP - Diastolic Blood Pressure.

DM - Diabetes Mellitus

ESRC - Ethics and scientific Research Commission

GFR - Glomerular Filtration Rate

LMIC - Low- and Middle-Income Countries

NCRH - Nyeri County Referral Hospital

QRISK - Average risk of acquiring cardiovascular diseases in the next 10 years

SBP - Systolic Blood Pressure

SPSS - Statistical Package for Social Sciences.

UK - United Kingdom

US - United States

USAID - United States Action for International Development

WHO - World Health Organization

OPERATIONAL DEFINITION OF TERMS

Behavioral risk factors: These are unhealthy behaviours that can predispose a person to cardiovascular disease. Examples include: alcohol intake, physical inactivity smoking and diet.

Biologic risk factors: These are biological characteristics of people that can either be modified or not modified and increase the chances of cardiovascular disease. Examples include: hypertension, diabetes, obesity

Cardiovascular disease: these are a group of disorders that affect the cardiovascular system such as Ischemic cardiomyopathy and cerebrovascular accident.

Risk factors: These are variables that are associated with increased chances of developing cardiovascular diseases**.**

WHO CVD risk Score: The average risk of a person getting a cardiovascular disease in the next 10 years that is predicted by evaluating both biologic and behavioral risks, it can either be high, moderate or low risk. It is calculated in the WHO guideline titled "HEARTS: Risk based VD management 2022". The parameters which are used to predict the cardiovascular disease risk score in the chart include age, sex, smoking status, body mass index (kg/m^2) and systolic blood pressure

(mmHg). The charts are color-coded based on the severity of risk to aid in accurately placing the patients in their respective categories.

ABSTRACT

Background: Globally, cardiovascular disease is among the leading causes of morbidity and premature death. Several risk factors have been shown to be associated with increased risk of acquiring cardiovascular disease. In Sub Saharan Africa, the trend has been rising steadily. Most of the population in Kenya is unaware of these risk factors. Moreover, there is lack of access to appropriate healthcare among the rural population. Few studies exist in Kenya that highlight the determinants of cardiovascular disease.

Broad Objective: The aim of this study was to determine the risk factors associated with cardiovascular disease among patients attending Nyeri County Referral Hospital.

Methods: This was a cross-sectional study using probability proportion to size and systematic sampling method targeting 320 respondents based in a hospital. Data was collected [from the based on?] a structured questionnaire. Analysis of the data was undertaken by using SPSS and bivariate linear regression was used to describe the relationship between the socio-demographic characteristics and the WHO CVD risk score.

Study findings Hypertension, as a risk factor for cardiovascular disease, had a prevalence of 23.8% (95% CI 22.9%-24.6%), diabetes had a prevalence of 4% (95 % CI 2.92%-5.08%) while obesity had a prevalence of 13.2% (95% CI 9.5%-16.9%). Among the respondents, 21.9% took alcohol, 8.5% smoked tobacco, 34.8% engaged in moderate exercise adequately, 7.8% took fruits and vegetables daily, 38.9% took sugar, 88% of them had starchy foods more than 2 days/week and 12% took fish, poultry daily. WHO CVD risk scores showed that 79% had low CVD risk score, 16.3% and 4.4% had moderate and low CVD risk scores respectively. There was a strong association between age, gender, residence, education and employment status, income level and cardiovascular disease risk.

Conclusion: Prevalence of biological risk factors was similar to national estimates. Prevalence of behavioral risk factors varied. WHO CVD risk scores demonstrated that majority had low CVD risk scores while the rest had moderate to high CVD risk scores. Several socio-demographic characteristics increased cardiovascular risk among the population.

CHAPTER 1: INTRODUCTION

1.1 Background of the Study

The cardiovascular system is the system that supplies the body with blood. It consists of the heart and blood vessels including arteries, veins and capillaries. Cardiovascular diseases (CVDs) are a group of disorders that affect the cardiovascular system. They can be divided into 2 categories; diseases that affect the heart and diseases that affect the blood vessels: Cardiac diseases include: Coronary heart disease, Rheumatic or Valvular heart disease, Ischemic cardiomyopathy, Dilated cardiomyopathy, Hypertrophic cardiomyopathy, congenital heart disease and Arrhythmias. Vascular diseases include Peripheral Arterial and Venous disease, Cerebrovascular Accidents or Stroke, Venous thromboembolism, Connective Tissue disorders and Atherosclerosis (Flora et al., 2019).

There are several risk factors that are strongly linked with the occurrence of cardiovascular disease in different populations. The main risk factors can be classified into different categories based on WHO classifications. They are behavioral risk factors that are inclusive of a sedentary lifestyle, tobacco use, excessive alcohol intake and an unhealthy diet. The second category is biological which can be divided into modifiable and non-modifiable. The modifiable biological factors include hypertension, diabetes and elevated cholesterol levels. The non-modifiable biological risk factors are age, gender, race/ethnicity, genetic and family history (Mensah et al., 2019).

Other emerging novel risk factors associated with cardiovascular disease are undergoing research. Environmental exposure is an important but underappreciated risk factor contributing to the development and severity of cardiovascular disease (CVD). The heart

and vascular system are highly vulnerable to a number of environmental agents and ambient air pollution. Metals such as arsenic, cadmium, and lead have been studied as independent risk factors for cardiovascular disease (Akther et al., 2019).

COVID -19 has proven to be a risk factor to the occurrence of cardiovascular disease mainly resulting in myocardial injury and blood clots in the arterial and venous system. This has been shown to lead to strokes, thromboembolic events and heart attacks mainly due to the systemic inflammation associated with the virus (Siripanthong et al., 2020). Other factors include biochemical markers, genetic markers, estimated GFR, uric acid and homocysteine levels. These factors have been shown to be associated with the disease but do not have a significant prediction of outcome.

There are also social determinants of CVD reflecting current changes worldwide for example globalization, urbanization, poverty, depression, increased stress among other psychosocial factors (Sims et al., 2020). This impact is mainly felt in LMIC countries in Sub Saharan Africa. A study done in Nairobi Slums showed favourable socioeconomic indicators, such as being employed or attaining primary school level education and higher were associated with decreased risk of CVD (Wekesah et al., 2020). It was also demonstrated that employees who experience work-related stress and individuals who are socially isolated or lonely had an increased risk of a first CHD event. In addition, short-term or chronic emotional stress could act as a trigger of adverse cardiovascular outcomes among individuals (Asma et al., 2021). Therefore, it is important to recognize the role played by social determinants of health as a risk factor for cardiovascular disease morbidity and mortality.

The Ministry of Health, Kenya in "National Guidelines for Cardiovascular disease Management, 2018" stipulates that CVDs were a major public health concern with significant economic implications in terms of health care-needs, lost productivity and premature death. This places a heavy economic burden on the financial resources reducing national growth and development. It is therefore vital to look at the association and interaction between the risk factors of cardiovascular disease in the Kenyan population. This could enable policy makers, local and national leaders to make appropriate recommendations on how to manage this growing concern.

1.2 Statement of the Problem

An estimated 17.9 million people died from CVDs in 2019 representing 32% of all global deaths. Of these deaths, 85% were due to heart attack and stroke. It was projected that CVD would cause more than 23 million deaths in 2030 globally yet nearly two thirds of global deaths by CVDs occur in middle to low-income countries especially in Sub Saharan Africa. The number of people affected by cardiovascular disease has also been shown to double in the last three decades with deaths occurring among younger people as compared to developed nations (Yuyun et al., 2020)

In Kenya, cardiovascular disease had been highlighted to be growing exponentially in recent years. The estimated prevalence of cardiovascular disease in Kenya is 8%. Mortality due to CVD in Kenya is approximated to be 6.1% to 8%. Post mortem studies however postulate that more than 13% of mortalities among adults could be due to CVDs (MoH-Kenya, 2015) According to the Global Burden of Disease study in 2019, cardiovascular disease was the second highest cause of death in Kenya with an estimated 81 per 100,000

deaths. Ischemic cerebrovascular accidents and ischemic heart disease were seen to be the most common CVD mortalities in the Kenyan population. Hypertension is the most important risk factor for cardiovascular diseases and the leading cause of death worldwide. Despite growing evidence that the prevalence of hypertension is rising in sub-Saharan Africa, national data on hypertension that can guide programming are missing for many countries.

Studies have shown the most common cause of cardiovascular disease related morbidity and mortality globally is hypertension. According to the 2015 Kenya STEPs study, a cross sectional study carried out nationwide among 18–69-year old, the overall age standardized prevalence of hypertension was 24.5% (Mohamed et al., 2018). This means approximately a quarter of the population could be at risk of cardiovascular disease. Central Kenya in particular had been shown to have a high prevalence of CVDs and its associated risk factors mainly hypertension and diabetes. This leads to other complications including kidney disease, eye disease and peripheral vascular disease (Otieno et al., 2020).

Because regional research in morbidity and mortality rates due to CVDs is scarce, it was important to study the prevalence and associated risk factors to cardiovascular disease in rural populations so as to tailor specific interventions to manage this concern.

1.3 Research Questions

i. What is the prevalence of the biological risk factors associated with cardiovascular disease among patients attending Nyeri County Referral Hospital?

ii. What is the prevalence of the behavioral risk factors associated with cardiovascular disease among patients attending Nyeri County Referral Hospital?

iii. What is the cardiovascular disease risk score among patients attending Nyeri County Referral Hospital?

iv. What is the link between sociodemographic factors and cardiovascular risk score among patients attending Nyeri County Referral Hospital?

1.4 Objectives

1.4.1 Broad Objective

To assess the risk factors associated with cardiovascular disease among patients attending Nyeri County Referral Hospital, Kenya.

1.4.2 Specific Objectives

i. To determine the prevalence of the biological risk factors associated with cardiovascular disease among patients attending Nyeri County Referral Hospital.

ii. To establish the prevalence of the behavioral risk factors associated with cardiovascular disease among patients attending Nyeri County Referral Hospital?

iii. To investigate the cardiovascular disease risk score among patients attending Nyeri County Referral Hospital.

iv. To assess the association between sociodemographic factors and cardiovascular disease risk score among patients attending Nyeri County Referral Hospital.

1.5 Hypothesis

1.5.1 Null Hypothesis

There is no relationship between the risk factors associated with cardiovascular disease and the cardiovascular disease risk score among patients attending Nyeri County Referral Hospital.

1.5.2 Alternate Hypothesis

There is a relationship between the risk factors associated with cardiovascular disease and the cardiovascular disease risk score among patients attending Nyeri County Referral hospital.

1.6 Justification of the Study

Cardiovascular disease related morbidity and mortality has a significant impact on Kenya's development and has now led to a double burden of communicable diseases, in particular HIV, TB, malaria and non-communicable disease e.g., CVDs.

There is a rising trend in incidence across the population despite various health policies targeted at reduction of cardiovascular disease in the County. Nyeri County was chosen by the Ministry of Health to benefit from the Universal Health Coverage pilot in 2019-2020 with a focus on NCDs due to this high prevalence. Many individuals living in rural areas have low levels of awareness on the dangers of living with cardiovascular disease. They are therefore at risk of severe complications as a result of having cardiovascular disease

that is either unmanaged or sub –optimally managed. This also means that the determinants of cardiovascular disease have neither been clearly identified nor addressed putting the population at risk.

Scientific studies are therefore crucial to understanding the magnitude of CVD risk factors in Nyeri County. Understanding these particular healthcare needs leads to creation of programmes tailored to the population in Nyeri County

Some interventions by the Ministry of Health in Kenya, county government and collaborating partners such as AMPATH, USAID have been initiated. However, these have primarily focused on the access of healthcare after the occurrence of CVD. Few policies have been implemented to promote screening and prevention of cardiovascular disease within the region. More health policies need to be formulated to create conducive environments to encourage health promotion, disease prevention, risk reduction and early treatment.

It also increased insight on the population about their risk for cardiovascular disease depending on their cardiovascular risk score. High risk scores were directly associated with higher incidence of this disease. Therefore, the study triggered individuals to modify their lifestyle e.g., smoking, poor dietary habits or sedentary lifestyle thus eliminating their risk factors and averting cardiovascular disease.

1.7 Significance of the Study

There was a lack in scientific data addressing the prevalence of the determinants of cardiovascular disease in the population residing in Central Kenya. This study showed the magnitude of the biologic and behavioral risk factors associated with cardiovascular disease in Nyeri County.

Patients being managed at Nyeri County Referral Hospital were evaluated for their cardiovascular disease risk score. This information was beneficial as those who are moderately to high-risk patients were referred for lifestyle modification, nutritional assessment and evaluation by a physician to manage the risk factors. These interventions would have potential to help in lowering the risk of getting cardiovascular disease.

Healthcare workers practicing within the region also benefited from the study. It triggered a higher index of suspicion of cardiovascular disease based of the individuals cardiovascular risk score. Timely referrals were initiated to prevent adverse outcomes including complications, high morbidity or mortality among the individuals within the study.

Finally, the research findings are helpful to local authorities heading the Department of Health and related stakeholders. The study aided in bringing to light the gaps in programs addressing cardiovascular risks in Nyeri County. The need for targeted CVD risk reduction initiatives and funding was evident. Therefore, it encouraged them to allocate more resources to screening and combating cardiovascular disease.

1.8 Scope of the Study

The scope of the research includes the study of biological risk factors of cardiovascular disease namely hypertension, diabetes and obesity. It will also cover behavioral risk factors namely smoking, alcohol intake, physical inactivity and dietary habits. The population under study will be adults attending Nyeri County Referral Hospital in Nyeri County, Kenya.

1.9 Assumptions of the Study

The information given by the respondents will depict a true account of their experiences

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Non-communicable diseases are the leading cause of global mortality. Cardiovascular diseases, mainly ischemic heart disease and stroke, are the leading cause of global mortality and a major contributor to morbidity and disability. Majority of these deaths related cardiovascular deaths occur in LMICs with up to 80% of all NCD deaths being attributed to CVDs (Mendis et al., 2022). Globally, cardiovascular disease is a huge economic burden on society. Medications and interventions to treat cardiovascular disease encompass 30% of all community prescribing. The economic impact on many countries such as the UK, USA and Turkey is also significant. This is due to direct health care related costs as well as indirect costs such as loss of productivity and social costs to an individual's family after loss of life. (Ekinci et al., 2023).

In Kenya, cardiovascular disease is responsible for 8% of the premature deaths specifically, among the 30–70-year-old patients with the percentage of disability adjusted life years resulting from CVDs at 6.3%. A study conducted in Western Kenya in 2016 identified multiple cardiovascular risk factors among the rural SSA population. This included mainly undiagnosed hypertension, dysglycemia and inappropriate diet (Chege et al., 2016).

The Ministry of Health in Kenya came up with National Guidelines for Cardiovascular disease management in 2018. The document describes in detail the prevention of cardiovascular diseases with specific advice for management of risk factors. It also includes a discussion on specific conditions and their management across the health system from

tier 1- tier 6. This guideline is essential in the practical approach to reduction of cardiovascular disease risk.

The main risk factors associated with CVD are classified into biological, behavioral and novel risk factors. Some of them include smoking and tobacco use, sedentary behaviour, insufficient physical activity, harmful alcohol consumption, and insufficient fruit and vegetable intake. Other determinants such as stress, sociodemographic and education levels also have an impact on cardiovascular health. However certain risk factors are crucial to the development of CVD as discussed below.

2.2 The Theoretical Framework

Three main theories have been postulated to influence behavior change especially in relation to cardiovascular disease risk. They include the health-belief model, social cognitive model and the trans-theoretical model. Understanding these models will help in the design of interventions that may mitigate the risk of cardiovascular disease. In the health belief model, people's health seeking behavior is influenced by several beliefs including their belief in their likelihood of developing cardiovascular disease, their belief in severity of the disease as well as the effects on their health, how undertaking prevention strategies lowers their risk of developing cardiovascular disease and finally, beliefs in any barriers there are to these prevention strategies.

The Social cognitive theory addresses the role of social norms in influencing health seeking behavior as well as how CVD risk factors may be reduced by social support. It also addresses how a person's beliefs on the ease at which they can maintain healthy lifestyles influences their motivation to implement these lifestyle changes. Finally, this model

underscores the role of modelling and how observing others can increase motivation to pursue cardiovascular disease risk reduction lifestyles.

The trans-theoretical model postulates that for a person to change, they must pass through several stages including, pre-contemplation, contemplation, preparation, action and maintenance. These stages influence how an individual may respond to an intervention based on how ready they are to accept the said intervention. Through implementation of the above theories on cardiovascular risk reduction programs, the likelihood of effectiveness and the scope of impact is much higher since healthcare workers and policy makers can understand how to approach individuals in their unique context.

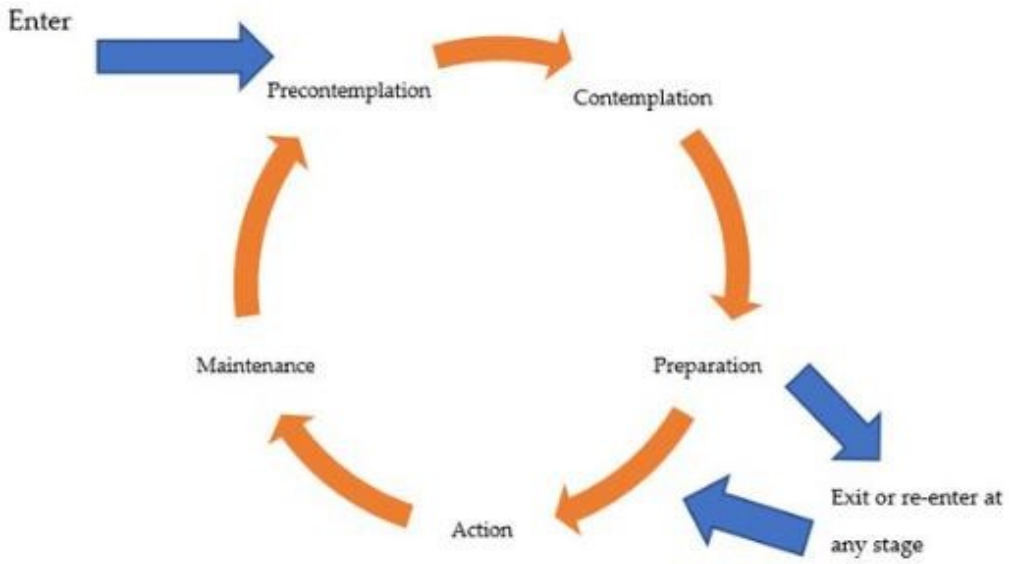

Figure 1: A Graphical Representation of Trans-Theoretical Model

Source:https://www.researchgate.net/publication/349928990_The_Validity_of_the_Theory_of_Planned_Behaviour_for_Understanding_People's_Beliefs_and_Intentions_toward_Reusing_Medicines/citations/figures

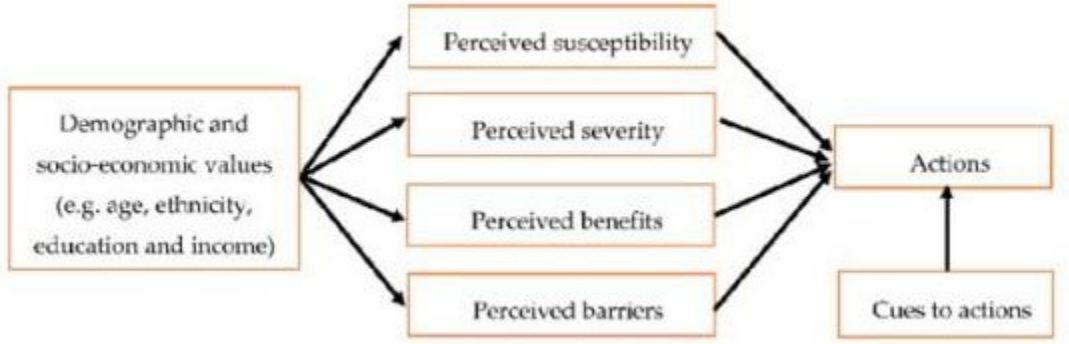

Figure 2: A Graphical Representation of the Health Belief Model.

Source:https://www.researchgate.net/publication/349928990_The_Validity_of_the_Theory_of_Planned_Behaviour_for_Understanding_People's_Beliefs_and_Intentions_toward_Reusing_Medicines/citations/figures

2.3. Biological Risk Factors.

2.3.1. Hypertension

Hypertension is elevated arterial blood pressure. The European Society for hypertension/European Society for Cardiology in 2023 defined hypertension as persistent elevated systolic BP of 140mmh/hg and/or Diastolic BP of 90mmhg. There are two types of hypertension; essential (primary) hypertension and secondary hypertension with 80-95% of patients having essential hypertension. Hypertension is classified into different categories that is grade 1, grade 2, grade 3, isolated systolic hypertension and isolated diastolic hypertension (Mancia et al., 2023).

Development of several cardiovascular diseases such as coronary artery disease, congestive heart failure, atrial fibrillation, cerebrovascular disease, peripheral arterial disease, aortic aneurysm, and chronic kidney disease is directly related to increasing levels of blood pressure. Poorly controlled hypertension leads to increased complication rate and cardiovascular related deaths with up to 14 years between development of heart failure and occurrence of hypertension (Tackling et al., 2023).

It is the leading risk factor associated with development of cardiovascular disease and death globally. It affects an estimated 1.3 billion people killing 10 million people per year. Approximately 700million of these people are untreated. There is a growing prevalence of hypertension in Sub Saharan Africa among other LMICs with Sub-Saharan Africa having the highest age-adjusted prevalence of hypertension (Mills et al., 2020). In Kenya, a National survey used data from the Kenya Stepwise study to reveal that 24.5% of adults have elevated BP and also that hypertension is the most important risk factor for development of cardiovascular disease related mortality and morbidity (Mohamed et al., 2018). Lack of awareness of hypertensive status was demonstrated to be the main barrier to achieving satisfactory control rates of hypertension in the Kenyan population. This predisposes a large portion of the population to cardiovascular disease (Ogola et al., 2019).

It is therefore essential to manage hypertension within the accepted targets to improve prognosis and clinical outcomes. Reduction in BP related cardiovascular deaths involves a parallel strategy involving clinical strategy of new therapies for BP control and a population strategy and community engagement.

2.3.2 Diabetes

Diabetes is a group of metabolic diseases characterized by increased blood glucose concentration. The WHO classifies diabetes into 2 main types, Diabetes Mellitus and diabetes Insipidus. Diabetes Mellitus can be classified further into Type 1 DM and Type 2 DM. Other types include Gestational diabetes, immune mediated diabetes, infection related diabetes, drug-chemical induced diabetes, exocrine or endocrine related diabetes, genetic disorders associated with diabetes, monogenic diabetes and unclassified diabetes.

The diagnostic criteria for diabetes are fasting blood glucose of > 7 mmol/l, Hba1c of > 6.5%, and a random blood glucose or oral glucose tolerance test value of > 11.0 mmol/l. These 4 modalities are effective in correctly diagnosing diabetes with a follow up second abnormal test (Harreiter et al., 2019). The main type of diabetes that causes cardiovascular complications is Type 2 Diabetes Mellitus. The most common manifestations of cardiovascular disease in diabetes include heart failure, coronary heart disease and vascular complications which are macro-vascular or micro-vascular (Glovaci et al., 2019).

Type 2 Diabetes is also part of a syndrome caused metabolic syndrome that's characterized by elevated cholesterol levels, hypertension, abdominal obesity, increased waist circumference and elevated fasting glucose levels. Metabolic syndrome highly predisposes one to cardiovascular mortality and morbidity (Tune et al., 2017). Diabetes has been described as the epidemic of the century with over 425 million people currently affected by this disease. This population is expected to grow exponentially to approximately 629 million people by 2045. The highest burden of disease is found in West-Pacific, North America, and in European regions. In Sub Saharan Africa, approximately 16 million people

are affected by diabetes and this figure is expected to rise by 156% to 41 million by 2045 (Lovic et al., 2020).

In Kenya, a study showed the prevalence of pre-diabetes and diabetes was 3.1% and 2.4 % respectively compared to the global prevalence of 9%. Approximately less than half of them were aware of their diabetes, 20% were on treatment for the diabetes and only 7% had good glycaemic control. This is a worrying state due to the high risk of cardiovascular related complications among the untreated or sub-optimally treated (Mohamed et al., 2018). Interventions need to be put in place to avert this rising trend.

There are various interventions employed to effectively control T2DM. These include lifestyle modification, pharmacologic therapy and metabolic surgery. Pharmacological therapy is the main intervention used to control diabetes through either oral or injectable medication. However, according to the American Diabetes Association, lifestyle management or modification is a vital component in reduction of CVD risk in T2DM patients. It encompasses medical nutrition therapy increased physical activity, reduction of alcohol intake, cessation of smoking and psychosocial care. Adequate control of diabetes through either of these interventions is a proven strategy to minimize cardiovascular disease risk, morbidity and mortality.

2.3.3 Obesity

Obesity is a complex disease that is characterized by an excess amount of body fat. It is a multifactorial disease caused by poor diet, genetics, environmental factors, social economic factors and the built environment (Caballero et al., 2019). It is defined by the WHO using the Body Mass Index (BMI) where > 25 kg.m2 is overweight and > 30kg/m2

is obese. However, recent studies have shown the inadequacy of BMI as a nutritional measure. This is because it has low sensitivity and can be influenced by other factors such as ethnicity, sex or even age. Therefore, more objective measures such as waist circumference and waist-hip ratio are preferred. There is a higher risk of cardiovascular disease in people with greater visceral adipose fat as well as fat deposition in the liver and muscles therefore these objective measurements can indicate to one about their CVD risk (Chooi et al., 2019).

Collaborators of the Global Disease group in 2015 estimated that more than 603 million adults are obese. Approximately 4 billion people died due to Elevated BMI levels. Of these deaths, two thirds can directly be attributed to CVD. Lower- and middle-income countries worldwide have an increasing prevalence in obesity. Countries such as India, has approximately 135 million people affected by obesity. Regions such as South west India are affected at a greater rate as a result of changing lifestyles, high socio-economic status and consumption of foods that are highly calorific and over processed (Ahirwar et al., 2019).

Among African countries, for instance in Libya it has been found that a large proportion of the population are overweight or obese. A larger proportion of obese individuals are women at 47.4% as compared to men at 33.8%. This proves that obesity is a growing public health issue that requires urgent solutions (Lemamsha et al., 2019). In the Kenyan population, according to the WHO Stepwise Survey 2015, the prevalence of overweight/obesity exhibited its peak among married people married individuals [odds ratio (OR) = 1.78, 95% confidence interval (CI) 1.19, 2.66], female participants, (OR = 4.08, 95% CI 3.02, 5.51), individuals residing in urban areas(OR = 1.70, 95% CI 1.28,

2.25), and those possessing higher levels of education(OR = 2.15, 95% CI 1.72, 2.70) and greater wealth. (OR = 2.45, 95% CI 1.91, 3.14) (Mkuu et al., 2021).

With such a large proportion of the population suffering from obesity, it's obvious that traditional remedies to combat the disease have not resulted in large scale successful programs. Aetiology of obesity has not been well understood thus a crude oversimplification of increased activity and reduce food intake has not seemed to make significant changes in the population. A combination of holistic approaches and a greater understanding of the interplay between biological, social and economic environments has to be implemented to better define and address this challenge (Swinburn et al., 2011).

While obesity is on the rise, malnutrition is still prevalent in sub-Saharan regions. Moreover, non-communicable diseases exist in these populations. A study in Western Kenya showed that the population was lean with 92% of them having a normal to low BMI. This was demonstrated to be due to low access to nutrition, low socioeconomic status and education levels. However, these populations still have considerable levels of cardiovascular disease such as coronary disease, thromboembolisms and strokes that cause considerable mortality and morbidity.

2.4 Behavioral Risk Factors

2.4.1 Alcohol Intake

Moderate alcohol consumption has been proven in various studies to exhibit some protective effects on the heart. Other studies have proven minimal relationship between cardio-protection and consumption (Masip et al., 2021). Although the evidence is mixed, {it still believed by who?] that the recommended amount of alcohol could have some

protective effects against CVDs. Several factors and bias are related to this finding including genetic make-up, age, gender and other individual characteristics (Hoek et al., 2022) Furthermore, some studies among hospitalized patients with a history of heavy drinking have proven that such patients have significantly lower rates of cardiovascular events compared to other patients during discharge after all other confounding factors have been adjusted (Krishnamoorthy et al., 2018).

Although consensus has not been achieved, the current guidelines recommend 1-2 drinks per day approximately 14g of alcohol. WHO guidelines suggest that > 60g/ day for men and > 40g/day for women is more than adequate for the general population. It has been globally accepted that more than 1 (women) or 2 (men) standard drinks per day has deleterious effects on health. This has been shown in the latest meta-analysis to lower CVD risk. However, data on CVD outcomes and CVD related mortality on moderate drinking is conflicting and needs further research (Mostofsky et al 2016)

Worldwide, approximately 4.5 million people die from alcohol related deaths. These deaths cause untold suffering to their families as well as loss of productivity. These deaths could be as a result of liver failure, dementia, physical injuries, cardiovascular events among others (Chikritzhs et al., 2021). In South Africa, alcohol has been shown to contribute approximately 7% of the total deaths and disability adjusted life years (DALYs) in the last few years. This ranks it the 5th cause of death and DALYs in the country. While not all alcohol related deaths happen in the same mechanism, non-communicable diseases and cardiovascular disease contributed at least 32% of these deaths. It also contributed 11.1% of DALYs. Studies done in Kenya reveal the prevalence of alcohol consumption at 13.3%. There may be regional discrepancies with areas in Western Kenya having a prevalence as

high as 31.7%. Most of the consumers are young males and the key components of alcohol consumption are social environment instead of individual socio demographic factors (Takahashi et al., 2017).

2.4.2 Dietary Habits

Adherence to a healthy diet is essential to optimize cardiovascular health. This starts at pre-conception all the way through to adult life. A well-balanced healthy diet is strongly associated with a decreased risk of cardiovascular related mortality and morbidity. Due to this relationship, it's important to understand the best based diets to avert cardiovascular disease (Badimon et al., 2019). Among these, one of diets that gives the most cardiovascular protection are the Mediterranean diets which is rich in fruits and vegetables. Low fat diets have also been shown to improve primary prevention of cardiovascular disease. In a randomized control trial in Spain, Mediterranean diets were also proved to have benefit in reducing complications in patients with established cardiovascular disease (Delgado-Lista et al., 2022).

Evidence based dietary components to promote cardiac health should include 1) adjusted carbohydrates to maintain a healthy weight, 2) plenty of fresh fruits and vegetables, 3) healthy sources of proteins mainly plant based, fish, lean unprocessed meat 4) Use liquid oils as opposed to tropical/hydrogenated fats, 5) beverages with added sugars should be avoided, 6) minimal salt intake.7) moderate to low fat and dairy products. This type of diet has been promoted in DASH diets (Dietary Approach to Stop Hypertension) and NICE (The National Institute for Health and Care Excellence) guidelines as cardio-protective.

A global study, the PURE study, replicated in 80 countries with a median follow up at 9 years, revealed that a higher diet score was associated with lower rates of CVD mortality in most world regions. A healthy diet score was developed based on the foods described It was also shown that regions with lower gross incomes had higher diet scores than regions with higher gross incomes (Mente et al., 2023). In Kenya, a rise in GDP and socioeconomic status has had a direct relationship to increase in foods that are detrimental to cardiovascular health. Increase in wheat products, sugar and sweeteners, processed foods, and cooking oils that have saturated fats has been observed especially in urban communities. This eventually leads to cardiovascular disease risk in such populations (Onyango et al., 2018).

Factors that influence poor diet quality among people include lack of knowledge, lack of availability, marketing strategies, increased cost, little time for food preparation, social cultural values. Behavior modification is primarily the best way to promote good dietary habits. Assumptions that people will make appropriate choices are sometimes hopeful. Even with adequate knowledge, the above factors influence various diets unless the population is provided with the exact requirements by an external force. Low income in particular plays a crucial role in nutritional choices in children and adults (Townsend et al., 2017). Policies such as subsidies on agricultural products, fruits and vegetables also bring about drastic change in dietary quality especially among the populations with lower income bracket or minority ethnicities who may not have access to such products due to high costs (Zenk et al., 2018). Advances in technologies may lead to improved nutritional standards among the urban population. Information via the internet and social media has helped

produce nutritional information in an instant. This helps in improving dietary choices thereby reducing cardiovascular risk, disease and mortality.

2.4.3 Smoking

Tobacco use can be described as a process that induces a physiologic and psychological addictive effect among users. It can be either combustible products for example cigarettes, cigars, water pipes (hookah), cigarillos and pipes or non-combustible products such as electronic cigarettes or tobacco forms that are chewed, snuffed or dipped (Onor et al., 2017). Cigarette smoking has been shown to be strongly associated with CVD morbidity and mortality e.g., myocardial infarction, heart failure, strokes and atherosclerosis. It also leads to progression of disease from mild forms to severe complications (Ishida et al., 2024)

Approximately 10 % of all CVD deaths are related to smoking. Smokers are 60-80 % more at risk of death than non-smokers. According to the WHO and the Global Disease Burden database 2019, tobacco smoking is one of the greatest causes of death and one of the significant public health threats. It accounts for over 8 million deaths annually around the globe including 1.2 million people who die from passive smoking exposure. Despite worldwide policies by the WHO and its member states promoting tobacco cessation, smoking among current users was responsible for 7·69 million (7·16–8·20) deaths and 200 million (185–214) disability-adjusted life-years.

In Japan, approximately 29.4% of men and 7.2% of women have been shown to be active smokers. This means a high percentage of the population is at risk of CVD associated morbidity and mortality with up to 33% having cardiovascular disease (Kondo et al., 2019).

In Ethiopia, the prevalence of smoking has been on an increasing trend in recent years with a prevalence of 8.5% in 2005 to 11.7% in 2011. Most of the smokers were young men in urban centres. Despite many health awareness campaigns and government policies, many individuals still smoke to this day. In the Kenyan STEPwise Survey for Non-Communicable Diseases 2015, it was reported that 13% of Kenyans have smoked some form of tobacco-based product. 23% of men and 4% of women have been shown to having a history of smoking.

8% of Kenyans are daily tobacco smokers with the mean number of manufactured cigarettes smoked per day being seven sticks per smoker. Current use of smokeless tobacco was reported in 3.6 percent of Kenyans. Twenty four percent and 20.9 percent of Kenyans are exposed to second hand smoke at home and work respectively (Ngaruiya et al., 2018). In Kenya, the premature CVD mortality rate attributable to tobacco is 2% of the total deaths, which is much lower than the global 10%. However, few studies have been shown to evaluate the CVD risk adjusting for non-cardiovascular outcomes. It is necessary because smoking can be responsible for several outcomes simultaneously.

Time spent smoking and pack years have a significant risk in terms of cardiovascular disease mortality. People who have never smoked, former heavy smokers and current heavy smokers have been compared in various studies. It has been shown that cessation of smoking by 10-15 years offers a decline in CVD risk. Heavy smokers (> 20 pack years) have a significantly lower risk for CVD disease 5 years after cessation compared to current smokers. Whereas as compared to never smokers, there was still a significant risk in CVD even 5 years after cessation (Duncan et al., 2019). This proves the importance of cessation of smoking in an effort to reduce cardiovascular risk.

2.4.4 Physical Activity

Physical activity is a well-known modifiable risk factor for establishment of cardiovascular disease. Several guidelines like the American College of Cardiology/ American heart Association recommend a minimum of 150 minutes of moderate intensity aerobic physical exercise or 75 minutes of vigorous intensity aerobic physical exercise per week (Arnett et al., 2019). According to WHO 2020 guidelines, inadequate moderate or vigorous exercise and sedentary behavior are viewed as two different factors in CVD risk. Similarly, all adults are encouraged to engage in either 150-300 minutes of moderate-intensity physical activity, or 75-150 minutes of vigorous-intensity physical activity, or a combination of both moderate and vigorous-intensity aerobic activities per week. Sedentary behavior should be discouraged, however there has been minimal quantification of sedentary behavior threshold (Bull et al., 2020).

In the advent of the COVID 19 pandemic, social distance became important as a strategy to prevent further transmission of the virus. This led to increased inactivity and promotion of sedentary lifestyle. However, it is important to understand the adverse health risks of social distancing on cardio-metabolic health so as to take proper action to promote good health by increasing physical activity among others (Laddu et al., 2023). In a global study conducted in low-, middle- and high-income countries like Canada, India, Zimbabwe, physical activity was studied as well as its effect on cardiovascular disease. Both recreational and non-recreational physical activity was considered. The findings were consistent with existing literature meaning higher physical activity was seen as cardio-protective and should be employed as a cost-effective global strategy to reduce CVD risk (Lear et al., 2017). In Kenya, approximately 30% of the population is not aware of the

WHO recommendations for exercise and the population doesn't take part in structured physical activity. There also exists an inverse relationship between physical activity and socioeconomic status according to a study conducted in Eldoret, Kenya (Maguta et al, 2022).

2.5. Social Demographic Factors

2.5.1 Age

Age plays a vital role in deterioration of the function of the cardiovascular system. The aging and elderly are particularly susceptible to cardiovascular disease. It is an independent risk factor however due to the physiological make-up of the elderly, other factors like frailty, co-morbidities, obesity and diabetes give them a higher risk of developing CVD. Furthermore, other than inflammation due to aging causing CVD, other lifestyle choices increase this risk such as smoking, poor nutrition and inactivity (Rodgers et al., 2019).

Due to this high risk, the elderly requires special attention including primary prevention strategies for cardiovascular disease risk, intensified screening programs, early diagnosis and prompt referral for care to avoid increased morbidity and mortality. Globally, incidence of CVD among the 40–59-year-old age group is 40%, 60% among the 60–79-year-olds and 86% among the >80-year-old (Benjamin et al., 2019).

A study done in China revealed a rising trend in CVD incidence rates among the elderly between 2011 and 2018. There was also variation in gender, socioeconomic status and geographical location with higher CVD rates recorded among women with higher socioeconomic status in the Northern provinces (Wu et al., 2023). According to the 2019 National Census, 6% of Kenya's population is aged 60 years and above. This means

approximately 2.4 million people are at risk of developing cardiovascular disease. According to a study in Kenya over the 47 counties, people over 50 years were 5 times more likely to be hypertensive, meaning they were at higher risk of acquiring CVDS (Mohamed et al., 2018). Populations living in the Nairobi slums showed increased CVD mortality related to age (hazard ratio (HR) 1.11; 95% confidence interval (CI) 1.03–1.20, $p = 0.005$) and hypertension (HR 2.19, 95% CI 1.44–3.33, $p < 0.001$), lower socioeconomic status and low education levels. Individuals who were older also proven to be more likely to die from cardiovascular disease (Wekesah et al., 2020).

2.5.2 Gender

Men and women have different physiological compositions that predispose them to cardiovascular diseases. These differences are attributed to both genetic and hormonal differences between both sexes (Shufelt et al., 2018). Traditionally, there has been little research in gender specific risk factor assessment due to minimal enrolment of women in clinical trials. Moreover, other than the traditional risk factors, menopause, depression and hypertensive disease in pregnancy may increase risk of women acquiring cardiovascular disease (Saeed et al., 2017).

Socio cultural factors related to sex and gender are also important factors to consider while assessing cardiovascular risk. Factors such as low literacy levels, poor healthcare access, and low socioeconomic status among women disproportionately enhance risk of cardiovascular disease and subsequent poor outcomes among women. Furthermore, women experience under diagnosis, treatment delays and sub optimal therapy for cardiovascular disease (Regitz-Zagrosek et al., 2023). Despite these factors, men have been proven to be at higher risk of CVD related morbidity and mortality. In a hospital-based

study in the United Status among young adults, it was shown that the number of men admitted due to cardiovascular disease complications was higher than in females (41.4% vs 15.9%). Admission frequency in hospitals in patients with CVD risk factors was also higher among males than in females. 55.1% vs 24.6% (Desai et al., 2020).

Moreover, in a prospective study done in 27 countries, both HMIC and LMICs, it was consistently found out that women had a lower CVD risk factor profile than men. Primary prevention strategies were also more common in women than men and had lower chance of CVD risk recurrence after an initial event. There were also lower levels of cardiovascular disease related mortality among women 30 days after a cardiovascular event. Meanwhile, secondary prevention strategies and therapies were more available to men than to women within the same period (Walli-Attaei et al., 2020). In a study conducted in Sub-Saharan Africa, with Kenya being one of the sites under research, it was shown that men had a higher risk of cardiovascular disease. 3.0% as compared to women 1.9% and an average WHO CVD risk score of 2.4% with some sites reporting almost a three-fold higher risk in men than in women (Wagner et al., 2021).

2.5.3 Marital Status

The role of non-traditional risk factors of cardiovascular disease is increasingly gaining recognition as the burden of cardiovascular disease increases. Marital status has a significant effect on cardiovascular disease. Severally, it's been proven in studies that married people have had a lower risk of CVD as opposed to their single, divorced or widowed counterparts with fewer adverse outcomes due to cardiovascular events. Furthermore, among the unmarried, there may be a higher prevalence of unhealthy habits

and stressors such as alcohol intake, smoking, physical activity or lack of compliance to medication which increases the risk of a cardiovascular event (Dhindsa et al., 2020).

Men who were not married were particularly susceptible to cardiovascular disease with many studies showing an increased mortality due to cardiovascular disease in unmarried men. This proves that marriage was cardio-protective to men in many populations. However, among females, they were noted to have lower levels in cardiovascular risk factors for instance hypertension and type 2 diabetes (Ramezankhani et al., 2019).

A study done in Italy was done to investigate the relationship between marital status and CVD. The results were only significant among women where unmarried women were shown to have lower incidence and mortality of coronary heart disease. There was no association between marital status and CVD among men (Humbert et al., 2023).

Similar observations were made in Ghana where it was revealed that marital status among women was a risk factor for hypertension and other cardiovascular factors however there was no significant association among the men (Tuoyire et al., 2019).

2.5.4 Residence

In Sub-Saharan Africa, the population is rapidly growing leading to rapid urbanization. As urban areas grow, informal settlements are also growing in number exposing the population to CVD risks. Urban environments tend to promote unhealthy habits, smoking, alcohol consumption as well as sedentary lifestyle. However, some studies have found a contrary opinion. According to a study in China ("Report on Cardiovascular Health and Diseases in China 2021: An Updated Summary.," 2022, p. 2), there is a greater number of people with cardiovascular disease in rural areas at 46.7 % compared to 44.2% in rural areas.

Similarly, a study among Malaysian youth conducted to stratify risk among urban and rural populations revealed that the rural population had a higher risk of cardiovascular disease (74.2%) than their urban counterparts (64.8%) with more of them having at least one risk factor. On the other hand, among the elderly in the same country, there was a greater risk of cardiovascular disease if they lived in rural areas. This may be due to exposure of other risk factors such as a sedentary lifestyle (Chan et al., 2021).

In Nigeria, a study looking into the characteristics of cardiovascular disease risk factors among rural populations (44%) and urban populations (41%) showed no significance in areas of dwelling. This means that the area of residence didn't influence one's chances of getting cardiovascular disease. However, it was found out that among both urban and rural dwellers, nearly 50% of the participants had moderate to high risk of cardiovascular disease. This underscores the burden of the disease within the country and the need for targeted interventions (Odunaiya et al., 2023). In informal settlements in Nairobi Kenya, cardiovascular disease is a growing concern. Approximately 26% of mortality's occurring within the region were attributable to cardiovascular disease. Majority of the population who succumbed to the disease had an increase in age and were women (54.5%) with almost two-fold increase in those having hypertension and diabetes.

2.5.5 Education

It has been widely proven that higher education levels have been associated with lower cardiovascular disease levels. Individuals with greater literacy levels tend to have a lower risk factor profile as well. This is because with greater literacy levels, there is a higher likelihood of adjusting lifestyle behaviours that may lead to cardiovascular deaths. This is

due to better access to primary prevention awareness and strategies on reduction of risks associated with cardiovascular disease.

Low education acts as a barrier to reduction of cardiovascular disease risks due to lack of uptake of screening, inadequate perceptions and understanding of severity and risk of cardiovascular disease and lack of adherence to treatment that would prevent cardiovascular disease (Okop et al., 2021). In a large prospective study covering 21 countries in high-, low- and middle-income countries, it was observed that individuals with major cardiovascular events tended to have lower levels of education. This was mostly evident in lower income countries. They also tended to have higher mortality levels related to cardiovascular disease. Yet, they had lower risk factor profiles compared to individuals with higher education levels. They also had less access to treatment modalities in the event of cardiovascular disease leading to increased morbidity and mortality (Rosengren et al., 2019).

In a US based serial cross-sectional study looking at trends in cardiovascular disease risk factors from 1999-2018 covering over 50,000 participants with a large variety of sociodemographic factors, it was noted that participants with higher education levels mainly college education and higher showed lower levels of cardiovascular risk factors than their counterparts with primary level or no formal education levels (He et al., 2021). A study in Kenya looking into determinants of mortality caused by cardiovascular disease among slums in Nairobi showed the cardio-protective effect of primary education or higher. Subsequently, there were fewer individuals with higher education who died due to cardiovascular disease (19.8% vs 56.7%). It was also shown that it the population was to

attain primary level education or higher, this would result in a 39% reduction in CVD deaths (95% CI 5%–60%, p = 0.026) (Wekesah et al., 2020).

2.5.6 Employment Status/Income

Emerging evidence has shown that socioeconomic status has a direct relationship to lifestyles which in turn has an effect on cardiovascular disease risk. It also shows that poorer health outcomes are observed in individuals with low socioeconomic status due to poor accesses to health, higher cost of healthcare financing as well as lack of health equity (Mannoh et al., 2021). Economic uncertainty, recessions and unemployment has recently been studied as a factor that contributes or can trigger increased incidence in cardiovascular diseases including ischemic heart disease and cerebrovascular diseases. Due to the physiological stresses occurring during such a time, as well as the maladaptive coping mechanisms adopted by individuals to cushion them, there is often an increase in cardiovascular disease risk factors such as poor dietary habits and minimal physical activity. Moreover, certain biological processes occur when an individual is faced with economic uncertainty. This leads to poorer outcomes, poor access to healthcare with resultant morbidity and mortality (Kawachi et al., 2023).

In a US and UK cohort study evaluating the association between lifestyles and socioeconomic status, it was noted that unhealthy levels of smoking, alcohol intake, leisure time and physical activity as well as obesity was more prevalent among individuals with lower socio-economic status. These lifestyles mediated cardiovascular disease at 3.0 and 13% respectively. There was also a strong association between high mortality due to cardiovascular disease and low SES. These findings were similar to studies conducted

within Europe and Australia where adults with low SES were 26% more at risk of acquiring cardiovascular disease (Zhang et al., 2021).

In New Zealand, among middle aged men, it was shown that unemployment and job loss contributed largely to the burden of cardiovascular disease. These economic losses were mostly prevalent after the COVID 19 pandemic where many people were subjected to change in economic status abruptly. Although other factors may have come into play, there was a strong association noted between mortality and morbidity of cardiovascular disease and unemployment among these individuals (Nghiem et al., 2020). A study looking at data from 1960 -2015 among individuals in 32 countries showed there was no association between economic fluctuations and incidence of cardiovascular disease mainly heart disease among various ages and sexes (Dadgar et al., 2020). On the other hand, in a study in rural South-Central Uganda, one of the largest risk factors for cardiovascular disease; hypertension was associated with individuals with higher incomes. (aPR 1.23; confidence interval 1.09-1.38; $p = 0.001$) (Mustapha et al., 2022).

These findings are consistent with a nationwide study conducted in Kenya where a major risk factor of cardiovascular disease that is hypertension was more prevalent among richer households than among poorer households (29.0% vs 19.4%). Blood pressure control was also poorer among the higher income households versus the lower income households (40.2 % vs 81.7%). This shows that higher levels of income were at higher cardiovascular disease risk than lower income households in Kenya (Mohamed et al., 2018).

2.6 Cardiovascular Disease Risk Scores

Cardiovascular disease results from an exposure to several risks as highlighted. Reduction in these risk factors leads to reduction in development of atherosclerosis which mediated CVD. Over the years, several criteria have been developed with an aim of assessing cardiovascular disease risk. These include Framingham's criteria, QRISK, ASCVD by the American College of Cardiology. In 2007, the WHO developed a comprehensive CVD risk assessment guideline. In 2019, the guidelines were updated to include region specific charts for example East African, West Africa, North Africa, Central Europe etc. This assessment guideline estimates the 10-year risk of a fatal or non-fatal CVD event. The importance of these guidelines is to improve awareness among patients and health care providers that will improve management of these risk factors. They include hypertension, diabetes, and age, sex, smoking status, and diabetes and cholesterol levels.

There are 2 different charts that are utilized based on availability of the resources in the community. They include non-laboratory-based charts and laboratory-based charts. In areas that have resource constraints, the non-laboratory-based charts are ideal because they assess parameters that are easily measured in primary health care facilities e.g., BP and weight. Furthermore, patients who are classified to be moderately or high risk of a CVD event are evaluated with the laboratory-based risk score charts to accurately predict their scores. The additional parameters in laboratory-based charts are total cholesterol levels and presence/absence of diabetes.

Risk stratification is imperative because it aids in prevention of premature disability, morbidity and mortality in patients at high risk. Patients who are assessed are placed in

different categories that are colour coded based on the percentage risk of a CVD event. The colour codes are green <5% (low risk) yellow 5-<10% (borderline risk) orange 10-<20%, (Intermediate risk) red 20-<30% (High risk) and deep red >30%. (Very High risk). The European Society of Cardiology stratifies its population according to member states with the highest risk as well as various characteristics for example age, gender, weight, cholesterol levels among others. This effectively ensues that complications or deaths that arise from cardiovascular disease are controlled and monitored. (Parums et al., 2021).

The guidelines also provide information for healthcare providers on how to approach and manage a patient based on their risk profile. The management ranges from further laboratory and radiological assessment, lifestyle modification to initiation of drug therapy. Some studies have evaluated the sensitivity of predicting CVD using the WHO CVD risk score charts with successful outcomes. Many patients were accurately predicted to have different CVD risk scores. However, there are still gaps in implementation of the guidelines and initiation of the recommended therapy for high-risk patients (Bailey et al., 2021).

This study will utilize the WHO cardiovascular risk (non-laboratory-based score charts to estimate the risk of occurrence cardiovascular disease among the respondents based on their characteristics and risk factor profile. This is because it is a fairly simple tool with high specificity and sensitivity according to several studies. Moreover, this tool can be operationalized in a resource constrained health facility making it the most appropriate tool to predict the risk of cardiovascular disease. It has been observed –with concern that CVD risk has been rising gradually over the years. A systematic review described cardiovascular disease risk factors in Sub-Saharan Africa from 1990 to 2016 and noticed a rising trend in these factors as well as a rise in morbidity and mortality (Yuyun et al., 2020). Similarly,

another systematic review which included Ghana, Nigeria, Sudan, South Africa and Tanzania demonstrated congruent findings (Hamid et al., 2019).

2.7 Identification of Knowledge Gap

There is minimal data within the context of Central Kenya in regard to risk factors of cardiovascular disease and cardiovascular risk scores. Moreover, in order to develop strategies to combat cardiovascular disease, the correct target group needs to be identified and mapped out. This is to minimize wastage of resources as well as increase impact and effectiveness of these interventions. Some studies have explored some of these factors in Western Kenya and nationally, however in order to fully understand cardiovascular disease, such studies are crucial to inform policy makers and healthcare workers on the most effective methods to reduce cardiovascular disease. The gap in research in how certain socio-demographic factors are associated with cardiovascular disease risk is also glaring. There needs to be studies done on this subject matter to develop contextual and relevant interventions to avert cardiovascular disease.

2.8 Conceptual Framework

This study determined the risk factors associated with cardiovascular disease and the estimated cardiovascular disease score among the study respondents. Social demographic factors such as age, gender, employment status, income and level of education were considered as variables associated with cardiovascular risk score. The biological factors under study were hypertension, diabetes and obesity while the behavioral factors under study were smoking status, alcohol intake, physical inactivity and dietary habits. These were based on WHO guidelines on prevention and management of cardiovascular disease

INDEPENDENT VARIABLES DEPENDENT VARIABLE

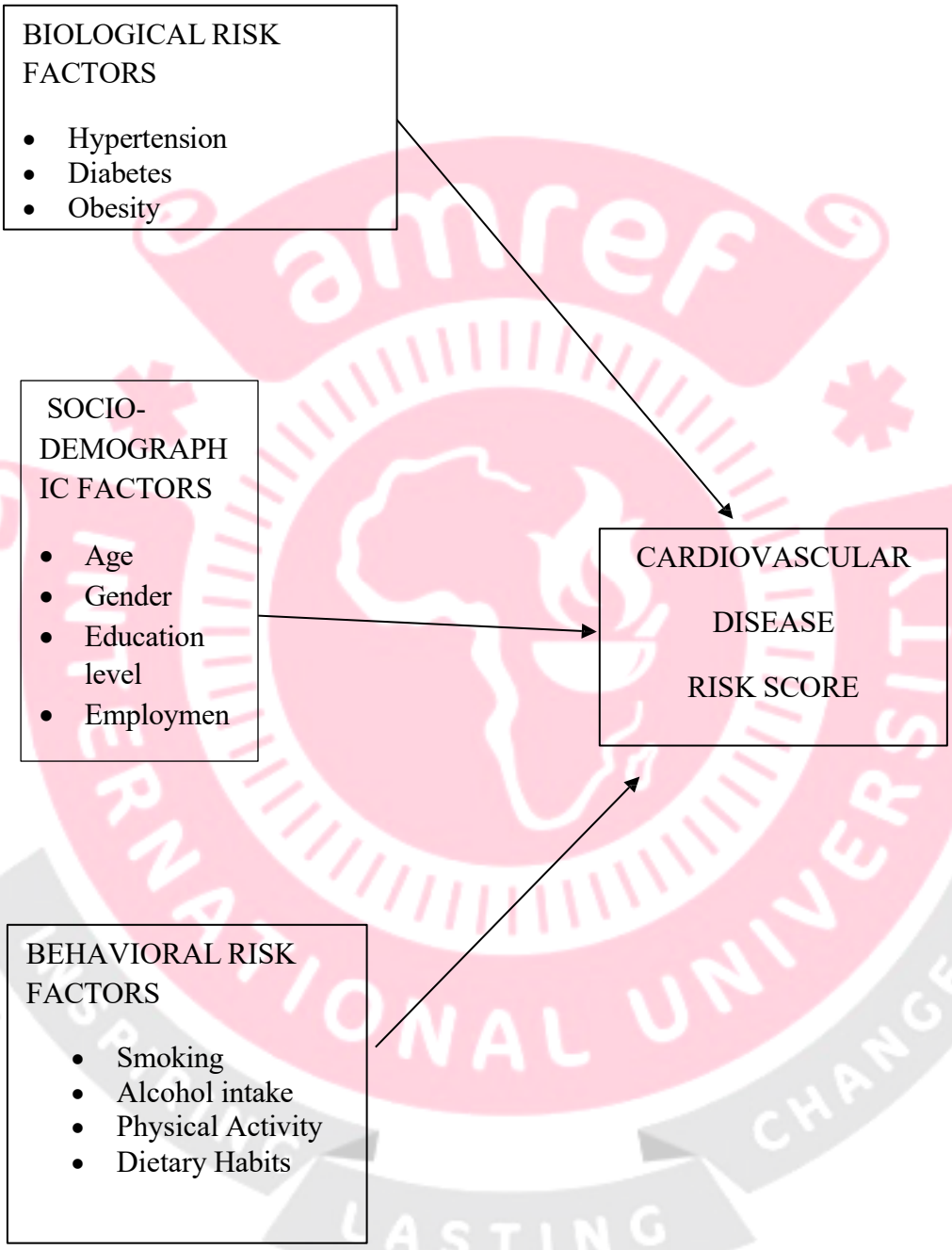

Figure 3: Conceptual Framework

A conceptual framework demonstrating the relationship between the independent variables which are biological and behavioral risk factors, sociodemographic factors and the dependent variable which is cardiovascular risk score.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This Chapter describes in detail the methodology that was applied during the study. It includes the research design, location, target population, data collection instruments and procedures, data analysis and ethical considerations that were utilized in the course of the study.

3.2 Research Design

This research was a descriptive cross-sectional study design on a random sample of adult respondents. It was the most appropriate type of study to determine the risk factors associated with cardiovascular disease in the study population.

It also showed a snap-shot (point prevalence) of a disease in a certain time and was able to show the relationship between the risk factors associated with cardiovascular disease and the cardiovascular disease risk score; the exposure and the outcome at the same time. Finally, the study design assisted in making inferences on a population based on an appropriate sample.

3.3 Study Setting

The study was conducted in Nyeri County Referral hospital which is situated in Kimathi Way, Ruringu, Nyeri Central Sub County, Nyeri County, Central Kenya. It is a tier 5 facility with a daily outpatient attendance of over 600 patients and offering specialized medical care to people of Nyeri County, Central Kenya and its environs. (Nyeri County Review 2021). In the inpatient department the hospital contains 12 wards with a bed capacity of approximately 220 beds.

3.4 Study Population

The study respondents were participants recruited from Nyeri County Referral Hospital outpatient and inpatient departments. Being a referral hospital, the hospital receives patients from the county and neighbouring counties with a target population of about 750,000 people. The population mainly resides in the rural regions of the county and their main socio-economic activities are agriculture both cash crop and subsistence farming, animal rearing, trade and commerce

3.4.1 Inclusion Criteria

1. Respondents > or = 18 years.
2. All patients attending Nyeri County Referral Hospital outpatient department and inpatient wards
3. Respondents gave written informed consent

3.4.2 Exclusion Criteria

1. Respondents of unsound mind or diminished capacity
2. Respondents who are require emergency medical attention
3. Respondents with self-reported cardiovascular disease

3.5 Sample Size Calculation and Sampling Procedures

Epi Info Version 7.2.4.0 was used to estimate the sample size based on a 5% prevalence of CVD in Kenya. At a 95% CI, α at 0.05 and power set at 80%, the estimated sample size was 291. For incomplete, missing questionnaires or non-response, 10% was added making the sample size 320 respondents.

Respondents were divided into 2 broad categories based on the departments in which they were being attended to i.e., the outpatient and inpatient department. It was important to study populations in both departments because a large number of patients in both demographics also suffer from cardiovascular risk despite being in hospital for various other diseases. It would also inform clinicians on the need to look out for risk factors and manage them appropriately during inpatient stay or refer to the appropriate physicians for specialised care to avert premature death or increased complications. Probability proportion to size was used since the population size from the departments are different on any given month. The outpatient department attends to an average of 400 patients per day while the inpatient department has a bed capacity of approximately 220 beds. Therefore, to get 320 respondents, a ratio of 1:1.82 was utilized Systematic sampling method was then employed. The sampling fraction was calculated by dividing the actual sample size by the population in each department. 206/400= 1/1.9, 114/220 = 1/1.9. The first respondent was chosen at random, then subsequently, every 2nd respondent was interviewed. A total of 206 outpatients and 114 inpatients were to be studied. The ratio of men to women in Nyeri County is fairly even according to the Kenya National Bureau of Statistics, therefore half of the respondents were from each gender, and this was achieved by alternating respondents of each gender.

3.6 Data Collection Instruments

The questionnaire was adapted from the PAHO/WHO STEPwise approach to NCD risk factor surveillance (STEPS), where step one interviews the participant to determine self-reported CVD risk factors e.g. alcohol abuse, cigarette smoking, dietary habits and physical activity levels; the second step measures pulse rate, blood pressure, height and weight.

Blood Pressure and pulse rate measurements were taken by a fully automatic digital BP machine, 'Omron Blood Pressure HEM-7120-IN. Weight and height were measured using a digital weighing scale "*Hospital Digital Weighing Scale* 200KG With Height Meter; ALLFINE; Model Number: WT-800 7" in kilograms and centimetres respectively. Presence of diabetes was self-reported in the questionnaire by the respondents.

Cardiovascular risk scores were assessed using the 'WHO cardiovascular disease risk non-laboratory-based charts' for Eastern Sub-Saharan Africa found in the WHO guideline titled "HEARTS: Risk based VD management 2022". The parameters which were used to predict the cardiovascular disease risk score in the chart will be Age, Sex, Smoking Status, Body Mass Index (kg/m^2) and Systolic Blood Pressure (mmHg). Measuring systolic blood pressure only unfortunately may have negative clinical implications on the respondents under study since respondents with high diastolic blood pressure maybe under diagnosed. The charts are color-coded based on the severity of risk to aid in accurately placing the patients in their respective categories. Each patient was given a percentage risk score which coincided with either a low, moderate or high CVD risk level. Patients with moderate and high CVD risk level were informed and referred for appropriate care after completing the questionnaire.

3.7 Validity and Reliability

A pre-test was administered to 10% of the sample size a week before data collection began in the Medical Outpatient Clinic, Nyeri County Referral Hospital. This was to ensure validity and reliability of the questionnaire and the reliability and accuracy of the study instruments that is the weighing machine and BP machine. Patients in the Medical Outpatient Clinic would be a different demographic than respondents presenting in the

outpatient or inpatient departments. OPD patients visit the hospital for a variety of reasons not necessarily related to specialized physician care while inpatients are admitted for a variety of reasons as well. Conducting a pilot study in MOPC would therefore ensure validity as well as accuracy of the instruments.

3.8 Data Collection Procedures

Well trained research assistants administered a standard, structured close-ended questionnaire via face-to-face interviews to the respondents. The questionnaire was disseminated to the respondents in a safe, quiet and confidential room to collect sufficient data for the study. Blood pressure was recorded by a well calibrated standard digital BP machine. The participants were seated comfortably with their back supported, feet flat on the floor, and arm supported at heart level. They were asked to rest quietly for at least 5 minutes before BP measurement to minimize the effects of physical activity or stress. The cuff was positioned on the upper arm at heart level. Three consecutive BP measurements were taken, with a 1-2-minute interval between readings, and the average was recorded to reduce variability. Blood pressure was recorded in mmHg. Systolic blood pressure was mainly considered since it is a parameter utilised in the WHO CVD charts. However diastolic pressure should be considered due to clinical implications on the patient.

Afterwards, the weight measurement was undertaken. The participants were weighed using calibrated digital scales, with minimal clothing and no shoes. The scale was checked for accuracy and zeroed before each measurement.

Finally, height measurement was done. The participants' height was measured using a stadiometer with the individual standing upright, heels together, and head positioned in the Frankfort horizontal plane.

BMI was calculated using the formula BMI = Weight (kg) / Height (m^2). The calculated BMI values were categorized according to established BMI classifications that is underweight, normal weight, overweight, obesity.

The data from the interviews, BP readings and BMI calculations were recorded on paper sheets questionnaires then entered to a Microsoft Excel worksheet and then transferred to SPSS worksheet for analysis.

3.9 Data Analysis and Presentation

Data was collected, cleaned in a Microsoft Excel worksheet. Descriptive Statistics were presented as frequencies/percentages for categorical variables and means +/-SD used for continuous variables. The data was then analysed using SPSS (Statistical Package for Social Sciences) statistical package 23 series. Bivariate linear regression analysis was utilized to identify statistically significant independent variables that are associated with the dependent variable. 95% CIs were reported, and results were deemed statistically significant with a significance level of $p< 0.05$. Tables and figures were used to present the findings.

3.10 Ethical Considerations

The proposal was submitted to AMREF ESRC for approval. A permit from the National Commission of Science, Technology and Innovation was sought. Finally, principal investigator applied for approval for the research from the Nyeri County Referral Hospital

Training Committee. Written Informed consent were obtained from the respondents without use of inducements or rewards. The respondents were informed of their right to withdraw from the study at any time without interruption or denial of the services that should be accorded to them, and those who withdrew any data that was obtained from them was discarded. Confidentiality and anonymity were upheld by use of unique identification numbers. The principle investigator, research assistants and statisticians signed Data confidentiality agreements. The documents were kept safely in the hospital administration records department. Electronic data was saved as password protected documents to limit access. This data was to be stored for one year and then discarded.

COVID-19 guidelines were adhered to prevent spread of the virus to the respondents; the researchers and respondents wore facemasks when conducting interviews and the instruments were sanitized after taking measurements for every respondent.

Respondents who were found to have elevated blood pressure, high BMI and high cardiovascular disease risk scores were referred for further evaluation and assessment by the hospital physicians and nutritional counsellors for appropriate management. The results were communicated to AMIU and Nyeri CRH and the findings published in a reputable scientific journal.

3.11 Study Limitations

i. This study was based at public health facilities thus certain populations who seek healthcare services in other health facilities such as private institutions or faith-based organizations were excluded from the study.

ii. Certain biological determinants might not have been evaluated due to the financial implications. This could have provided a deeper insight into cardiovascular health among the population. Sodium intake was also not measured during the data collection process. This would have given a better picture on the quality of the diet and its CVD implications. The study will endeavor to further research through the support of the county government in order to measure key factors such as diabetes and cholesterol.

iii. Some respondents might have reported misleading information in several questions based on what they believed was socially acceptable, like smoking status and alcohol intake. To overcome this, the respondents were interviewed in a safe, quiet, confidential room. Research assistants were also paired with respondents of similar gender to encourage trust and discourage false or lack of information

iv. Some of these risk factors have also been challenged as accurate markers for cardiovascular health in African populations. However, they are still currently being utilized in clinical setups to assess cardiovascular disease risk. This is due to a paucity of frameworks to guide assessment within African populations.

CHAPTER 4: RESULTS

4.1 Introduction

This chapter presents comprehensive and detailed results from this study that examined the prevalence of biological and behavioral risk factors as well as their corresponding confidence intervals. This chapter also describes the cardiovascular disease risk score of the participants under study. Finally, this chapter also presents findings from a bivariate linear regression analysis that explores the relationship between socio-demographic characteristics (such as age, gender, income level, and educational attainment) and cardiovascular risk scores. This analysis seeks to identify potential associations between socio-demographic factors and cardiovascular risk, contributing valuable insights into the determinants of CVD risk within the study population.

4.2 Socio-Demographic Characteristics of the Study Respondents

The study was conducted among 319 study respondents. The response rate was 99%. 1 questionnaire was reported as missing. 27 respondents opted not to answer the question on income per month in Ksh, however all respondents completed all the other questions on the questionnaire. Univariate analysis was conducted on the socio-demographic factors of the study respondents. There was almost an equal proportion of the respondents who resided in rural (52.4%) and urban (47.6%) areas. With a mean age of 47 years, majority of the respondents were female (57.7%), married (63.6%), self-employed (37.0%), and earned less than Ksh. 10,000 a month.

Table 1: Socio-Demographic Factors of the Study Respondents

Characteristics	**n = 319** n (%)
Residence	
Rural	167 (52.4%)
Urban	152 (47.6%)
Age (years)	
Mean (SD)	47.02 (17.48)
18-35	93 (29.2%)
36-45	69 (21.6%)
46-59	73 (22.9%)
> 60	84 (26.3%)
Gender	
Female	184 (57.7%)
Male	135 (42.3%)
Marital status	
Married	203 (63.6%)
Single	116 (36.4%)
Employment status	
Formal employment	53 (16.6%)
Informal employment	35 (11.0%)
Self-employment	118 (37.0%)
Unemployment	113 (35.4%)
Income per month(ksh)	
Below 10,000	164 (51.4%)
10,000-50,000	129 (40.4%)
Anthropometric measurements	
BMI (kg/m^2)	
<18.5	22 (6.9%)
18.5-24.9	131 (41.1%)
25-29.9	124 (38.9%)
≥ 30.0	42 (13.2%)
Blood pressure	
Normal (<140 mmHg)	228 (71.5%)
High (≥ 140 mmHg)	91 (28.5%)

Table 2: Distribution of BMI and Blood Pressure by Age Among the Study Respondents

Characteristic	**Age (years) (n = 319)**			
	18-35	**36-45**	**46-59**	**>60**
BMI (kg/m^2)				
<18.5	8 (34.4%)	4 (18.2%)	2 (9.1%)	8 (36.4%)
18.5-24.9	51 (38.9%)	16 (12.2%)	28 (21.3%)	36 (27.5%)
25-29.9	30 (24.2%)	32 (25.8%)	31 (25.0%)	31 (25.0%)
≥ 30.0	4 (9.5%)	17 (40.5%)	12 (28.6%)	9 (21.4%)
Blood pressure				
Normal (<140/90 mmHg)	86 (37.7%)	54 (23.7%)	46 (20.2%)	42 (18.4%)
High (≥ 140/90 mmHg)	7 (7.7%)	15 (16.5%)	27 (16.5%)	42 (46.2%)

BMI was highest among the 36-45 years age group at 40.5% and lowest among the >60 age group as well 18-35 age group at 36.4% and 34.4% respectively. 46.2% of the study population over 60 years old had high blood pressure while normal blood pressure was observed mainly in the 18-35 age group at 37.7%

Table 3: Distribution of BMI and Blood pressure by gender among the study respondents

Characteristic	Gender (n =319)	
	Female	**Male**
BMI (kg/m^2)		
<18.5	6 (27.3%)	16 (72.7%)
18.5-24.9	65 (49.6%)	66 (50.6%)
25-29.9	77 (62.1%)	47 (37.9%)
≥ 30.0	36 (85.7%)	6 (14.3%)
Blood pressure		
Normal (<140 mmHg)	130 (57.0%)	98 (43.0%)
High (≥ 140 mmHg)	54 (59.2%)	37 (40.7%)

High BMI was noted to be higher in females than in males (85.7% vs 14.3%). Blood pressure was also noted to be higher in females than in males, (59.2% vs 40.7%).

4.3. Prevalence of the Biological Risk Factors Associated with Cardiovascular Disease among the Study Respondents

Characteristic	Number of cases n=319	Age-standardized Prevalence estimate (%)	95% Confidence interval
Hypertension SBP > 140mmHg and /or diastolic BP>90mmHg	120	23.8%	(22.9%, 24.6%)
Type 2Diabetes Mellitus	61	4%	(2.92%. 5.08%)
Obesity BMI > 30kg/m^2	42	13.2 %	(9.5%, 16.9%)

The age standardized prevalence of hypertension was calculated to be 23.8% (95% CI 22.9-24.6). The age standardized prevalence for diabetes was 4% (95 % CI 2.92-5.08) while that of obesity was 13.2% (95% CI 9.5-16.9%).

4.4. The Prevalence of the Behavioral Risk Factors Associated with Cardiovascular Disease among Study Respondents

Table 4: Descriptive characteristics of behavioral risk factors associated with CVD among the study respondents

Characteristics	**n = 319 n (%)**
Exercise	
Sedentary lifestyle	73 (22.9%)
Moderate exercise 1-3 times/week	135 (42.3%)
Moderate exercise > 4 times/week	111 (34.8%)
Smoking status	
Smokers	27 (8.5%)
Non-smokers	292 (91.2%)
Alcohol intake	
Drinkers	70 (21.9%)
Non-drinkers	249 (78.1%)
Fruits and vegetables	
0-2 days	130 (40.8%)
3-6 days	164 (51.4%)

Daily	25 (7.8%)
Deep fried foods	
0-2 days	259 (81.2%)
3-6 days	58 (18.2%)
Daily	2 (0.6%)
Sugar intake	
0-2 days	124 (38.9%)
3-6 days	88 (27.6%)
Daily	107 (33.5%)
Starchy foods	
0-2 days	35 (11.0%)
3-6 days	117 (36.7%)
Daily	167 (52.4%)
More than 8 glasses of water	
0-2 days	131 (41.1%)
3-6 days	115 (36.1%)
Daily	73 (22.9%)

Fish and poultry	
0-2 days	280 (87.8%)
3-6 days	39 (12.2%)

Table 5: Prevalence of behavioral risk factors associated with CVD among the study respondents

Characteristics	Number of cases n=319	Prevalence estimate (%)	95%Confidence interval
Tobacco smokers	27	8.5 %	(5.6%, 12.04%)
Alcohol intake	70	21.9 %	(17.4%, 26.8%)
Adequate exercise >4times a week	111	34.8 %	(29.4%, 39.9%)
Dietary habits			
Fruits and Vegetables daily	25	7.8 %	(4.9%, 10.8%)
Deep fried foods daily	2	0.006 %	(0%, 0.01%)
Sugar intake daily	107	33.5 %	(28.4%, 38.2%)
Starchy food daily	167	52.4 %	(46.9%, 57.9%)
Fish and poultry daily	39	12. 2%	(8.8%, 16.2%)

Respondents who exercised more than 4 times per week were 34.8% (95% CI 29.4%-39.9%), tobacco smokers were 8.5% (95% CI 5.6%-12.04%) and respondents who exhibited harmful alcohol use were 21.9%. (95% CI 17.4%-26.8%). In terms of their dietary intake, 7.8 % (95% CI 4.9%-10.8%) of them consumed fruits and vegetables daily. Respondents who consumed deep dried food 0-2 days/week were 81.2% (95% CI 76.9%-85.4%) while those who consumed sugar 0-2 days per week were 38.9% (95% CI 33.3%-

44.3%). Meanwhile respondents who consumed starchy foods 0-2 days per week were 11.0% (95% CI 7.5%-14.4%) and fish and poultry 3-6 days per week were 12.2% (95% CI 8.8%-16.2%).

4.5 The Cardiovascular Disease Risk Score of the Study Respondents

Over three-quarter (79.3%) of the respondents had low risk of cardiovascular disease whereas only 4.4% of them were at a high risk of cardiovascular disease. The WHO CVD risk scores of the study respondents are presented in Figure 4.

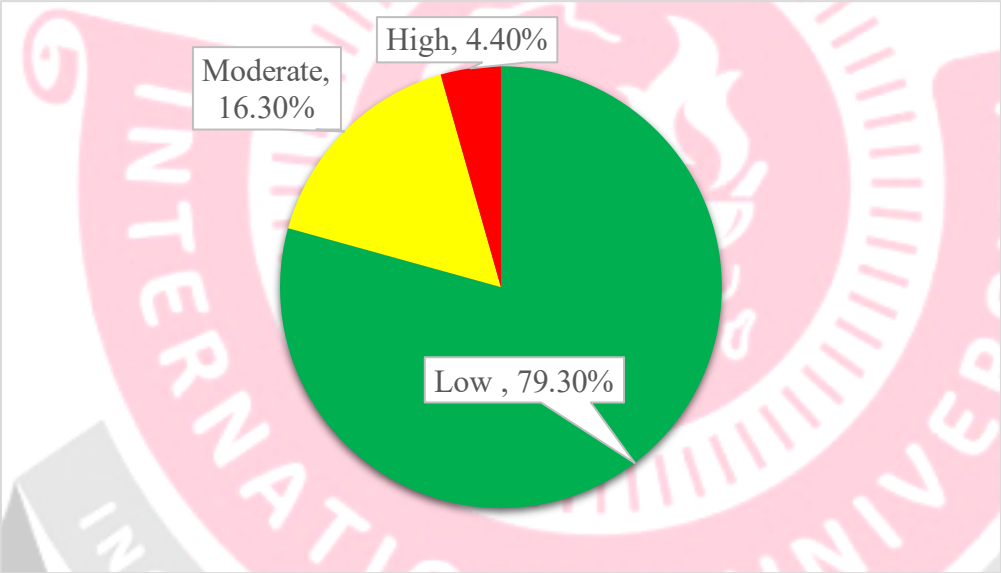

Figure 4: The WHO CVD risk scores of the study respondents

4.6. Association between Socio-demographic Factors and CVD Risk Score among the Respondents

The relationship between demographic and risk factor variables and WHO Cardiovascular Disease (CVD) risk among patients at Nyeri County Referral Hospital in Kenya is represented in Table 6.

Table 6: Bivariate linear regression between socio-demographics factors and WHO CVD risk score

Demographic Factors	WHO CVD Risk score					
	Outpatient			Inpatient		
	Std β (Std. Error)	**95% Confidence Interval**	**Sig.**	**Std β (Std. Error)**	**95% Confidence interval**	**Sig.**
Residence	1.267 (0.504)	(0.28, 2.26)	.013*	0.683 (0.775)	(-0.84, 2.21)	.380
Age	2.411 (0.183)	(2.05, 2.77)	.000**	2.046 (0.269)	(1.52, 2.57)	.000**
Gender	-2.113 (0.478)	(-3.05, - 1.18)	.000**	-1.980 (0.695)	(-3.34, - 0.62)	.005**
Marital Status	.359 (0.273)	(-0.18, 0.89)	.190	-0.002 (0.328)	(-0.65, 0.64)	.996
Level of Education	.590 (0.328)	(-0.05, 1.23)	.074	0.278 (0.416)	(-0.54, 1.09)	.506
Employment Status	1.062 (0.248)	(0.58, 1.55)	.000**	.792 (0.330)	(0.15, 1.43)	.018*
Income Level	1.033 (0.439)	(0.17, 1.89)	.020*	-0.307 (0.582)	(0.83, 1.44)	.019*
Model R^2	0.712			0.644		

Std β, standardized beta coefficient; SE, standard error, Confidence Interval, 95%

Bivariate linear regression was used to analyse the relationship between demographic factors and WHO CVD risk score.

Firstly, age demonstrated a robust and consistent relationship with CVD risk across both outpatient and inpatient groups. Outpatients exhibited a strong positive association, with a Std β of 2.411 and a highly significant p-value (p = .000). Inpatients also showed a substantial relationship between age and CVD risk, with a Std β of 2.046 and a similarly

significant p-value (p = .000). These findings underscored the significance of age in predicting CVD risk, emphasizing the need for healthcare providers to focus on effective risk management as patient's age, irrespective of their outpatient or inpatient status.

Secondly gender emerged as a pivotal factor influencing CVD risk for both outpatients and inpatients. Outpatients exhibited a strong negative association, with a Std β of -2.113, signifying a lower risk for females, and a highly significant p-value (p = .000). In the inpatient group, the relationship remains statistically significant but slightly weaker, with a Std β of -1.980 and a p-value of .005. These results underscored the gender-specific nature of CVD risk, implying the necessity for tailored interventions or risk assessment strategies to effectively mitigate CVD risk based on gender.

Thirdly, researchers observed a distinct contrast in the impact of residence on CVD risk between outpatients and inpatients. Among outpatients, there was a positive association with a standard beta coefficient (Std β) of 1.267, signifying that residing in urban area was linked to higher CVD risk. However, this connection was not as clear among inpatients, with a weaker association (Std β of 0.683) and a non-significant p-value (p = .380). These results suggest that place of residence may play a more critical role in predicting CVD risk for outpatients than for inpatients.

Additionally, the standard coefficient for marital status among outpatients was 0.359 (Std. Error 0.273), with a non-statistically significant p-value of .190, indicating a lack of a significant association between marital status and CVD risk in the outpatient group. A similar trend was observed among inpatients, where the Std β for marital status was -0.002 (Std. Error 0.328), and the p-value was not statistically significant (p = .996). These

findings suggest that marital status was not a significant predictor of CVD risk in this particular study population.

Besides, the standard coefficient for level of education was 0.590 (Std. Error 0.328), and the p-value was .074, indicating a borderline statistically significant association with CVD risk. In contrast, among inpatients, the Std β for level of education was 0.278 (Std. Error 0.416), and the p-value was not statistically significant (p = .506). These results suggested a tentative link between higher levels of education and higher CVD risk among outpatients, but no significant relationship between education level and CVD risk in inpatients. Further exploration may have been required to fully understand the connection between education and CVD risk among outpatients.

It was observed that among outpatients, the standard coefficient for employment status was 1.062 (Std. Error 0.248), with a highly statistically significant p-value of .000. This indicated a strong positive association between employment status and CVD risk in the outpatient group. Among inpatients, the Std β for employment status was 0.792 (Std. Error 0.330), and the p-value was statistically significant (p = .018), suggesting a positive but slightly weaker association between employment status and CVD risk in the inpatient group. These findings implied that employment status was significantly linked to CVD risk in both outpatient and inpatient groups, with employed individuals being at a higher risk of CVD.

Finally, among outpatients, the standard coefficient for income level was 1.033 (Std. Error 0.439), and the p-value was statistically significant (p = .020), indicating a positive association between income level and CVD risk. In the inpatient group, the Std β for

income level was -0.307 (Std. Error 0.582), and the p-value was also statistically significant (p = .019), suggesting a negative association between income level and CVD risk in inpatients. These results revealed a significant association between income level and CVD risk in both groups. However, the direction of this association differed, with higher income being associated with higher CVD risk among outpatients and lower income being associated with higher CVD risk among inpatients.

The R-squared (R^2) values for the regression models for outpatients and inpatients were 0.712 and 0.644, respectively, providing insights into how well and succinctly the regression models explained the variance in WHO Cardiovascular Disease (CVD) risk for these two study groups.

For Outpatients ($R^2 = 0.712$), the R^2 value of 0.712 indicated that the regression model effectively explained approximately 71.2% of the variance in WHO CVD risk among this group, with the independent variables, including demographics and other factors, accounting for over 70% of the variation in CVD risk among outpatients. For Inpatients ($R^2 = 0.644$), the R^2 value of 0.644 suggested that the regression model effectively explained around 64.4% of the variance in WHO CVD risk among inpatients. This indicated that the model captured more than 64% of the variation in CVD risk among inpatients.

The findings imply that in the outpatient model, with its relatively high R^2 value, was well-suited for predicting and understanding CVD risk in this group, suggesting a strong relationship between the independent variables (residence, age, gender, marital status, level of education, employment status, and income level) and CVD risk among outpatients. The

inpatient model, with a slightly lower R^2 value, was still useful for understanding and predicting CVD risk in the inpatient population, indicating its capability in explaining a substantial portion of CVD risk variance among inpatients.

CHAPTER 5: DISCUSSIONS

5.1 Introduction

This chapter presents the discussion, conclusions, and recommendations based on the findings of the study. The discussion section examines the results of the study and compares them with previous studies. It also provides a detailed interpretation of the findings and their implications for policy and practice. The conclusions section summarizes the key findings of the study and their significance. Finally, the chapter provides recommendations based on the study's findings. These recommendations aim to address the identified risk factors and reduce the burden of CVD in Nyeri County. They include policy changes, public health interventions, and further research that can inform better prevention and management of CVD in the County.

5.2. Discussions

5.2.1 Prevalence of Biological Risk Factors

Slightly more than one fifth (23.8%) of hypertension was demonstrated in Nyeri County but this prevalence was lower than other regions of Kenya for example Western Kenya at 27% (Mogaka et al., 2022). It is similar to the prevalence registered in national cross-sectional studies such as the Kenya Demographic and Health Survey 2022 and the Kenya STEPwise Non-Communicable disease study at 20 and 24.5 % respectively. It has also been studied that counties with the highest percentage of women with hypertension are Kirinyaga (20%), Taita/Taveta (18%), and Laikipia (16%) (KDHS 2022, (Mohamed et al., 2018). Moreover, it was much higher than global prevalence of hypertension (16.5%) and

East Asia (9.6%) but similar to prevalence in Sub-Saharan Africa at 24.9% (Beaney et al., 2018). Hypertension is therefore an important factor to take into consideration since about 1 in 4 people suffer from it in the region. Awareness and effective treatment and adequate control of hypertension should also be emphasized especially in primary care centres to avoid morbidity, increased complications and untimely deaths related to cardiovascular disease (Tackling et al., 2023).

Type 2 Diabetes Mellitus research in Kenya has estimated age standardized prevalence of diabetes to be 2.4% which is slighter lower than prevalence in this population which was estimated to be 4% (Mohamed et al., 2018). The KDHS 2022 puts the prevalence of diabetes at an even lower level of 1% among the ages 15-49. However, this survey doesn't take into account that majority of diabetes patients lie over the cut off age. This may explain the very low prevalence. The prevalence in the study population is however similar to the prevalence in many of the Sub-Saharan countries at 4.9%. Meanwhile, global diabetes prevalence estimates are much higher than the study population (9.3%) with China, USA and India having the highest number of people living with diabetes at 116 million, 77 million and 33 million respectively. Interestingly, in contrast to other Sub Saharan Africa countries, a systematic review showed that Sudan and Mauritius have an estimated prevalence of 22.1% (Saeedi et al., 2019). This is much higher than the prevalence demonstrated by the study population.

Obesity is a complex multifactorial disease that has been widely believed to influence cardiovascular disease risk. Findings from this study revealed 87% of the population to be at a healthy weight with only about 13% being obese. This was much lower than the national prevalence of 31.13% (Mkuu et al., 2021). These findings were similar to studies

from Western Kenya where over 90% of the population had a low or normal BMI (Chege et al., 2016). According to a systematic review by Wagner et al. (2021), this prevalence of obesity was similar to global statistics (12%) as well as prevalence rates from various Sub-Saharan countries (15%). North American countries seemed? to have the largest prevalence of obesity with ranges from 20-35% (Wagner et al., 2021). Other countries in Africa like Libya also showed an extraordinarily high rate of overweight and obesity with women at 47.4% and men at 33.8% (Lemamsha et al., 2019).

5.2.2 Prevalence of Behavioral Risk Factors

Behavioral risk factors of cardiovascular disease are a core component requiring consideration when studying determinants of cardiovascular disease. Smoking remains one of the major drivers of morbidity and mortality globally. According to this study, the findings show a lower prevalence of smoking at 8.5% compared to national findings from the Kenyan STEPwise Survey for Non-Communicable Diseases 2015, which reported that 13% of Kenyans have smoked some form of tobacco-based product (Ngaruiya et al., 2018). The findings from this study are also congruent with the more recent Kenya Demographic and Health survey 2022 which showed that nationally, more men than women used tobacco products, (11% vs 1 %) with significant regional differences within the counties. The prevalence is also lower than global statistics which indicate there are still over 1.1 billion smokers with prevalence rates of approximately 33.3 % among men and 6.7% among women (Flor et al., 2021). Additionally, Central and Eastern Europe, Asia, Oceania and Latin America led in the highest smoking prevalence of up to 39.5 % in men and 15.5% among women. Unfortunately, some regions in Sub Saharan Africa, for instance Malawi recorded the highest increase in smokers over the last 2 decades (Reitsma et al., 2021).

Harmful use of alcohol has been controversially associated to risk of cardiovascular disease with various studies giving a wide array of results. Among the study population, over 20% reported harmful use of alcohol. This observation corresponds to the prevalence reported by studies in Kenya that estimate a national average prevalence of 13.3% with some areas in Western Kenya at 31.7% (Takahashi et al., 2017). Some countries in the region demonstrate similar prevalence of alcohol use like Uganda at 28.6% (Kabwama et al., 2016). In contrast, Tanzania had almost three-fold increase in prevalence compared to the study population at 60.7% (Mushi et al., 2023). Given that over 30 % of alcohol related deaths can be attributed to cardiovascular disease in countries in Sub Saharan Africa such as South Africa having over a fifth of the population taking more than the recommended amount of alcohol is worrying (Matzopoulos et al., 2022).

Physical activity has a direct link to increased cardiovascular disease risk. Among this population, only about 35% fulfil the criteria for adequate physical activity. Studies from other Sub Saharan countries for example Cameroon revealed a much lower estimated prevalence of 11.9 % especially among young adults (Nansseu et al., 2019). These findings compare favourably to studies in high income countries that estimates physical activity to be between 40-60%. Moreover, physical activity in sub Saharan Africa is estimated to be 22% which is similar to findings from the study (Yuyun et al., 2020). This prevalence of physical activity could be due to lack of sedentary lifestyles within the region. Walking, running and sporting activities are encouraged among young adults while socioeconomic activities such as subsistence agriculture promote physical activity within local farms.

In an effort to optimize cardiovascular health, a well-balanced, healthy diet is necessary. From this study, majority of the population do not practice dietary habits ideal for

cardiovascular health. Fruits and vegetables should be consumed approximately 5 servings daily, sugar and starchy foods should be eaten moderately and fish and other white meat should be eaten often. Few of the respondents can adhere to this diet where an emphasis is put on starchy foods and vegetables. This is because such foods are readily available and affordable to majority of the population. While diets for example the Mediterranean diet have proven benefit in reducing complications and mortality related to cardiovascular disease (Delgado-Lista et al., 2022), such diets may not be feasible in the communities around Central Kenya. In a study done in Tanzania, there was no significant association between the "Western diets" and hypertension or cardiovascular risk. (Katalambula et al., 2017). Interestingly, a systematic review showed that plant-based diets in Sub-Saharan Africa may have a cardio-protective effect as opposed to meat inclusive diets although research on this subject is still minimal (Lopes et al., 2022). In contrast to this study, populations who adhered to a "mixed" or "rice, pasta and fish" diet showed a decreased cardiovascular risk in urban and rural Ghana while for Ghanaian immigrants living Europe, a similar diet caused an increase in cardiovascular risk (Boateng et al., 2019). Due to these inconclusive studies, further research should be done contextually to ascertain the most appropriate diet to reduce cardiovascular risk within this population.

5.2.3 Cardiovascular Disease Risk Scores.

Cardiovascular disease risk scores predict a 10-year risk of acquiring cardiovascular disease. In this study, approximately 1 in 5 of the population had moderate or intermediate to high risk of cardiovascular disease. This was higher than studies in an Iranian population where 15.7 % had a similar risk (Zibaeenejad et al., 2022). However, a study in Tanzania that explored the magnitude and distribution of cardiovascular disease risk among diabetics

showed that majority of the population (60%) had a high cardiovascular risk score. This underscores the fact that biological risk factors have a significant role in predicting cardiovascular disease (Kassam et al., 2023). With over 20% of the study population at risk of CVD, strategies should be put in place to avert further morbidity and mortality.

5.2.4 Socio-Demographic Characteristics and Cardiovascular Disease Risk Score

Socio-demographic characteristics in the population were studied and associations between cardiovascular disease risk scores identified and analysed. Age was shown to have a strong association to cardiovascular disease risk. It was demonstrated that among the population with hypertension in Kenya, increase in age was related to prevalence of hypertension fivefold with resultant cardiovascular risk. This was according to the Kenya Stepwise Non-communicable disease study (Mohamed et al., 2018). This was congruent to studies done among Chinese adults, where higher cardiovascular disease risk observed among the elderly (Wu et al., 2023). Similarly, a study among an apparently healthy elderly population in Poland revealed that they all had either high to very high risk of cardiovascular disease (Hudzik et al., 2023). These findings underscored the significance of age in predicting CVD risk, emphasizing the need for healthcare providers to focus on effective risk management as patients' age.

Due to various physiological and social cultural factors, men and women are disproportionately affected by cardiovascular disease risk. In this study, gender was demonstrated to influence CVD risk with females having lower risk than men in acquiring cardiovascular disease. These findings were congruent to research done among the Kenyan population that revealed men had a higher cardiovascular risk than women, (3%vs 1.9%)

with some study sites in South Africa reporting almost a 3-fold higher risk in men (Wagner et al., 2021). Similar findings have been found in various studies done in both low- and high-income countries. A prospective study done in over 27 countries revealed women had lower levels of CVD risk and mortality despite the absence of adequate secondary prevention therapies and strategies for women (Walli-Attaei et al., 2020). Men could be more at risk of CVD due to poor health seeking behaviour, poor lifestyle choices such as excessive use of alcohol and tobacco smoking. Moreover, more men have low awareness of CVD risk factors as well as having poor adherence to medication.

Areas of residence demonstrated to be a predictor of cardiovascular disease in some populations with little to no effect on other populations. In this study, residence revealed to be a significant risk factor among outpatients. Urban dwellers were shown to having a strong association to higher cardiovascular disease risk scores. This was similar to studies done in informal settlements in urban areas in Nairobi, Kenya where there seemed to be a higher mortality due to cardiovascular disease as compared to other regions (Wekesah et al., 2020). This association could be due to lifestyle habits that are popular in urban areas such as poor diet quality, sedentary lifestyle, and harmful use of alcohol and tobacco smoke. Meanwhile, In Nigeria, there was no significant association between area of residence and CVD risk (Odunaiya et al., 2023). However, these findings contrasted a study done in Malaysia that showed rural populations were higher at risk of cardiovascular disease although other risk factors also seem to come into play to increase this risk (Chan et al., 2021). The findings from the study reveals urban areas need more intensive healthcare systems than rural areas to combat cardiovascular disease risk.

Marriage and strong social support have been widely proven to have an inverse relationship to cardiovascular disease risk. It has been proven that lower cardiovascular disease risk, complications and mortality are seen in married men and women. However, according to this study marital status was not a significant predictor of CVD risk in this particular population. This was similar to studies done in Italy, where there was no association between marital status and cardiovascular disease risk in men (Humbert et al., 2023). Moreover, congruent findings were demonstrated in Ghana where no significant association was seen among men, yet marriage was a significant predictor of cardiovascular disease among women (Tuoyire et al., 2019).

Education seems to be a factor that influences cardiovascular risk. In this study, higher levels of education were demonstrated to be weakly associated to cardiovascular disease risk in the outpatient group and no association in the inpatient group. These findings are in stark contrast to most studies where lower levels of education as seen to have higher cardiovascular disease levels (Rosengren et al., 2019). In Sub- Saharan Africa, it was demonstrated from systematic reviews that low levels of literacy also often lead to low levels of awareness of CVD risk factors or clinical symptoms as well as low levels of health seeking behaviour (Bull et al., 2023). Wekesah et al. (2020) also demonstrated that populations in slums in Nairobi who had primary education or higher had a 39% reduction in CVD related deaths as well as a lower rate of cardiovascular disease at 19.8% compared to lower education levels at 56.7% (Wekesah et al., 2020). Findings from this study mean that individuals with higher education levels could have unhealthy lifestyles, reduced physical activity and dietary changes. The more educated tend to have a higher income and live in urban areas where healthy lifestyles are rarely adhered to.

Employment status and higher income have been studied widely as a predictor of cardiovascular disease. Findings from this study were congruent with studies done on the association between CVD risk and these factors. Respondents who were employed were seen to have a higher cardiovascular disease risk as compared to those who were not employed. Similarly, income level was strongly demonstrated to be associated to cardiovascular disease. However, from this study there was a difference between the inpatients and outpatients' groups. A positive association was demonstrated in outpatients but a negative association in inpatients. This means that lower income earners seem to have a higher risk of cardiovascular disease among the inpatients but a lower risk of cardiovascular disease among the outpatients. This may be due to lack of awareness of cardiovascular disease, lower perception of risk or suboptimal management of cardiovascular risk factors.

Consequently, complications arise from exposure to these risk factors leading to hospital admissions. Among the outpatient group, higher income earners have a higher risk of cardiovascular disease. This could be due to unhealthy diets, increased harmful alcohol use and sedentary lifestyles and that are adopted among populations with higher incomes. These findings are similar to analysis of data from the Kenyan Step Wise NCD study that showed that respondents in the highest wealth quintile had higher prevalence of type II diabetes (Kibachio et al., 2020). These populations also had a higher prevalence of hypertension, (29.0% vs 19.4%) as well as poorer control of hypertension (40.2 % vs 81.7%) (Mohamed et al., 2018). These factors are key risk factors of cardiovascular disease. Consequently, higher income households demonstrate higher cardiovascular disease risk. Studies done in Uganda also reveal similar patterns in the prevalence of

hypertension among individuals from higher income households (Mustapha et al., 2022). While in Africa there is a direct relationship between the two factors, in Europe, Australia and North America, the relationship is inverse. The lower the income, the higher the CVD risk. Middle aged men from New Zealand who were unemployed as a result of the 2020 COVID pandemic had a larger burden of cardiovascular disease (Nghiem et al., 2020). Yet, analysed data from 1960 to 2015 from populations in 32 countries that showed that the economy has no association to cardiovascular disease (Dadgar et al., 2020). However, studies done in the US and UK cohorts show a similar association between lower socio-economic status households and high cardiovascular disease risk (Zhang et al., 2021). This could be due to poor access to medical interventions, and therapies that would reduce cardiovascular risk. Healthier food and opportunities for exercise are also more expensive and less accessible in the Western world. This increases CVD risk substantially in lower income households.

CHAPTER 6: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the conclusions and recommendations of the study. It summarizes the results and findings as well as the discussions that have been brought forward as a result of the study. Finally, this chapter suggests possible further research that may be undertaken in order to advance existing studies as well as explore the findings of this study in deeper context.

6.2 Conclusions

The results from this study demonstrated that biological risk factors such as hypertension had a high prevalence of 23.8% while diabetes had a low prevalence of 4% among patients in Nyeri County Referral Hospital. This study also showed that, among the interviewed respondents, only 21.9% took alcohol, 8.5% smoked tobacco and 13.2% were obese. On the other hand, majority of the respondents consumed a diet that doesn't fulfil global recommendations with only 7.8% taking fruits and vegetables daily, 38.9% of them taking sugar and 88% of them having starchy foods more than 2 days/week. Fish and poultry were also consumed by only 12% of the population. Of the respondents, 34.8% also engaged in moderate exercise adequately. These results point out that the prevalence of behavioral risk factors among the patients at Nyeri County Referral Hospital varies depending on the risk factor under study. The results from the WHO CVD risk scores taken from the respondents of this study shown that 79% had low CVD risk score, 16.3% had moderate CVD risk score and 4.4% had high CVD risk scores. The study also demonstrated there was a strong association between most of the socio-demographic factors and cardiovascular disease risk.

They included age, gender, residence, education and employment/income. However, there was no significant association between marital status and cardiovascular disease risk.

6.3 Recommendations

Healthcare providers should monitor the cardiovascular risk score among patients above 40yrs seeking health services at Nyeri county referral hospital in order to identify early and educate the patients on the need for treatment, referral and behavior modification. This includes encouraging regular screenings and outreaches. While diabetes prevalence may not be very high, diabetes screening and management needs urgent, specific and targeted therapies within the region given that this number is projected to grow by 142.9% in the next two decades. Both international and national diabetes strategic plans should be implemented and strengthened within health care systems to curb the growing population dealing with diabetes. This will have a significant effect on reduction of cardiovascular disease risk.

Despite the low prevalence of smoking demonstrated in the study population, tobacco cessation frameworks and policies need to be enhanced to reduce the prevalence to a much lower figures due to the effect of smoking on health. This will also reduce the harmful effects of smoking on people with second hand exposure within the community. Healthy BMI levels should be encouraged and maintained among the study population. Appropriate diet, avoiding ultra-processed foods and adequate physical activity will be beneficial to maintain body weight at healthy levels. Respondents who are struggling with obesity can be managed in a multidisciplinary team involving a trained physician and nutritionist to achieve this goal.

Local government authorities in partnership with social services need to identify and intervene in individuals who are struggling with alcohol use even as the health sector improves on educating the community on appropriate and WHO recommended use of alcoholic drinks. Meanwhile, education on a good quality diet based on WHO recommendations is advisable. Practices such as increased water intake, reduction of complex carbohydrates from the diet as well as promotion of vegetables, fruits and proteins that are lean, plant based or fish should be taught in the population. Diets that are frequently adopted in urban areas for example ultra-processed foods, sugars and sweeteners and saturated fats, often have a deleterious effect on cardiovascular health and should be discouraged.

Most respondents learnt about WHO CVD risk score for the first time during the interview, therefore, there is need to conduct mass health education among patients at Nyeri County referral hospital and the whole county in general. This mass education should include all healthcare stake holders starting from the community health promoters to clinicians in the highest level of care within the county facilitated by the County Department of Health. Risk stratification should play a key role in averting this disease with an aim of identifying the most vulnerable in the community and offering immediate patient care as well as initiating risk reduction. CHPs should be equipped with instruments e.g. blood pressure machines and weighing scales and with the knowledge of risk stratification to increase coverage in the communities. Primary prevention strategies, adherence to medication, awareness of risk factors and building capacity among healthcare workers on recognizing these risk factors are also other essential interventions to consider in order to reduce this level of cardiovascular disease risk in this population.

Healthcare workers in urban areas also need to have a higher index of suspicion for cardiovascular disease risk than those in rural areas to avoid mortality among urban dwellers. There should also be multi-disciplinary collaboration among healthcare professionals in development of strategies and policies to curb the CVD risk factors. Provision of care for patients with CVD risk factors should also be initiated in an appropriate and timely manner with effective coordination between the various levels of care. Risk stratification should be implemented among patients within non communicable disease clinics and patients should be educated on their CVD risk to encourage adherence to primary or secondary prevention interventions

Health literacy and health promotion activities especially among the vulnerable population should utilize a 3-tiered approach involving the mass population, the individual and the community. Interventions such as peer education, social media advocacy, mass media campaigns, motivational interviewing, incentives and use of pharmacotherapy should be intensified to avert preventable deaths due to cardiovascular disease. Stringent government regulations should also be implemented to reduce second-hand smoke exposure from active smokers since there is a positive association between CVDs and passive smokers. Finally, monitoring and evaluation of cardiovascular disease prevention programmes within healthcare facilities or in the community, should be done and appropriate actions need to be put in place to ensure effectiveness and efficiency in the use of resources. This would also inform healthcare program managers of any gaps within the programme that may need interventions.

6.4 Recommendations for Further Research

Further research should be conducted on the CVD Risk score involving the use of the WHO laboratory-based CVD risk score that includes measurement of cholesterol levels and random glucose levels. Other cardiovascular disease risk score measurement tools can also be utilized to research CVD risk within the community for accurate diagnosis for example the Framingham Coronary Heart disease risk score calculator or the ASCVD 2013 risk calculator by ACC/AHA. The relationship between education and cardiovascular disease risk should also be explored further to ensure appropriate interventions are applied within the right context including more robust studies such as qualitative studies or mixed methods studies. Other risk factors of cardiovascular disease risk should also be explored such as effects of mental health, the COVID 19 pandemic and exposure to household air pollution and biomass fuels. Finally, research into clinical governance, adoption of health policies or utilization of national guidelines in healthcare facilities should be carried out to evaluate their effectiveness in reducing CVD risk and to enable healthcare workers to tailor strategies relevant to the population.

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APPENDICES

Appendix I: Informed consent form.

STUDY TITLE: RISK FACTORS ASSOCIATED WITH CARDIOVASCULAR DISEASE AMONG PATIENTS ATTENDING NYERI COUNTY REFERRAL HOSPITAL

INVESTIGATOR: BEATRICE WAIRIMU MUHU

My name is Beatrice Wairimu Muhu. I am postgraduate student in Masters of Public Health in Applied Epidemiology student at Amref International University. I intend to carry out a study titled "***Risk factors associated with cardiovascular disease among patients in Nyeri County Referral Hospital"*** This is a scientific study being carried out among the patients who are being attended to at Nyeri County Referral Hospital with the aim of identifying patients who possess the risk factors that accelerate the development of cardiovascular disease.

This research that I invite you to partake in is voluntary therefore refusal to participate in this study will not incur a penalty or withdrawal of any services in the hospital. You are also within your rights to withdraw from participating in the study at any time without loss of benefits or services to which you are entitled.

Research Protocol

Participants in this study have been chosen randomly from the population. Questions will be asked via questionnaire in face-to-face interviews that by trained, competent research assistants. The interview will take approximately 10 minutes. Afterwards, the research

assistants will take measurements of your height, weight, waist and hip circumference as well as your blood pressure. These measurements will take approximately 5 minutes. Consent for any of these procedures or consent to answering selected questions can be withdrawn at any time within the course of the interview. If changes are made to the study or new information becomes available, you will be informed. Participants are free to withdraw from the study at will and any information obtained from them will not be included in the study.

Study duration

This study takes place over the course of 1 month

Risks.

An extra 15 minutes may be incurred before receiving your routine services. However, the questions asked within the course of the interview are free from embarrassment and the measurements taken are safe and non-invasive.

Benefits

The information provided will assist the investigator to calculate your cardiovascular disease risk score. They will assist in identifying the participants' risks factors with an aim to reduce cardiovascular disease. The at-risk participants will be notified and promptly referred for specialist care under a physician. Furthermore, the at-risk participants will be referred to nutritional counsellors within the hospital for nutritional and lifestyle assessment and modification.

Confidentiality

Confidentiality and anonymity will be maintained. The questionnaire will be administered in a closed room. Use of a unique serialized ID code will be employed to identify selected participants. The completed questionnaires will be handled and stored safely within the NCRH hospital administration records department.

Results dissemination

The findings from this study will be shared with Amref International University, Department of Community Health, the Nyeri County Referral Hospital clinical staff and a reputable scientific journal.

Compensation

This study is voluntary and takes places within the NCRH. Therefore there won't be any rewards for participation in the research nor compensation for any expenses incurred. Your access to medical care will not be enhanced nor interfered with.

If you have any questions, you can ask anyone from our team now or later. If you have questions later, you may contact Beatrice Wairimu Muhu, 0705011817, beatricewmuhu@gmail.com.

If you have questions about your rights as a study subject, you may contact:

The Research Officer

Amref Health Africa in Kenya

Wilson Airport, Langata Road

Office Tel: +254 20 6994000

Mobile No: 0795746777

Fax: +254 20 606340

P.O Box 30125-00100

Nairobi, Kenya

Do you have any questions at this time?

Part II: Certificate of Consent

I have read the above information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to participate in this study.

Print name of participant	
Signature of the participant	
Date	

If visually impaired, physically impaired, mentally impaired or illiterate

I have witnessed the accurate reading of the Consent Form to the potential study subject, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Print Name of participant	
Thumb/Foot print of Subject	
Signature of Witness	
DATE	

Statement by the researcher/person taking consent.

I confirm that the study subject was given an opportunity to ask questions about the study, and all the questions asked by the study subject have been answered correctly and

to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this Informed Consent Form has been provided to the study subject.

Print Name of researcher/person taking the consent	
Signature of researcher/person taking the consent	
DATE	

Appendix 2: AMREF ESRC Approval letter

amref health africa

Amref Health Africa in Kenya

REF: AMREF – ESRC P1324/2022 **March 29, 2023**

Beatrice Wairimu Muhu
Amref International University
P.O Box 27691-00506
Nairobi, Kenya
Tel: +25470501817
Email: beatricewmuhu@gmail.com

Dear Beatrice Muhu,

RESEARCH PROTOCOL: RISK FACTORS ASSOCIATED WITH CARDIOVASCULAR DISEASE AMONG PATIENTS ATTENDING NYERI COUNTY REFERRAL HOSPITAL, KENYA

Thank you for submitting your protocol to the Amref Ethics and Scientific Review Committee (ESRC).

This is to inform you that the ESRC has reviewed and approved your protocol. Your application approval number is ESRC P1324/2022. The approval period is from March 29, 2023, to March 28, 2024, and is subject to compliance with the following requirements:

a) Only approved documents (including informed consents, study instruments, advertising materials, material transfer agreements, etc.) will be used.
b) All changes including (amendments, deviations, violations, etc.) are submitted for review and approval by Amref ESRC before implementation.
c) Death and life-threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the Amref ESRC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to Amref ESRC within 72 hours.
e) Clearance for export of biological specimen must be obtained from the relevant government authorities for each batch of shipment/export.
f) 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.
g) In case of late renewal, the Amref ESRC shall not be held responsible for any serious adverse events (SAEs) that may occur as a result of research activities that were carried out after the expiry of approval.
h) Submission of an executive summary report within 90 days upon completion of the study to the Amref ESRC.
i) All government regulations for prevention and control of the spread of COVID-19 including social distancing, provision of personal protective equipment for participants and research assistants should be adhered to during data collection. All research assistants should be monitored for COVID 19 symptoms and referred for testing in case they present with symptoms.

Appendix 3: NACOSTI Approval letter

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 398869

Date of Issue: 29/April/2023

RESEARCH LICENSE

This is to Certify that Dr., Beatrice Wairimu Muhu of Azzref International University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nyeri on the topic: RISK FACTORS ASSOCIATED WITH CARDIOVASCULAR DISEASE AMONG PATIENTS ATTENDING NYERI COUNTY REFERRAL HOSPITAL, KENYA. for the period ending : 29/April/2024.

License No: NACOSTI/P/23/25011

398869

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013 (Rev. 2014)
Legal Notice No. 108: The Science, Technology and Innovation (Research Licensing) Regulations, 2014

The National Commission for Science, Technology and Innovation, hereafter referred to as the Commission, was the established under the Science, Technology and Innovation Act 2013 (Revised 2014) herein after referred to as the Act. The objective of the Commission shall be to regulate and assure quality in the science, technology and innovation sector and advise the Government in matters related thereto.

CONDITIONS OF THE RESEARCH LICENSE

1. The License is granted subject to provisions of the Constitution of Kenya, the Science, Technology and Innovation Act, and other relevant laws, policies and regulations. Accordingly, the licensee shall adhere to such procedures, standards, code of ethics and guidelines as may be prescribed by regulations made under the Act, or prescribed by provisions of International treaties of which Kenya is a signatory to
2. The research and its related activities as well as outcomes shall be beneficial to the country and shall not in any way;
    i. Endanger national security
    ii. Adversely affect the lives of Kenyans
    iii. Be in contravention of Kenya's international obligations including Biological Weapons Convention (BWC), Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), Chemical, Biological, Radiological and Nuclear (CBRN).
    iv. Result in exploitation of intellectual property rights of communities in Kenya
    v. Adversely affect the environment
    vi. Adversely affect the rights of communities
    vii. Endanger public safety and national cohesion
    viii. Plagiarize someone else's work
3. The License is valid for the proposed research, location and specified period.
4. The license any rights thereunder are non-transferable
5. The Commission reserves the right to cancel the research at any time during the research period if in the opinion of the Commission the research is not implemented in conformity with the provisions of the Act or any other written law.
6. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research.
7. Excavation, filming, movement, and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
8. The License does not give authority to transfer research materials.
9. The Commission may monitor and evaluate the licensed research project for the purpose of assessing and evaluating compliance with the conditions of the License.
10. The Licensee shall submit one hard copy, and upload a soft copy of their final report (thesis) onto a platform designated by the Commission within one year of completion of the research.
11. The Commission reserves the right to modify the conditions of the License including cancellation without prior notice.
12. Research, findings and information regarding research systems shall be stored or disseminated, utilized or applied in such a manner as may be prescribed by the Commission from time to time.
13. The Licensee shall disclose to the Commission, the relevant Institutional Scientific and Ethical Review Committee, and the relevant national agencies any inventions and discoveries that are of National strategic importance.
14. The Commission shall have powers to acquire from any person the right in, or to, any scientific innovation, invention or patent of strategic importance to the country.
15. Relevant Institutional Scientific and Ethical Review Committee shall monitor and evaluate the research periodically, and make a report of its findings to the Commission for necessary action.

National Commission for Science, Technology and Innovation(NACOSTI),
Off Waiyaki Way, Upper Kabete,
P. O. Box 30623 - 00100 Nairobi, KENYA
Telephone: 020 4007000, 0713788787, 0735404245
E-mail: dg@nacosti.go.ke
Website: www.nacosti.go.ke

Appendix 4: Nyeri County Approval Letter

REPUBLIC OF KENYA

COUNTY GOVERNMENT OF NYERI
DEPARTMENT OF HEALTH SERVICES
OFFICE OF THE DIRECTOR

Email: nyericountyhealth@yahoo.com
0758563121

COUNTY COMMISSIONER'S HQ
BLOCK 'A'
P.O. Box 110 – 10100
NYERI

REF: CGN/HEALTH/HRM/5/VOL.II **Date: 31st May 2023**

The Medical Superintendent
County Referral Hospital
NYERI

RE: RESEARCH AUTHORIZATION

The bearer of this letter, **Dr. Beatrice W. Muhu** is a student at Amref International University pursuing a Masters of Public Health in Applied Epidemiology.

She has written to this office seeking authority to conduct research at your facility.

Consent has been given and she is hence introduced to carry out a research on "**Factors associated with cardiovascular disease among patients attending Nyeri County Referral Hospital.**"

Kindly accord her the necessary assistance.

The student must deposit a copy of the final report with the department following completion of the study.

Dr. Oscar Agoro
For: County Director of Health
NYERI

Appendix 5: Questionnaire.

RISK FACTORS ASSOCIATED WITH CARDIOVASCULAR DISEASE AMONG PATIENTS IN NYERI COUNTY REFERRAL HOSPITAL, KENYA

IDENTIFICATION NUMBER …….

INSTRUCTIONS: Fill in all the required fields in the corresponding blank spaces

SECTION 1: DEMOGRAPHIC CHARACTERISTICS

RESIDENCE (SUB COUNTY) …….

DC1 AGE (years):

☐ 18-29

☐ 30-39

☐ 40-49

☐ 50-59

☐ 60-69

☐ 70-79

☐ >80

DC2 SEX

☐ MALE

☐ FEMALE

☐ OTHER

DC3 MARITAL STATUS

☐ SINGLE

☐ MARRIED

☐ SEPARATED

☐ DIVORCED

☐ WIDOW/WIDOWER

☐ OTHER

DC4: HIGHEST LEVEL OF FORMAL EDUCATION COMPLETED

☐ NONE

☐ EARLY CHILDHOOD EDUCATION

☐ PRIMARY SCHOOL LEVEL

☐ SECONDARY SCHOOL LEVEL

☐ TERTIARY EDUCATION LEVEL (TVET/COLLEGE/UNIVERSITY)

DC5: EMPLOYMENT STATUS

☐ FORMAL EMPLOYMENT

☐ INFORMAL EMPLOYMENT

☐ SELF EMPLOYED

☐ UNEMPLOYED

☐ RETIRED

DC6 AVERAGE MONTHLY INCOME (KSHS)

☐ <10000

☐ 10,000-<50,000

☐ 50,000-<100,000

☐ >100,000

SECTION B: MEDICAL HISTORY.

Instructions: Tick the most appropriate box

MH1. i) Have you ever been diagnosed with hypertension (elevated blood pressure)?

Y ☐ N ☐

MH2 i) Have you even been diagnosed with Diabetes Mellitus (elevated blood sugar levels)?

Y ☐ N ☐

SECTION C: LIFESTYLE

PHYSICAL ACTIVITY

(Moderate exercise is brisk walking, swimming, jogging, cycling or any exercise that elevates the heart rate for >30 minutes)

Which of the following categories best describes your physical activity on a weekly basis?

E1 Sedentary, less than once per week ☐

E2 Moderate exercise, 1-3 times per week ☐

E3 Moderate exercise 4-5 times per week ☐

E4 Moderate exercise > 5 times per week ☐

SMOKING

Which of the following best describes your smoking habits?

- ☐ S1 Never smoked ☐
- ☐ S2 Stopped Smoking >1 year ago ☐
- ☐ S3 Current smoker (< 20 cigarettes/day) ☐
- ☐ S4 Current Smoker (> 20 cigarettes/day) ☐
- ☐ S5 Passive smoker/exposure to biomass fuels ☐

ALCOHOL INTAKE

(1 drink is estimated to be 2 units of alcohol)

Approximately how much alcohol do you drink on a weekly basis?

A1 Non-drinker ☐

A2 Average 1 drink daily or 7 drinks per week(14 units) ☐

A3 Average > 1 drink daily or >7 drinks per week. (>14 units) ☐

DIETARY HABITS.

Tick below the statement that best describes your daily average dietary intake

DH1. How often do you eat 2-3 servings of fruits and vegetables in a week?

☐ 0-2 DAYS

☐ 3-6 DAYS

☐ DAILY

DH2. How often do you take deep fried foods e.g., chips in a week

☐ 0-2 DAYS

☐ 3-6 DAYS

☐ DAILY

DH3. Do you take sugar in tea/coffee or sugary processed foods e.g., cake, biscuits?

☐ Yes.

☐ No.

If yes how much sugar/ sugary foods in a week? .....

DH4. How many times do you eat more than 2 servings (half plate full) of highly starchy foods in a week?

☐ 0-2 DAYS

☐ 3-6 DAYS

☐ DAILY

Which starchy foods do you commonly use? …….....

DH5. How many glasses of water and other non-alcoholic drinks such as juice and tea, do you drink in a day? ……..

DH6. How often do you have fish or poultry in a week?

☐ 0-2 DAYS

☐ 3-6 DAYS

☐ DAILY

SECTION D:

Instructions: Fill in the correct value in the corresponding space.

ANTHOPOMETRIC MEASUREMENTS

AM1 Height (Meters) …….

AM2 Weight (Kilograms) …….

AM3 Body Mass Index (BMI) …….

BLOOD PRESSURE MEASUREMENTS

BP1 Systolic Blood Pressure …… BP2 Diastolic Blood Pressure ……...

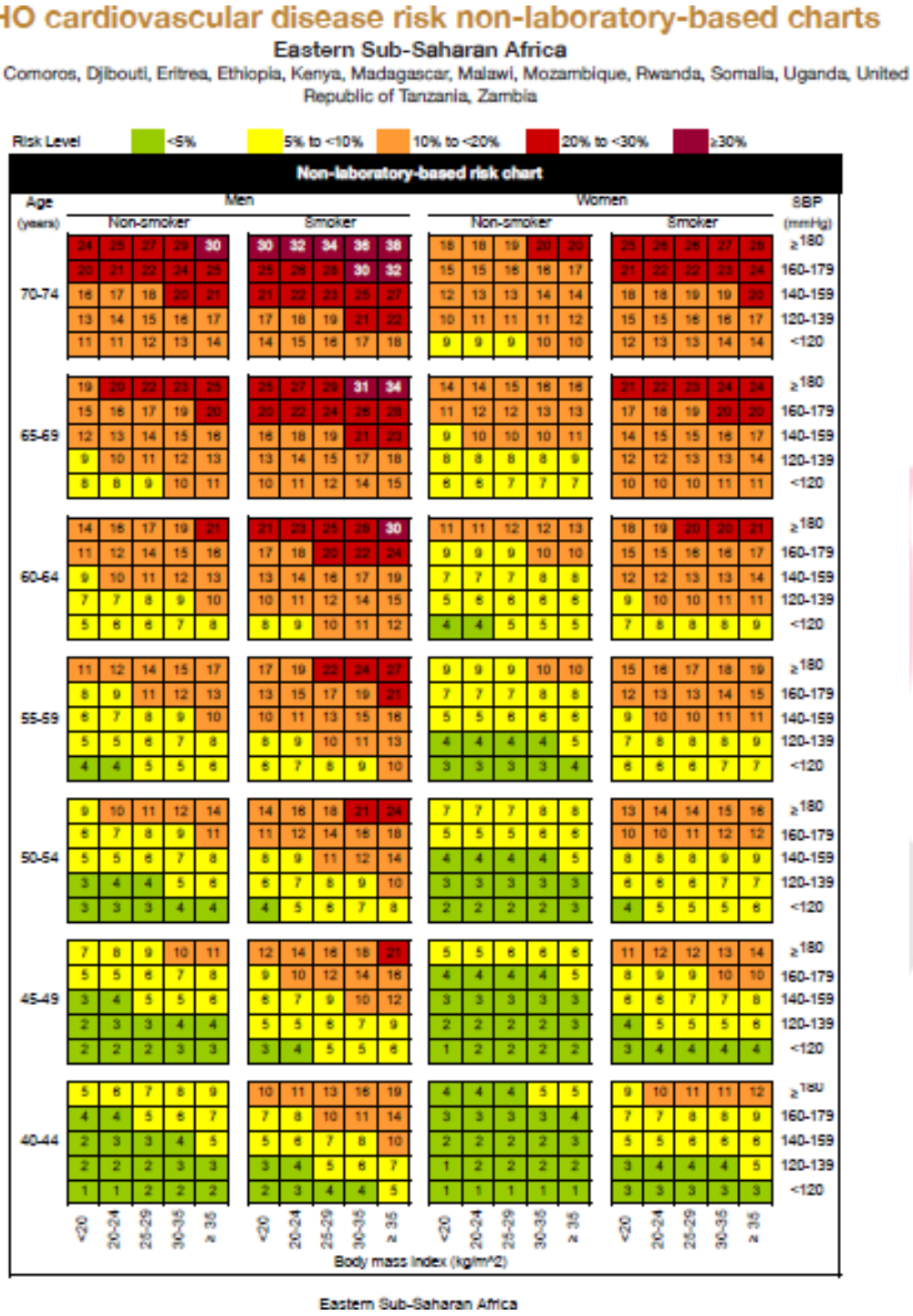
SECTION E:

WHO CVD RISK (NON-LABORATORY BASED) SCORE.

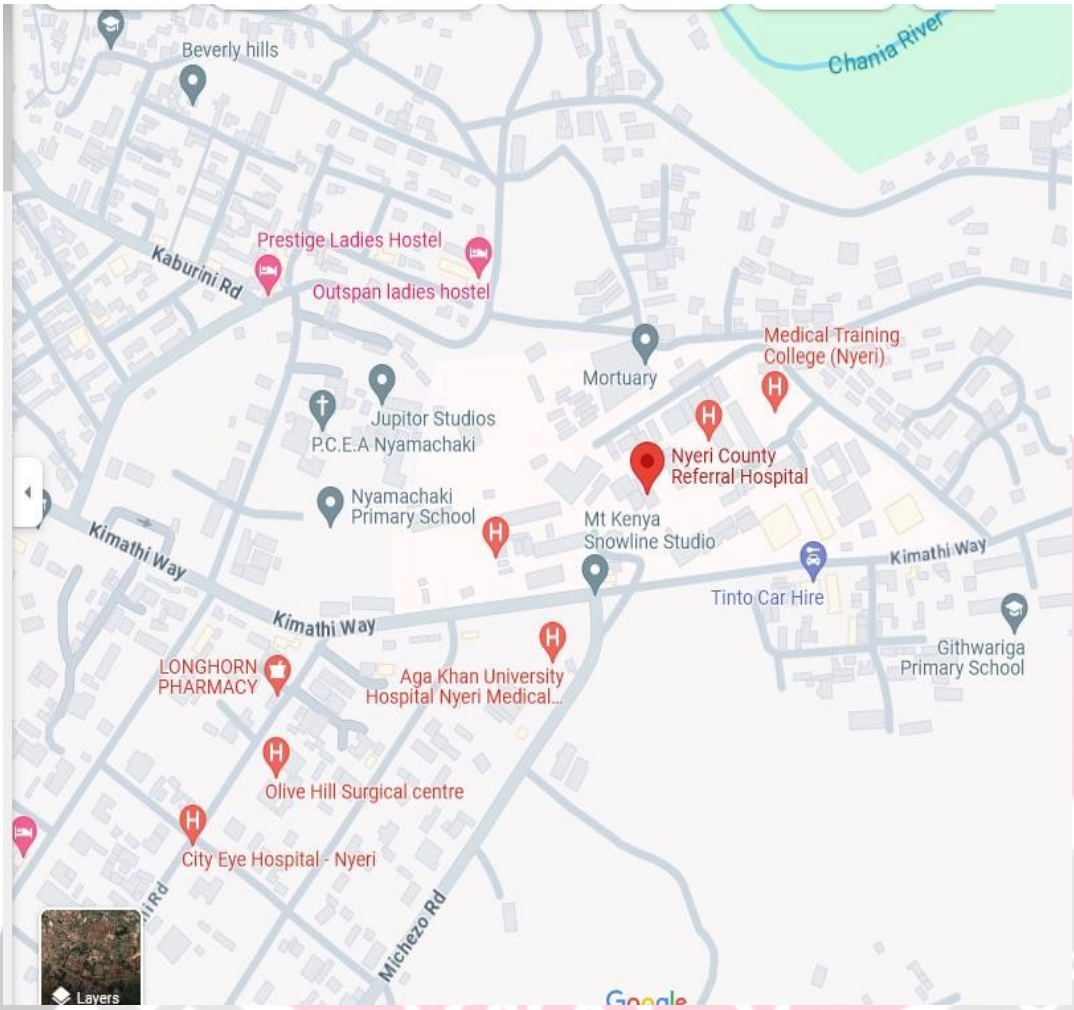
..…… %

Thank you for your participation in completing this questionnaire

Appendix 6: WHO CVD risk charts.

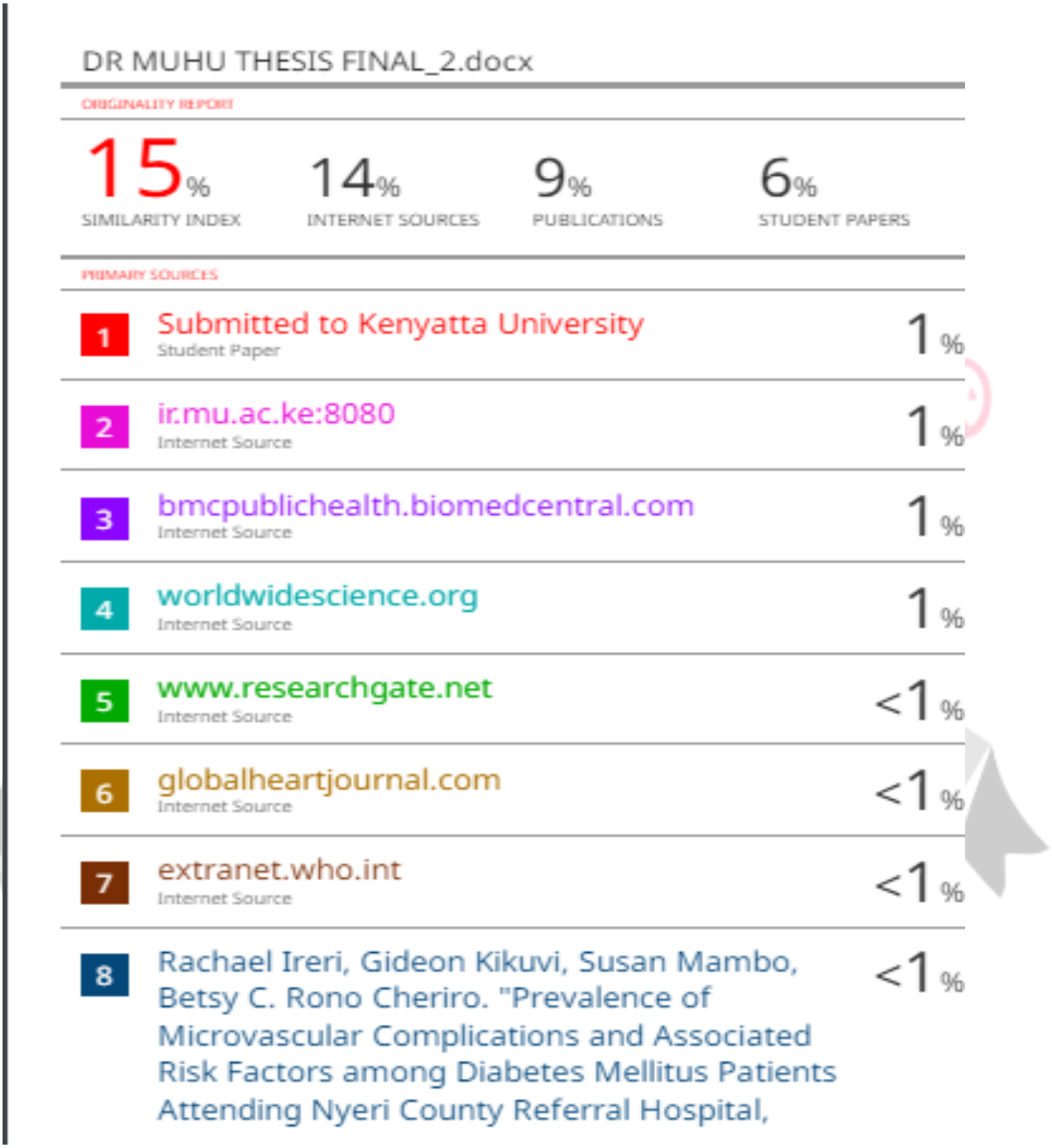


Appendix 7: Map of Study Area



Map showing Nyeri Country Referral Hospital, Nyeri Central Sub County, Nyeri County and its environs.

Appendix 8: Similarity Report



DR MUHU THESIS FINAL_2.docx

ORIGINALITY REPORT

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PRIMARY SOURCES

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