RISK FACTORS FOR HYPERTENSION AMONG ADULT PATIENTS ATTENDING NAKURU COUNTY TEACHING AND REFERRAL HOSPITAL, NAKURU COUNTY. KENYA

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A Thesis Submitted to the Institute of Postgraduate Studies of Kabarak University in Partial Fulfillment of the Requirement for the Award of Master of Science in Human Nutrition and Dietetics Degree

KABARAK UNIVERSITY

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DEDICATION

This work is dedicated to my beloved family, whose unwavering love, prayers, and encouragement have been my most significant source of strength throughout this journey. To my mentors, thank you for your guidance, wisdom, and belief in my potential, which have shaped both my academic and professional growth. To my friends, your constant support, understanding, and motivation kept me going even in the most challenging moments.

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ABSTRACT

Hypertension is a leading cause of cardiovascular morbidity and mortality globally and remains a growing public health concern in Kenya. Despite this, limited data exist on its determinants within urban outpatient settings such as Nakuru County. This study examined sociodemographic, lifestyle, and nutritional factors associated with hypertension among adult outpatients at Nakuru County Teaching and Referral Hospital. A descriptive cross-sectional design was used, involving 215 adults (≥18 years) attending the outpatient clinic. Participants were purposively selected and interviewed using a semi-structured questionnaire that captured sociodemographic characteristics, lifestyle behaviors, and dietary practices. Dietary intake was assessed using a food frequency questionnaire and a multistage 24-hour recall, while anthropometric measurements were obtained using standard procedures. Data were analyzed using descriptive statistics, chi-square tests, and multivariable logistic regression at a 95% confidence level. Only 5.1% of participants had normal blood pressure, while 18.6% had elevated blood pressure, 52.6% Stage 1 hypertension, and 23.7% Stage 2 hypertension. After adjustment for potential confounders, older age, lifestyle behaviors, and excess adiposity were independently associated with hypertension. Adults aged 45–54 years (AOR = 2.67; 95% CI: 1.19–6.00) and those aged ≥55 years (AOR = 3.78; 95% CI: 1.59–8.99) had significantly higher odds of hypertension compared to adults <35 years. Alcohol use (AOR = 2.91; 95% CI: 1.32–6.44) and smoking (AOR = 2.67; 95% CI: 1.18–6.03) were significant behavioral predictors. Overweight, Class I and II obesity, and significantly increased waist circumference (AOR = 3.55; 95% CI: 1.78–7.07) were strong anthropometric predictors. Frequent salt addition during cooking and low vegetable intake were also significantly associated with elevated blood pressure. These findings highlight the need for targeted interventions in Nakuru County that prioritize screening for adults aged 45 years and above, promote weight and salt reduction, and address alcohol and tobacco use within routine hypertension management.

Keywords: *Hypertension; Dietary Practices; Fruit And Vegetable Intake; Sodium–Potassium Balance; Kenya*

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LIST OF ABBREVIATIONS AND ACRONYMS

BMI	Body Mass Index
CVD	Cardiovascular Disease
DALYS	Disability-adjusted years
HTN	Hypertension
KDHS	Kenya Demographic Health Survey
LMIC	Low- and Middle-income countries
MOH	Ministry of Health
NACOSTI	National Commission for Science, Technology, and Innovation
NPGH	Nakuru Provincial General Hospital
NS	Nutrition Status
SPSS	Statistical Packages for Social Sciences
USD	United States Dollars
WHO	World Health Organization

CONCEPTUAL AND OPERATIONAL DEFINITION OF TERMS

Adult: Any study participant aged 18 -65 years

Alcohol Use: Current alcohol user or reported drinking any alcoholic beverage in the past 12 months; otherwise classified as non-user.

Blood Pressure Status: Normal: SBP <120 and DBP <80 mmHg; Elevated: SBP 120–139 or DBP 80–89 mmHg; Stage 1: SBP 140–159 or DBP 90–99 mmHg; Stage 2: SBP ≥ 160 or DBP ≥ 100 mmHg

Body Mass Index BMI) Categories: Overweight: 25.0–29.9 kg/m^2; Obesity: ≥ 30.0 kg/m^2 (further classified as Class I, II, III in analysis).

Central obesity (Waist Circumference): Not at risk: <94 cm (men), <80 cm (women); Increased risk: 94–101 cm (men), 80–87 cm (women); Greatly increased risk: ≥ 102 cm (men), ≥ 88 cm (women).

Dietary Practices: Usual pattern of food consumption assessed by food cereals, roots/tubers, fruits, vegetables, pulses, animal-source foods, oils/fats, and sweets.

Patient with Hypertension : A Person who has been previously diagnosed with Hypertension

Physical Activity: Adequate = reported ≥ 3 days per week of moderate and/or vigorous activity lasting at least 10 minutes

Smoking Status: Current smoker or reported smoking any tobacco product at any point in their lives; otherwise classified as a non-smoker.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The 2st century has witnessed a rise in chronic and life-threatening health conditions that continue to challenge prevention and management efforts across the world. A major driver of this growing burden is the global shift in lifestyle behaviors, characterized by unhealthy dietary patterns, physical inactivity, excessive alcohol consumption, and tobacco use (Perron, 2023). These behavioral changes have been strongly associated with the increasing prevalence of non-communicable diseases (NCDs), which now account for a significant proportion of global morbidity and premature mortality. According to Badego (2020), NCDs contribute to nearly half of all global deaths, with cardiovascular diseases (CVDs), including hypertension, coronary artery disease, and stroke, being the leading culprits.

The World Health Organization (WHO, 2017) reports that low- and middle-income countries (LMICs) bear more than three-quarters of CVD-related deaths, underscoring persistent health inequalities between developed and developing nations. By 2015, NCDs were responsible for over 17 million global deaths, 82% of which occurred in LMICs, with cardiovascular diseases accounting for 37% of these fatalities (WHO, 2017). Among the cardiovascular conditions, hypertension, commonly referred to as high blood pressure, has emerged as one of the most significant and preventable risk factors. It is clinically defined as a persistent systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg in adults aged 18 years and above (Whelton et al., 2018). A regular blood pressure reading is typically below 120/80 mmHg, while pre-hypertension falls between 120–139/80–89 mmHg (Alexander & Courtois, 2017). Stage 1 hypertension is classified as 140–159/90–99 mmHg, and Stage 2 as≥160/≥100 mmHg. Persistent elevation in blood pressure has been linked to severe complications such as stroke, heart failure, renal impairment, and premature death (Mkuu et al., 2021).

Hypertension risk factors are generally categorized into modifiable and non-modifiable factors (Kaddumukasa et al., 2017). Modifiable factors include overweight and obesity, sedentary lifestyle, excessive alcohol intake, tobacco use, and poor nutrition, particularly high salt and fat consumption (Bosu et al., 2019). Non-modifiable factors encompass aging, family history, genetic predisposition, and co-existing conditions such as diabetes mellitus and chronic kidney disease (Anderson et al., 2019). A multi-country survey in Kenya, Ghana, Lesotho, Burundi, and Benin revealed that overweight and obese women were 5.3 times more likely to develop hypertension than those with normal body mass index (Bosu et al., 2019). Furthermore, longitudinal studies indicate that nearly 90% of normotensive adults above 55 years will develop hypertension during their lifetime (Anderson et al., 2019).

Globally, hypertension remains a significant public health issue. The Global Burden of Disease Report (2020) estimated that in 2010, about 1.39 billion adults were hypertensive,1.04 billion in LMICs and 349 million in high-income countries (Mills et al., 2020). By 2025, it is projected that one-third of the world's population will have hypertension (Kingue et al., 2020). The WHO (2017) further estimates that hypertension contributes to 45% of heart disease deaths and 51% of stroke deaths, with 80% of these fatalities occurring in developing countries, including Kenya. Hypertension accounts for more than 7.5 million deaths annually and nearly 57 million disability-adjusted life years (DALYs) (Mkuu et al., 2021).

In Africa, the situation is increasingly concerning. Over the past three decades, hypertension prevalence has risen sharply, with a continental rate of 30.8% in 2010

(Pengpid & Peltzer, 2020). The WHO (2019) reported an age-standardized prevalence of 46% in Africa, compared to 35% in the Americas. Current estimates indicate that sub-Saharan Africa (SSA) harbors about 20 million hypertensive individuals, roughly one-third of the global burden (Pengpid & Peltzer, 2020; Adeloye et al., 2021).

In Kenya, the burden mirrors regional trends. The prevalence of hypertension ranges between 12% and 36.9%, with urban populations most affected due to lifestyle transitions linked to urbanization (Beaney et al., 2017). A national survey across eight counties, Nyeri, Narok, Kwale, Embu, Kakamega, West Pokot, Makueni, and Samburu, reported an overall prevalence of 24.5% among adults (Mohamed et al., 2018). Similarly, the Kenya STEPwise (STEPS) survey (WHO, 2020) found a prevalence of 28.6%**,** yet only 29% of hypertensive adults were aware of their condition**,** 6.5% were on medication**,** and a mere 12.5% had controlled blood pressure. These findings highlight substantial gaps in screening, awareness, and management of hypertension nationwide.

Further evidence from the Healthy Heart Africa program, which screened nearly six million adults across 17 counties, found that 54.5% had pre-hypertension and 20.8% were hypertensive (Mbogori et al., 2020). A decomposition analysis of the 2015 STEPS data revealed that regional and socioeconomic inequalities, combined with behavioral risk factors such as alcohol and tobacco use, significantly explain variations in hypertension prevalence (Wekesa et al., 2020). Urban informal settlements such as Kibera recorded a prevalence of 22.8**%**, with only one in five hypertensive individuals aware of their condition (Mutua et al., 2020). In contrast, rural areas like Nandi County showed awareness levels as low as 6%, confirming disparities between urban and rural populations (Korir, 2020).

Regional studies in sub-Saharan Africa, including Nairobi, report hypertension prevalence ranging between 15–50%**,** with awareness levels of 39.4% in men and 53.8% in women (Mbaya et al., 2021). Collectively, this evidence indicates that hypertension has become a significant public health challenge in SSA, driven by urbanization, poor dietary habits, physical inactivity, and inadequate access to healthcare (Adeloye et al., 2021; WHO, 2023). Kenya's epidemiological profile now reflects a similar pattern, with NCDs surpassing infectious diseases as the dominant health concerns (Mutua et al., 2020). This shift has been exacerbated by rapid urbanization and nutritional transitions, leading to increased consumption of processed foods high in sodium and saturated fats, coupled with a sedentary lifestyle (Mbogori et al., 2020). Despite this trend, health systems remain ill-equipped to provide adequate screening, long-term management, and follow-up care (Wekesa et al., 2020).

Against this backdrop, there is an urgent need to understand the local determinants of hypertension among Kenyan adults. The present study, therefore, focused on Nakuru County, one of the most urbanized and economically active regions in Kenya. The county's rapid urban growth, dietary changes, and increasingly sedentary lifestyle present unique risk factors for hypertension (Mutua et al., 2020). However, there remains limited empirical evidence on how demographic, socioeconomic, lifestyle, and nutritional factors interact to influence hypertension in this setting

Accordingly, this study assessed the demographic and socioeconomic characteristics of patients with hypertension attending Nakuru County Teaching and Referral Hospital, their blood pressure status**,** lifestyle behaviors**,** and nutritional conditions, and the associations among these variables. The results are expected to generate context-specific evidence to guide health policy, inform local interventions, and strengthen clinical practice for hypertension prevention and management in Nakuru County and similar Kenyan contexts (Perron, 2023).

1.2 Statement of the Problem

Hypertension has emerged as a significant global public health concern, contributing substantially to morbidity, disability, and premature mortality. According to the World Health Organization (WHO, 2023)**,** over 1.28 billion adults worldwide are affected by hypertension, with nearly two-thirds residing in low- and middle-income countries (LMICs). In the African region, the burden of hypertension has more than tripled, rising from 19.7% in 1990 to approximately 31% in 2020, making it one of the most widespread non-communicable diseases (NCDs) on the continent (Pengpid & Peltzer, 2020).

Sub-Saharan Africa (SSA) bears a disproportionately high burden of hypertension globally, yet awareness, treatment, and control levels remain critically low (Adeloye et al., 2021). The situation is mirrored in Kenya, where hypertension continues to be a significant contributor to disease burden and premature death. National surveys indicate that approximately one in four Kenyan adults has elevated blood pressure, with regional prevalence ranging from 12% to 36.9% depending on population characteristics and level of urbanization (Mohamed et al., 2018; Wachira et al., 2024). Despite this alarming prevalence, hypertension in Kenya remains underdiagnosed, undertreated, and poorly controlled, primarily due to limited screening, inadequate follow-up care, and low awareness among patients (Ministry of Health [MOH], 2022).

Socioeconomic transitions, rapid urbanization, and evolving lifestyles have compounded this problem. In recent years, Kenya has experienced a marked shift from traditional diets to increased consumption of processed, calorie-dense foods, reduced physical activity, and higher rates of alcohol use and tobacco consumption, all recognized risk factors for hypertension (Mutua et al., 2023; Wekesa et al., 2020). These transformations have created an environment conducive to the rising prevalence of NCDs, particularly in rapidly growing urban centers.

One such urban center is Nakuru County, which has undergone rapid demographic and economic transformation over the past decade. The population of Nakuru increased by more than 500,000 people between 2009 and 2019, rising from 1.6 million to 2.1 million (Kenya National Bureau of Statistics [KNBS], 2019). Projections suggest continued growth through 2029, driven by rural-to-urban migration, industrial expansion, and urban sprawl. This population surge has intensified exposure to urban lifestyle risk factors such as dietary changes, sedentary behavior, and socioeconomic stress, all of which are known to elevate hypertension risk (Korir, 2020; Mutua et al., 2020).

Despite these developments, empirical data on how demographic, socioeconomic, lifestyle, and nutritional factors interact to influence hypertension in Nakuru County remain scarce. Most available data stem from national or regional surveys, which, while valuable**,** lack specific interventions relevant to Nakuru County. The limited county-specific evidence leaves healthcare planners and clinicians with limited guidance on designing culturally and contextually appropriate prevention and management strategies. Consequently, hypertension often goes undetected until advanced stages, when it manifests alongside severe complications such as stroke, heart failure, or chronic kidney disease (Jeong et al., 2018).

This study addressed the urgent need for context-specific, evidence-based research on hypertension in Nakuru County by identifying the determinants most relevant to its residents. By examining demographic, socioeconomic, lifestyle, and nutritional factors, the study generated critical insights that enhance early detection, guide targeted treatment, and strengthen community-based interventions for hypertension management. The findings have provided valuable evidence to inform county-level health policies and programs, while also supporting Kenya's broader commitment to reducing the burden of non-communicable diseases as outlined in the National Strategy for the Prevention and Control of NCDs (2021–2025) and the Kenya Vision 2030 health pillar **(**Ministry of Health, 2021**).**

1.3 Objectives of the study

1.3.1 General Objective of the Study

The objective of this study was to determine the risk factors for hypertension among adult patients attending Nakuru County Teaching and Referral Hospital.

1.3.2 Specific Objective of the Study

The study objectives were:

i. To assess the demographic and socioeconomic characteristics of patients with hypertension attending Nakuru County Teaching and Referral Hospital

ii. To determine lifestyle factors contributing to hypertension among patients attending Nakuru County Teaching and Referral Hospital

iii. To determine the nutritional status of patients with hypertension attending Nakuru County Teaching and Referral Hospital

iv. To assess the blood pressure status of patients with hypertension attending Nakuru County Teaching and Referral Hospital

v. To determine the association between hypertension, demographic and socio-demographic factors, lifestyle factors, and nutrition status among patients with hypertension attending Nakuru County Teaching and Referral Hospital

1.4 Research Questions

i. What are the demographic and socioeconomic characteristics of patients with hypertension attending Nakuru County Teaching and Referral Hospital?

ii. What are the lifestyle factors contributing to hypertension among patients with hypertension attending Nakuru County Teaching and Referral Hospital?

iii. What is the nutritional status among patients with hypertension attending Nakuru County Teaching and Referral Hospital?

iv. What is the blood pressure status among patients with hypertension attending Nakuru County Teaching and Referral Hospital?

v. To determine the association between hypertension, demographic and socio-demographic factors, lifestyle factors, and nutrition status among patients with hypertension attending Nakuru County Teaching and Referral Hospital.

1.5 Justification for the Study

Nakuru County was deliberately chosen as the study site, based on evidence. Nakuru has experienced rapid urbanization and demographic transformation, with its population increasing from 1.6 million in 2009 to 2.1 million in 2019, an increase of over 500,000 people within a decade (Kenya National Bureau of Statistics [KNBS], 2019). Projections indicate continued growth through 2029, driven by rural-to-urban migration, industrial expansion, and urban sprawl. This demographic shift has created a population exposed to a unique blend of urban and peri-urban risk factors, including high consumption of processed foods, reduced physical activity, and increased socioeconomic stress, all of which are known contributors to hypertension (Mutua et al., 2023; Wekesa et al., 2020).

Compared to other Kenyan counties, Nakuru is a critical case study because it embodies the dual burden of health transitions, in which traditional rural lifestyles coexist with urban risk exposures. Previous studies in Nairobi and Mombasa have primarily examined entirely urban populations (Mutua et al., 2020; Egondi et al., 2018), whereas research in rural counties such as Nandi and Kisii has focused on populations with distinct lifestyles and environmental exposures (Korir, 2020; Odhiambo et al., 2019). However, Nakuru's rapidly urbanizing environment provides a unique opportunity to examine how socioeconomic, lifestyle, and nutritional factors interact to influence hypertension outcomes in a mixed setting.

Despite being one of Kenya's fastest-growing counties, there is limited data on the risk factors for hypertension in Nakuru. Most available national data, such as the Kenya STEPwise Survey (WHO, 2020**)** and the Healthy Heart Africa program findings (Mbogori et al., 2020), provide valuable prevalence figures but do not disaggregate data by county. This lack of localized evidence hampers effective health planning and the development of targeted, culturally relevant interventions**.**

Conducting this study in Nakuru will therefore fill a critical knowledge and policy gap. The results will provide evidence to support Nakuru County's Integrated Development Plan (CIDP 2023–2027), which recognizes non-communicable diseases as emerging health challenges (Nakuru County Government, 2023). Moreover, findings from this study will guide county-level and national health authorities in developing practical, evidence-based interventions for early diagnosis, community screening, and management of hypertension.

Ultimately, the study is justified because it focuses on a region undergoing rapid social and economic transformation, where the convergence of urbanization, dietary change, and limited awareness of hypertension makes it an urgent yet underexplored health problem. By generating localized data, this research will help inform county and national health policies, improve health outcomes, and contribute to achieving Kenya's long-term health and development goals.

1.6 Significance of the Study

Hypertension remains one of the most pressing global health challenges, responsible for substantial morbidity, disability, and premature mortality. The World Health Organization (WHO, 2023) estimates that over 1.28 billion adults globally live with hypertension, with nearly two-thirds residing in low- and middle-income countries. This study contributes to the realization of Sustainable Development Goal (SDG) 3, which aims to ensure good health and well-being for all, and specifically to Target 3.4, which seeks to reduce premature mortality from non-communicable diseases (NCDs) by one-third by 2030 **(**United Nations, 2015**).** By determining the risk factors for hypertension within the Kenyan context, the research supports global and regional efforts to prevent avoidable deaths and strengthen the management of cardiovascular diseases.

At the national level, the study upholds Article 43(1)(a) of the Constitution of Kenya (2010), which guarantees every individual the right to the highest attainable standard of health. It also advances the goals of Kenya Vision 2030, particularly its social pillar, which seeks to improve access to quality healthcare and reduce the burden of disease across the population **(**Government of Kenya, 2010**)**. The findings will generate empirical evidence to support the implementation of the National Strategy for the Prevention and Control of Non-Communicable Diseases (2021–2025) and the Kenya Nutrition Action Plan (2018–2022)**,** which prioritize reducing dietary salt intake, tackling overweight and obesity, and improving access to nutrition and dietetic services (Ministry of Health [MOH], 2018; MOH, 2021**).**

This research also complements the Kenya Community Health Strategy (2020–2025) by generating data that will inform the integration of hypertension screening, health promotion, and management into primary healthcare and community-level services **(**MOH, 2020**).** Early detection and prevention are critical because many hypertensive individuals remain undiagnosed until they develop severe complications such as stroke, renal failure, or heart disease **(**Jeong et al., 2018; Mohamed et al., 2018**).** The study's outcomes will identify population-specific risk factors, as well as demographic, lifestyle, and nutritional factors, among adults with hypertension attending Nakuru County Teaching and Referral Hospital, providing essential data for targeted interventions and localized public health education.

Ultimately, this research is significant because it provides context-specific evidence to support data-driven hypertension control strategies in Kenya. It strengthens community health initiatives and national NCD prevention frameworks, enhances early detection and management, and contributes to reducing preventable deaths and disabilities. By situating the research within Nakuru County, a region experiencing rapid urbanization and lifestyle transitions **(**Kenya National Bureau of Statistics [KNBS], 2019; Mutua et al., 2023**)**, the study will provide strategies that can guide both county-level and national health responses. In doing so, it advances Kenya's constitutional commitment to health equity. It aligns with the nation's broader development agenda under Vision 2030, as well as the global goal of achieving universal access to high-quality healthcare for all.

1.7 Scope of the Study

The study was conducted among adult patients with hypertension attending outpatient clinics at Nakuru County Teaching and Referral Hospital (NCTRH). The research, in particular, considered the subjects' demographics, socioeconomic status, lifestyle, and dietary and nutritional status. The factors of interest in lifestyle concerns were alcohol consumption, smoking habits, dietary practices, and degree of physical exercise, as these factors have been reported to have significant effects on the development, progression, and management of hypertension. Anthropometry, specifically body mass index (BMI) and waist circumference, was measured to assess their relationship with hypertension prevalence and management among the study participants.

The study area was limited to Nakuru County, a fast-growing urbanizing area in Kenya with various socioeconomic and cultural dynamics that affect health and disease trends. The research was restricted to the study period during which data were collected among hypertensive patients attending NCTRH. The choice of study variables was driven by their importance in the study of hypertension, with a specific emphasis on the interaction among sociodemographic, lifestyle, and nutritional factors.

1.8 Limitations of the Study

This study had a few limitations that should be taken into account when interpreting the findings. To begin with, the use of a multi-pass 24-hour dietary recall introduced some recall bias**.** Participants may have had difficulty remembering everything they ate or drank the previous day, and their responses may have been influenced by what they believed was expected or acceptable. To address this, the data collectors were trained to probe gently, ask follow-up questions, and cross-check answers to improve the accuracy and completeness of dietary information.

Another notable limitation was the reliance on self-reported information for behaviors considered socially sensitive, such as smoking, alcohol use, and physical activity. The study reported a very low current smoking rate (only 1.9%), which may reflect underreporting rather than the true prevalence. Since smoking is often viewed negatively in clinical or formal settings, some participants might have chosen not to disclose their smoking habits. Even though participants were assured of confidentiality and the interviews were conducted in a private setting, this social desirability bias cannot be completely ruled out.

The cross-sectional nature of the study also limited its ability to determine cause-and-effect relationships. While the research identified several factors associated with hypertension, it could not establish whether these factors directly caused changes in blood pressure. Future research using longitudinal or experimental designs would be better suited to explore the timing and direction of these relationships.

Lastly, the research was conducted within a single urban referral hospital, Nakuru County Teaching and Referral Hospital. As a result, the findings may not fully reflect the experiences or risk factors of people in more rural or resource-limited settings. However, every effort was made to include a mix of participants from different socioeconomic and demographic backgrounds to enhance the study's relevance. Even with this limitation, the study still provided meaningful insight into how dietary and lifestyle practices relate to blood pressure among adults in Nakuru County, and can inform future policy and program planning

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter provides a literature review of the study's objectives. It commences with a summary of hypertension, followed by explanations of demographic and socioeconomic factors, blood pressure status, and lifestyle and nutritional factors that contribute to hypertension. It ends with the evidence on their associations and the conceptual framework that directs the study.

2.2 Overview of Hypertension

Hypertension is a chronic medical condition characterized by a consistently elevated force of blood against the walls of the arteries, exceeding normal physiological limits. It is commonly defined by the World Health Organization (2020) as a condition in which systolic blood pressure (SBP) is equal to or greater than 140 mmHg and/or diastolic blood pressure (DBP) is equal to or greater than 90 mmHg, based on two or more separate measurements. Similarly, the Kenya Ministry of Health (2023) adopts this classification and further categorizes blood pressure levels into stages: pre-hypertension is defined as an SBP of 120–139 mmHg or a DBP of 80–89 mmHg, Stage I hypertension includes SBP values between 140–159 mmHg or DBP values between 90–99 mmHg, and Stage II hypertension is characterized by SBP readings of 160 mmHg or higher or DBP readings of 100 mmHg or higher.

Two types of hypertension may be distinguished: primary (essential) and secondary. Primary hypertension, which comprises 90-95% of all cases, does not have a specific cause and is associated with genetic, environmental, and lifestyle factors (Carretero & Oparil, 2017). Secondary, however, is caused by identifiable conditions, such as renal disease, endocrine disorders, or medication effects. The classification plays a vital role in diagnosis and treatment because it defines treatment and prevention approaches.

Hypertension is also one of the significant public health problems worldwide since it is estimated that 1.28 billion adults between the ages of 30 and 79 years old have hypertension (WHO, 2023). Although there is an effective treatment, almost 46% of hypertension patients in adulthood are unaware of their health issue, and only one-fifth of them control it (Zhou et al., 2021). Hypertension has become increasingly prevalent among low- and middle-income countries (LMICs): today, two-thirds of all cases occur in this category (Mills et al., 2020).

The prevalence of hypertension in Sub-Saharan Africa has grown at a sudden rate during the last thirty years, in large part because of urbanization, lifestyle alterations, and dietary shifts (Ataklte et al., 2015). Research approximates that approximately 30 % of adults in the area are hypertensive, and there are insufficient levels of consciousness and management (Dzudie et al., 2020). Kenya is no exception, and according to the Kenya STEPwise Survey (MoH, 2023), the country has a national prevalence of 24%. The survey also indicated that the level of hypertension awareness and coverage of treatment is low, especially in rural communities where access to health services and health literacy is limited. The increasing prevalence in Kenya highlights the importance of community-based prevention, early diagnosis, and lifestyle modification programs.

The control of blood pressure is a complex physiological process that depends on the interactions among cardiac output, blood volume, vascular resistance, and neurohormonal mechanisms. The key processes that help maintain vascular tone and sodium balance are the renin-angiotensin-aldosterone system (RAAS), sympathetic nervous system, and kidney (Carretero & Oparil, 2017). When the systems that regulate these become impaired, resistance to blood flow increases, leading to long-term effects on blood pressure.

Genetic factors and environmental factors are the significant determinants of blood pressure. The key non-modifiable factors are age and sex; the modifiable ones include obesity, excessive sodium and low potassium consumption, physical inactivity, alcohol use, smoking, and psychosocial stress (Kiberenge et al., 2022; Whelton et al., 2018). Higher levels of blood pressure have also been associated with environmental exposures (i.e., air pollution and socioeconomic status) (Addo et al., 2018). These physiological and behavioral determinants are essential to understanding when establishing interventions to reduce the burden of hypertension in Kenya and other developing countries.

Hypertension, or high blood pressure, is among the most common non-communicable diseases (NCDs) globally and a significant cause of illness and death. It arises in cases when blood pressure is always high, which puts one at risk of cardiovascular diseases, including stroke, heart failure, and problems with the kidneys (World Health Organization [WHO], 2023). The number of adults with the disease among the world's 30-79-year-old population is estimated at 1.28 billion, of whom two-thirds live in low- and middle-income nations; therefore, awareness, treatment, and control levels remain low (WHO, 2023; Zhou et al., 2021). Hypertension in Sub-Saharan Africa is growing out of pace with people becoming more urbanized, adopting unhealthy lifestyles, and forgetting how to exercise (Ataklte et al., 2015; Dzudie et al., 2020). In Kenya, the Kenya STEPwise Survey reported a nationwide prevalence of 24%, indicating that this is a significant health issue for the population (Ministry of Health [MoH], 2023).

The etiology of hypertension is multifactorial, including both modifiable and non-modifiable factors. The non-modifiable factors include age, sex, and genetics, whereas the modifiable ones are unhealthy diets, physical inactivity, alcohol use, tobacco use, and obesity (Kiberenge et al., 2022; Adeloye et al., 2019). These behaviors and access to healthcare are also socioeconomic factors that influence hypertension outcomes, with education, income, and occupation playing a role (Adebayo et al., 2019; Geldsetzer et al., 2019). Such mutually dependent aspects highlight the importance of local research that puts global evidence into context for particular populations.

Despite a small number of Kenyan studies on hypertension, most are based in major cities such as Nairobi and Mombasa (Odhiambo et al., 2021; Muthuri et al., 2020). There is scant information on mid-sized urban regions like Nakuru County, where urban and rural lifestyles collide. Nakuru County Teaching and Referral Hospital (NCTRH) serves a heterogeneous population across both environments, providing an opportunity to study the relationships between demographic and lifestyle factors and nutritional factors that affect hypertension. The information gained through such research has become critical for designing interventions to control and reduce hypertension at the hospital and county levels.

2.3 Demographic and Socioeconomic Characteristics of Patients with Hypertension

Demographic and socioeconomic factors significantly influence the prevalence, awareness, treatment, and control of hypertension across populations. These factors determine individuals' exposure to risk behaviors, access to healthcare, and adherence to medical and lifestyle interventions (Etyang & Scott, 2013; Addo, Smeeth, & Leon, 2007). In Sub-Saharan Africa (SSA), the growing burden of hypertension has been strongly associated with demographic transitions, socioeconomic changes, and urbanization (Adeloye et al., 2021; Dzudie et al., 2020; Okello et al., 2016).

Age and gender are among the most consistent demographic predictors of hypertension. The risk of elevated blood pressure increases with advancing age due to vascular stiffening, endothelial dysfunction, and cumulative exposure to risk factors (Chobanian et al., 2017; Whelton et al., 2018). Studies in Kenya and Tanzania have shown that individuals aged 40 years and above are disproportionately affected (Joshi et al., 2014; Ministry of Health [MoH], 2023). Gender differences also emerge, with men typically developing hypertension earlier than women, partly because of higher rates of alcohol intake, tobacco use, and occupational stress (Owolabi et al., 2019; Mbouemboue & Assomo-Ndemba, 2020). However, postmenopausal women show rising hypertension prevalence due to estrogen decline and increased salt sensitivity (Peters et al., 2019).

Marital status and household structure can shape hypertension risk through social, emotional, and economic pathways. Married individuals often experience protective effects from emotional support and shared household responsibilities, which promote better health practices and treatment adherence (Chiang et al., 2019). Conversely, widowed, divorced, or single individuals may experience social isolation, loneliness, or psychological stress, which elevate blood pressure through neuroendocrine mechanisms (Kwaghe et al., 2021). Studies from Kenya and Ghana show that family support systems can improve treatment adherence among patients with hypertension (Sodzi-Tettey et al., 2017; Kyobutungi et al., 2019). Household size and dependency ratios also influence diet quality and access to healthcare, especially in low-income settings (Mutua et al., 2020).

Education level and health literacy are essential in hypertension prevention and management. Higher educational attainment is associated with increased awareness of disease symptoms, better dietary choices, and adherence to lifestyle modifications (Cappuccio et al., 2018; Geldsetzer et al., 2019). Conversely, individuals with limited education often delay seeking care or may not recognize the asymptomatic nature of hypertension (Khan et al., 2020). In Kenya, the 2023 STEPwise Survey reported that low literacy levels correlate with lower hypertension awareness and poor control (MoH, 2023). Studies from Uganda and Nigeria similarly demonstrate that limited health literacy is associated with low treatment compliance and poor blood pressure control (Kayima et al., 2013; Akinlua et al., 2015).

Income and occupation play a dual role in influencing both behavioral risk factors and access to care. Individuals in higher income brackets are more likely to access routine check-ups and antihypertensive medications, whereas low-income populations often rely on cheaper, high-sodium foods and face challenges in maintaining regular medical follow-up (Ataklte et al., 2015; Dzudie et al., 2020). Occupational stress, shift work, and sedentary office environments are linked to increased hypertension risk (Ganesh Kumar & Deivanai Sundaram, 2014). In Kenya, informal-sector workers frequently lack health insurance and experience poor continuity of care, exacerbating disease outcomes (Njeru et al., 2022). A Nigerian study by Oguoma et al. (2015) also found that blue-collar workers had lower hypertension awareness but higher physical activity levels than white-collar workers, suggesting complex occupational dynamics.

Urbanization and residential environment have transformed hypertension patterns in SSA. Rapid urban growth has encouraged Westernized diets, characterized by refined carbohydrates, excess fats, and processed foods, alongside decreased physical activity (Hall et al., 2021; Noubiap et al., 2019). Urban residents in Kenya exhibit a higher prevalence of hypertension than their rural counterparts due to these dietary and behavioral shifts (Joshi et al., 2014; Mwenda et al., 2021). Nonetheless, rural populations face barriers such as limited health infrastructure, fewer screening opportunities, and lower awareness, leading to underdiagnosis (Addo et al., 2007). Studies in Ethiopia and

Uganda have documented similar trends, highlighting the dual burden of modernization and healthcare inequality (Misganaw et al., 2017; Musinguzi & Nuwaha, 2015).

Finally, socioeconomic inequalities and healthcare access remain central challenges in managing hypertension in Kenya and SSA. Disparities in health insurance coverage, healthcare financing, and medication availability hinder consistent management (Adebayo et al., 2019; Olack et al., 2015). In low-resource settings, antihypertensive drugs are often unaffordable, leading to poor control rates despite growing awareness (Ibekwe, 2015; Etyang & Scott, 2013). Moreover, gendered and geographic inequalities limit rural women's access to screening and follow-up care (Mbouemboue & Assomo-Ndemba, 2020). Addressing these disparities requires strengthening primary healthcare systems, improving community outreach, and integrating hypertension management into existing public health programs.

In summary, demographic and socioeconomic determinants, including age, gender, marital status, education, income, occupation, and urbanization, interact to shape hypertension risk and management outcomes. Understanding these variables within the Kenyan context is essential for tailoring effective prevention and control strategies that reflect the country's unique social and economic realities.

2.4 Lifestyle Factors Contributing to Hypertension

Lifestyle factors play a central role in the development, progression, and management of hypertension. These modifiable determinants, including diet, physical activity, alcohol and tobacco use, stress, and sleep patterns, contribute substantially to the global and regional burden of high blood pressure (World Health Organization [WHO], 2020; Hall et al., 2021). Lifestyle-related hypertension has become one of the leading problems affecting populations in Sub-Saharan Africa (SSA) due to rapid urbanization and the westernization of lifestyles (Adeloye et al., 2021; Dzudie et al., 2020).

Diet plays a central role in regulating blood pressure. Among dietary factors, excess sodium intake is one of the most significant contributors to hypertension. Consuming too much salt causes the body to retain water, which increases blood volume and vascular resistance, ultimately raising blood pressure (Cappuccio et al., 2018; He & MacGregor, 2017). The World Health Organization (2020) recommends limiting daily salt intake to less than 5 grams. Yet, studies show that most African populations exceed this limit due to the frequent use of processed foods, salted meats, and stock cubes (Oyebode et al., 2016; Addo et al., 2018).

In contrast, low potassium intake, often due to limited consumption of fruits and vegetables, increases the harmful effects of excess sodium. Potassium helps the body excrete sodium through urine, relaxes blood vessel walls, and supports healthy endothelial function, all of which contribute to lowering blood pressure (Elliott et al., 2016; Mente et al., 2021). Increasing intake of potassium-rich foods such as bananas, beans, green leafy vegetables, and avocados can therefore help protect against hypertension.

Beyond sodium and potassium, other micronutrients such as magnesium and zinc also play essential roles in blood pressure control. Magnesium helps relax blood vessels and regulates calcium transport across cell membranes, thereby reducing vascular tension and promoting stable blood pressure (Joris & Mensink, 2017; Rosique-Esteban et al., 2018). Low magnesium levels have been linked to arterial stiffness and impaired vascular function (Zhang et al., 2020; Touyz, 2019). Similarly, zinc contributes to vascular health by controlling oxidative stress and inflammation, two processes that can damage blood vessels and raise blood pressure if unchecked. Zinc deficiency has also been associated with increased activity of the renin–angiotensin–aldosterone system (RAAS)**,** which promotes sodium retention and constricts blood vessels (Marreiro et al., 2017; Singh et al., 2021).

Across Africa, including Kenya, research has shown that diets low in fruits, vegetables, and whole grains, but high in processed foods, saturated fats, and refined sugars, are closely linked to rising hypertension rates (Adebayo et al., 2019; Mente et al., 2021). Traditional African diets, once rich in legumes, whole grains, and fresh produce, are rapidly being replaced by calorie-dense and nutrient-poor foods, especially in urban areas (Noubiap et al., 2019). In Kenya, individuals who consume more plant-based foods tend to have lower blood pressure compared to those with diets high in salt and animal fats (Joshi et al., 2014; Mwenda et al., 2021).

The Dietary Approaches to Stop Hypertension (DASH) diet remains a powerful example of how nutrition can help manage hypertension. Emphasizing foods rich in potassium, magnesium, and calcium while limiting sodium, the DASH diet has consistently been shown to lower both systolic and diastolic blood pressure (Sacks et al., 2001; Siervo et al., 2015). Together, these findings highlight how maintaining a diet that balances essential minerals, particularly limiting salt while ensuring adequate potassium, magnesium, and zinc intake, can play a significant role in preventing and managing hypertension.

Exercise is an essential aspect of preventing and controlling high blood pressure. Aerobic exercise regularly enhances vascular elasticity, weight loss, and cardiac efficiency, thereby reducing blood pressure (Whelton et al., 2018; Diaz and Shimbo, 2021). The WHO (2020) recommends that adults engage in at least 150 minutes of moderate-intensity physical activity per week. Nonetheless, sedentary living has been more prevalent in urban Kenya due to office-based employment, car-based transportation, and a lack of recreational facilities and places (Mutua et al., 2020). At least two and three studies in Nairobi and Kisumu have found that physically inactive adults are two to three times more likely to develop hypertension than their active counterparts (Joshi et al., 2014; Mwenda et al., 2021). Besides, screen time and extended sedentary behavior have also been associated with obesity and metabolic dysregulation, worsening the risk of hypertension (Diaz & Shimbo, 2021).

Risk factors that have been adequately determined are excessive alcohol intake and tobacco use, which increase blood pressure. Alcohol elevates blood pressure due to elevated sympathetic activity, oxidative stress, and dysfunction of the baroreceptor (Roerecke et al., 2018). Chronic excessive alcoholism also disrupts the antihypertensive drugs, weakening their effect. Tobacco consumption, however, leads to short-term vasoconstriction and permanent endothelial injury, which predisposes its users to long-term hypertension and cardiovascular disease (WHO, 2020). In a meta-analysis, Ofori et al. (2021) observed that smoking is a factor that puts one at risk of developing hypertension by around 30. Middle-aged men in Kenya drink and use tobacco, which affects the prevalence of hypertension between the genders, which is why this situation is observed in Kenya (Kiberenge et al., 2022; MoH, 2023).

Psychological stress has become a significant factor in the onset and inadequate control of hypertension. The ongoing secretion of cortisol and catecholamines, driven by prolonged activation of the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system under chronic stress, increases blood pressure (Chiang et al., 2019; Spruill, 2010). Unemployment, financial instability, traffic jams, and work-related stress, among others, are factors that create stress for urban dwellers, primarily, and have been associated with the prevalence of hypertension (Mbouemboue & Assomo-Ndemba, 2020). In addition, the factors of limited social support, anxiety, and depression may disrupt treatment compliance and self-care behaviors (Sodzi-Tettey et al., 2017). Community-based studies in Nigeria and South Africa show that interventions aimed at reducing stress, such as mindfulness and relaxation therapy, have a significant positive effect on blood pressure regulation (Motlagh et al., 2019).

Sleep quality and short duration of sleep are related to the high risk of developing hypertension. Sleep deprivation results in overwork of the sympathetic nervous system and disruption of circadian regulation of blood pressure (Gangwisch et al., 2016). In particular, sleep apnea is prevalent in overweight and obese patients and leads to resistant hypertension (Whelton et al., 2018). One of the most significant predictors of hypertension in the urban and middle-income population is obesity, which is the result of unhealthy lifestyle habits (Hall et al., 2021; Agyemang et al., 2016). Obesity in the central area increases vascular resistance and activates the renin-angiotensin-aldosterone system, which raises blood pressure (Peters et al., 2019). The growing rate of overweight and obesity, particularly in women, in Kenya is a symptom of the nutritional change and sedentary lifestyle in urban areas (MoH, 2023; Mutua et al., 2020).

The prevention and management of hypertension is based on lifestyle modification. Approaches to dietary change, increased physical activity, reduced alcohol and tobacco consumption, stress management, and better sleep have been associated with substantial reductions in blood pressure (Carey et al., 2018; WHO, 2020). Community-based interventions, such as diet and exercise education within primary healthcare, have shown significant outcomes in SSA (Dzudie et al., 2020; Kayima et al., 2013). In Kenya, campaigns like Healthy Kenya by the Ministry of Health, hypertension awareness campaigns have focused on reducing salt intake, weight, and screening (MoH, 2023).

Nevertheless, insufficient resources, cultural factors, and health illiteracy tend to hamper the sustainability of such programs.

To conclude, lifestyle choices such as diet, physical inactivity, alcohol and tobacco, stress, and obesity will continue to be the determinants of hypertension. These issues should be addressed through public health interventions, policy enforcement (e.g., salt reduction strategies), and individual counseling to reduce the rising hypertension burden in Kenya and across Sub-Saharan Africa.

2.5 Nutritional Status of Patients with Hypertension

Nutritional status is a key determinant of both the development and control of hypertension. Anthropometric measures, dietary patterns, macronutrient and micronutrient intakes, and the coexistence of under- and over-nutrition all influence blood pressure and cardiovascular risk. Nutrition transition has resulted in a twin burden in most of the low- and middle-income countries (LMICs) such as Kenya, with co-existence of overweight/ obesity and micronutrient deficiencies that make it difficult to prevent and treat hypertension.

Anthropometric indicators such as Body Mass Index (BMI)**,** Waist Circumference (WC)**,** and Waist-to-Hip Ratio (WHR) are widely used to assess overall and central adiposity, both of which are strongly associated with hypertension. BMI (kg/m^2) provides a general measure of total body fat and is categorized as underweight (<18.5), normal weight (18.5–24.9), overweight (25.0–29.9), and obese (≥30.0) **(**WHO, 2020**).** However, BMI does not distinguish between fat distribution patterns; therefore, central adiposity measures such as WC and WHR are often better predictors of cardiometabolic risk. Elevated WC-commonly defined as greater than 102 cm in men and 88 cm in women using Western cut-offs, with lower thresholds proposed for African populations and increased WHR have been shown to correlate positively with visceral fat accumulation, insulin resistance, activation of the renin–angiotensin–aldosterone system (RAAS)**,** and elevated blood pressure (Hall et al., 2021; Peters et al., 2019).

Evidence from numerous studies conducted across Africa, including Kenya, indicates that central obesity measures (WC and WHR) demonstrate stronger associations with hypertension than BMI alone. This underscores the importance of incorporating both general and central adiposity indicators in the assessment of cardiovascular and metabolic risk during clinical and epidemiological evaluations **(**Agyemang et al., 2016; Joshi et al., 2014; Kiberenge et al., 2022).

Eating habits, not individual nutrients, have a significant effect on blood pressure. The high intake of processed foods, refined carbohydrates, saturated fat, and added sugar (a pattern towards Westernization) is linked with high blood pressure. A high intake of fruits, vegetables, whole grains, legumes, lean proteins, and nuts (a pattern similar to the DASH pattern) is protective (Sacks et al., 2001; Mente et al., 2021). Convenience and processed foods have also led to decreased dietary fibre and fruit/vegetable intake, and to increased intake of salt and saturated fats in most Kenyan urban areas, resulting in poor nutrient adequacy in hypertensive adults (Mwenda et al., 2021; Noubiap et al., 2019). Low-income households also face food insecurity and cost-related issues that compel them to consume high-energy foods with low nutrient content, increase obesity, and cause micronutrient deficiencies (Mutua et al., 2020).

Hypertension is primarily caused by major modifiable factors, such as overweight and obesity. The overabundance of adiposity enhances cardiac output, peripheral vascular resistance, and inflammatory signaling, and boosts metabolic maladaptation (dyslipidaemia, insulin resistance), which raises blood pressure (Hall et al., 2021). The metabolic activity of central (visceral) adiposity is especially harmful (Peters et al., 2019). In Kenya and SSA, the prevalence of overweight/obesity has increased, particularly in urban women, in line with the increase in hypertension (MoH, 2023; Agyemang et al., 2016). Weight loss through reduced calorie intake and exercise has been shown to reduce systolic and diastolic pressure significantly, and weight management is an essential aspect of hypertension management (Whelton et al., 2018).

Micronutrients (Na^+, K^+, Ca^{2+}, and Mg^{2+}) play significant roles in regulating blood pressure and vascular function. The importance of sodium intake is a crucial issue, because a high consumption level raises blood volume and vascular resistance; a significant amount of population studies and clinical trials have proven that a decrease in salt intake is a successful way of lowering blood pressure in different populations (He and MacGregor, 2017; Cappuccio et al., 2018). It is especially pertinent that the African diet has become excessively sodium-intensive, often obtained from products such as stock cubes, processed foods, and chili salt.

However, as opposed to this, an optimal amount of potassium is helpful because it fosters not only natriuresis (excretion of sodium) but also vasodilation (blood vessel expansion); a diet high in fruits and vegetables, which are naturally high at potassium, is known to counteract the hypertensive effect of sodium and reduce overall cardiovascular risk (Elliott et al., 2016). In addition, calcium and magnesium play their roles in the control of vascular tone and endothelial activities. Although there is evidence that low dietary intake of these two minerals correlates with increased blood pressure and that limited supplementation can be beneficial to some patients with hypertension, there is no strong, consistent evidence to support the nutrients' role in any practical way (Song et al., 2016; Rosanoff et al., 2014).

Micronutrient insufficiency may be combined with overnutrition (e.g., the obese patients with low micronutrient intakes) in Kenya, making dietary counselling and treatment of the patients with hypertension more complex. The term "double burden" refers to the coexistence of undernutrition (micronutrient deficiencies and underweight) and overnutrition (overweight/obesity) within populations, households, or individuals. Kenya shows this dual burden: stunting and micronutrient deficiencies remain a national health concern among specific populations, but overweight and obesity are also increasing, especially among adults in urban and peri-urban areas (MoH, 2023; Misganaw et al., 2017). In hypertensive care, this implies that clinicians need to check not only for excess adiposity but also for nutrient deficiencies. As an illustration, an overweight patient can still have a low level of potassium or magnesium in their diet that aggravates the blood pressure or response to treatment. The public health measures thus must have two functions: they must meet energy balance and enhance diet quality and micronutrient sufficiency.

There exists a vast and increasing amount of SSA-related research that associates inadequate nutritional conditions with hypertension. The association between obesity (particularly central obesity), high dietary sodium, low fruit/vegetable intake, and poor nutrient profile is observed as a consistent correlate of high blood pressure by cross-sectional and cohort studies in West, East, and Southern Africa (Ataklte et al., 2015; Noubiap et al., 2019; Agyemang et al., 2016). Population-based surveys and facility studies conducted in Kenya indicate a strong relationship between BMI/WC and hypertension prevalence, and that hypertensive adults in the country are not adhering to recommended dietary patterns (Joshi et al., 2014; Mwenda et al., 2021; Kiberenge et al., 2022). Intervention studies that have applied salt-reduction methods, promoted the DASH dietary elements, or implemented diet-exercise interventions have shown small to significant reductions in blood pressure, but their sustainability and scale are issues in low-resource contexts (Siervo et al., 2015; Dzudie et al., 2020).

The nutritional status of an individual, reflected through anthropometric measurements, dietary intake, and micronutrient levels, plays a critical yet modifiable role in the development and management of hypertension. In Kenya and across Sub-Saharan Africa, the rise in overweight and obesity, together with excessive sodium intake, low dietary potassium, and widespread micronutrient deficiencies, has created a complex nutritional environment that increases vulnerability to hypertension and complicates disease control (Noubiap et al., 2019; Mohamed et al., 2018). Rapid urbanization and dietary shifts toward processed and energy-dense foods have led to reduced consumption of fruits, vegetables, and whole grains, which in turn lowers the intake of essential minerals such as potassium, magnesium, and zinc that help regulate blood pressure (Rosique-Esteban et al., 2018; Singh et al., 2021).

Potassium facilitates vasodilation and promotes sodium excretion, while magnesium aids in vascular relaxation and calcium regulation; both have been shown to reduce hypertension risk (Elliott et al., 2016; Touyz, 2019). Zinc also contributes to vascular health by mitigating oxidative stress and supporting endothelial function (Marreiro et al., 2017). These interlinked nutritional factors underscore the importance of evaluating general and central adiposity, identifying dietary inadequacies, and promoting balanced nutritional patterns rich in fruits, vegetables, and whole grains as part of both clinical and public health approaches to hypertension prevention and control (He & MacGregor, 2017; WHO, 2020).

2.6 Blood Pressure Status among Patients with Hypertension

Blood pressure status represents the extent of blood pressure elevation and serves as an indicator of both disease progression and the effectiveness of management among hypertensive patients. Accurate measurement and classification of blood pressure are essential for the diagnosis, treatment, and ongoing monitoring of hypertension. According to the World Health Organization (WHO, 2020) and the Kenya Ministry of Health (2023)**,** normal blood pressure is defined as a systolic blood pressure (SBP) of less than 120 mmHg and a diastolic blood pressure (DBP) of less than 80 mmHg**.** Prehypertension, or elevated blood pressure, is classified as SBP between 120–139 mmHg or DBP between 80–89 mmHg. Stage I hypertension is defined by SBP of 140–159 mmHg or DBP of 90–99 mmHg**,** while Stage II hypertension corresponds to SBP of 160 mmHg or higher or DBP of 100 mmHg or higher (Whelton et al., 2018). Persistent elevation beyond these thresholds substantially increases the risk of cardiovascular complications, renal impairment, and stroke **(**Carey et al., 2018; Hall et al., 2021**).**

Blood pressure measurement and monitoring have evolved to improve the accuracy of diagnosis and long-term care. The most popular is the application of a calibrated sphygmomanometer, which may be most conveniently either a manual (mercury) or an automated digital device. To measure it correctly, patients need to take at least 5 minutes of rest, apply a cuff of the right size, and maintain identical measurement conditions (WHO, 2020). Ambulatory and home blood pressure monitoring have become increasingly indicated to support diagnosis, identify white-coat hypertension, and assess treatment effectiveness (Stergiou et al., 2018). In resource-constrained environments like Kenya, however, the lack of equipment and trained staff is a significant impediment to effective monitoring (Joshi et al., 2014; MoH, 2023).

Medication adherence, lifestyle changes, comorbidities, and healthcare access are factors that determine blood pressure control in patients with diagnosed hypertension. Lack of compliance with antihypertensive therapy is one of the most significant predictors of uncontrolled hypertension, which is often caused by forgetfulness, side effects, or lack of knowledge about a disease (Ibekwe, 2015; Musinguzi & Nuwaha, 2015). Effective blood pressure management is also impaired by dietary habits, including excessive intake of salt and fats, sedentary lifestyle, obesity, and stress (Owolabi et al., 2019; Cappuccio et al., 2018). Stress, social isolation, and depression are psychosocial factors that are likely to increase blood pressure by neuroendocrine activation (Chiang et al., 2019). Also, limited access to medications, irregular follow-up, and healthcare costs significantly impact management outcomes in low- and middle-income countries (LMICs) (Adebayo et al., 2019; Etyang and Scott, 2013).

The pattern of blood pressure control in treated and untreated patients reveals significant gaps in control. The available evidence worldwide shows that a small number of hypertensive adults (around one in five) have their blood pressure adequately controlled, and the lowest rates are found in LMICs (Geldsetzer et al., 2019; Zhou et al., 2021). The Sub-Saharan region has the lowest control rates worldwide, often below 20% despite rising diagnoses and awareness (Adeloye et al., 2021; Noubiap et al., 2019). Research indicates that untreated patients are generally more severe in hypertension, have increased complication rates, and more hospitalizations (Hall et al., 2021). On the other hand, treated individuals usually show partial control, which is the difficulty in adhering to medications, polypharmacy, and fractured healthcare systems (Ataklte et al., 2015).

The research in Kenya shows that awareness and diagnosis of hypertension are improving, but the level of blood pressure control is poor. According to the Kenya STEPwise Survey (MoH, 2023), a small proportion (approximately 15%) of people on antihypertensive treatment achieved optimal blood pressure control. Joshi et al. (2014) reported that other researchers have the same finding in Nairobi and Kisumu, where the prevalence of uncontrolled hypertension among patients treated remained over 70%. Mwenda et al. (2021) found in rural Kenya that lack of follow-up care and irregular drug supply were the major contributors to poor control. Similar results have been observed in Uganda and Nigeria, where treatment coverage is low and most diagnosed individuals discontinue treatment within the first year (Kayima et al., 2013; Oguoma et al., 2015). Such trends highlight systemic problems, including insufficient healthcare funding, drug shortages, and ineffective patient education programs.

The fact that uncontrolled blood pressure still affects patients with hypertension in Kenya and other LMICs is indicative of a multidimensional approach. These include enhancing community-based screening, incorporating hypertension management into primary healthcare, and encouraging lifestyle changes and pharmacological management (Adedoyin et al., 2019; Dzudie et al., 2020). Increased technology utilization, including mobile health applications to monitor and provide reminders, has also been effective in enhancing compliance and performance (Nguyen et al., 2021).

Finally, blood pressure level among patients with hypertension is a decisive factor in the success of managing the disease. The success of control requires proper diagnosis, regular follow-up, patient adherence to treatment, and affordable medical care. In Kenya and the rest of Sub-Saharan Africa, these factors have to be tackled to enhance the treatment outcomes and the increasing burden of cardiovascular complications alongside uncontrolled high blood pressure.

2.7 Association between Hypertension and Demographic, Lifestyle, and Nutritional Factors

Socioeconomic position (SEP), commonly measured by education, income, and occupation, has a complex relationship with hypertension. In many LMIC settings, SEP shows a non-uniform pattern: higher SEP was initially linked to higher hypertension in the early years of the nutrition transition, but later changed to where low SEP groups have a greater burden of hypertension. As time passes, unhealthy foods grow cheaper, and healthcare access is uneven (Cappuccio et al., 2018; Mendenhall et al., 2017). In other settings, studies have also demonstrated that prevalence is higher among urban and wealthier populations in Sub-Saharan Africa, as the poor have greater uncontrolled hypertension and poorer outcomes due to low access to diagnosis, treatment, and medicines (Geldsetzer et al., 2019; Noubiap et al., 2019). Kenyan statistics also show that education and income are predictors of awareness and treatment: better-educated and better-off individuals are more likely to be diagnosed and treated, whereas low-income groups have lower control rates despite sometimes having lower measured prevalence (MoH, 2023; Kiberenge et al., 2022).

Age is a predictor of hypertension that is consistent and strong: there is a significant increase in prevalence after middle age because of vascular ageing and cumulative risk factor exposures (Whelton et al., 2018). Gender-related patterns of hypertension risk among women are more pronounced than those among men. Young and middle-aged men are more likely to be hypertensive, due to frequent use of tobacco and alcohol, and experience work-related stress, whereas after menopause, women are the most affected, due to hormones and increasing central adiposity (Peters et al., 2019; Agyemang et al., 2016). The lifestyle risk factors (diet, exercise, alcohol, smoking) are age- and sex-dependent: e.g., inactive living and weight gain in the middle-aged women might supplement the post-menopausal hypertension increase, but heavy alcohol/tobacco use in men increases the chances of early hypertension (Joshi et al., 2014; Owolabi et al., 2019).

Eating habits, exercise, and obesity are inseparable triad factors that mediate hypertension. Low potassium and high sodium diets, as well as high-energy diets, cause weight gain and increase blood pressure, both directly and indirectly via metabolic pathways (He et al., 2017; Mente et al., 2021). Exercise accelerates weight gain and worsens insulin resistance and endothelial function (Diaz & Shimbo, 2021). As demonstrated by multiple population studies, obesity, in particular central (waist) adiposity, enhances the effect of unhealthy diet and lack of physical activity on blood pressure; it is multiplicative, rather than additive, and combined lifestyle risk factors have a greater impact on blood pressure (Hall et al., 2021; Peters et al., 2019). Intervention trials (e.g., DASH and composite diet-exercise interventions) demonstrate that combined diet interventions and physical activity produce greater reductions in blood pressure than single interventions (Sacks et al., 2001; Siervo et al., 2015).

Modern models view hypertension as the result of the interplay among biological, behavioral, psychosocial, and structural factors. Bio-psychosocial models combine genetic identity and physiological processes (RAAS, sympathetic activation), behavioral factors (diet, alcohol, smoking, activity), psychosocial factors (poverty, work stress, social isolation), and health-system factors (access, affordability) (Carretero and Oparil, 2017; Spruill, 2010). Nutritional paradigms focus on the balance between macronutrients/energy, and on the adequacy of micronutrients (sodium-potassium balance, calcium, magnesium) as mediators of vascular activity (Elliott et al., 2016; Rosanoff et al., 2014). It is because of such multifactorial models that the same exposure can have different effects across different age, sex, and SEP strata, and why multivariate analytic methods are appropriate in epidemiological analysis.

The multifactor picture is supported by evidence on the SSA and Kenya regions. Synchronous and cohort studies provide similar results, in which hypertension is linked to age, central obesity, inadequate dietary habits (low amount of fruit/vegetables), physical immobility, alcohol/tobacco use, and low education/access to healthcare services (Ataklte et al., 2015; Joshi et al., 2014; Mwenda et al., 2021). Facility-based research in Kenya reveals that uncontrolled hypertension is high with the irregularity in medication supply, poor compliance, and socioeconomic barriers (Kiberenge et al., 2022; Mwenda et al., 2021). Community surveys demonstrate disparities in prevalence and awareness between urban and rural areas, with urban populations reporting higher measured prevalence, while rural populations experience greater underdiagnosis (Geldsetzer et al., 2019; MoH, 2023). The heterogeneity in effect sizes across countries in comparative analyses reflects differences in epidemiologic transition, dietary patterns, and health-system capacity (Adeloye et al., 2021; Noubiap et al., 2019).

Despite the expanding body of research on hypertension, notable gaps remain in both methodological approaches and contextual relevance. Studies are cross-sectional, which limits their ability to establish temporality or causal links between dietary or lifestyle factors and the onset of hypertension **(**Agyemang et al., 2016; Noubiap et al., 2019; Mwenda et al., 2021**).** Additionally, there is a shortage of locally specific data from mid-sized urban centers such as Nakuru, which represent mixed rural urban exposures. Much of the Kenyan evidence originates from large metropolitan settings such as Nairobi and Mombasa, or from predominantly rural regions, potentially biasing national generalizability **(**Ministry of Health [MoH], 2023; Mohamed et al., 2018; Joshi et al., 2014).

Third, inconsistencies in measurement techniques, for instance, reliance on single-clinic blood pressure readings instead of 24-hour ambulatory monitoring and variation in anthropometric cut-offs, limit the comparability of findings across studies **(**Hall et al., 2021; Peters et al., 2019; WHO, 2020**)**. In addition, relatively few studies have concurrently modeled the interactions among socioeconomic, psychosocial, lifestyle, and nutritional factors, making it difficult to estimate their relative contributions in Kenyan clinical populations **(**Mutua et al., 2020; Wekesa et al., 2020**).** Furthermore**,** longitudinal and intervention studies examining the effectiveness and sustainability of culturally sensitive lifestyle modifications within the Kenyan health system are few (MoH, 2021; Korir, 2020).

These research gaps provided the rationale for conducting the current study among hypertensive patients attending Nakuru County Teaching and Referral Hospital, to investigate how demographic, lifestyle, and nutritional factors interrelate using standardized and contextually relevant measures.

The existing literature consistently demonstrates that hypertension develops through a complex interaction among demographic, socioeconomic, lifestyle, and nutritional determinants, acting via both biological and psychosocial pathways **(**Adeloye et al., 2021; Mente et al., 2021**).** Although international and regional studies highlight similar risk patterns, the heterogeneity of social and cultural context**s**, together with methodological limitations, justifies localized, multivariate research, such as the present study, to inform targeted prevention and management interventions in Nakuru County and comparable Kenyan settings.

2.8 Summary of Literature Review

The reviewed literature reveals that hypertension remains a leading public health challenge globally, regionally, and nationally. It is influenced by a complex interplay of demographic, socioeconomic, lifestyle, and nutritional factors. The literature indicates that hypertension is strongly influenced by age, gender, education, income, and occupation (Adebayo et al., 2019; Geldsetzer et al., 2019; Kiberenge et al., 2022). There are usually higher prevalence rates among older adults and males with lower educational attainment and income levels, which are associated with inadequate health literacy, poor access to healthcare, and inappropriate disease control. On the same note, real-life changes like urbanization and lifestyle changes in low- and middle-income countries (LMICs), such as Kenya, have exposed people to risk factors, including unhealthy diets, lack of physical activity, alcohol use, and tobacco use (Adeloye et al., 2019; Dzudie et al., 2020).

Of special importance are nutritional factors, as elevated blood pressure has been strongly associated with high-sodium, low-potassium diets and the increasing consumption of processed foods (WHO, 2023). As BMI and waist circumference are anthropometric measures of obesity, they have become key modifiable determinants of hypertension across Sub-Saharan Africa (Muthuri et al., 2020; Ataklte et al., 2015). But malnutrition, whether over- or under-nutrition, is another challenge, especially in urbanizing populations like those in Kenya. The reviewed articles also report that blood pressure control in treated patients is low, and there are gaps in adherence, monitoring, and lifestyle modification (Odhiambo et al., 2021; Dzudie et al., 2020).

Despite the evidence collected globally and regionally, significant variations still exist in the magnitude and interactions of the risk factors. For example, although the association between socioeconomic status, education, and hypertension risk has been described in urban Kenya, the trends in mid-size and peri-urban counties have not been studied (Mogaka et al., 2021). Furthermore, few studies have examined the collective impact of demographic, lifestyle, and dietary patterns on blood pressure in county referral hospitals.

These gaps explain why the current study focused on patients at Nakuru County Teaching and Referral Hospital (NCTRH). The hospital's catchment area is a diverse combination of urban and peri-urban populations, offering a perfect setting to study the interactions among socioeconomic, lifestyle, and nutritional factors and how they affect the prevalence and management of hypertension. The results of the current research should provide contextual information to support specific interventions to support the strategy for managing hypertension in Nakuru County and other Kenyan contexts.

2.9 Conceptual Framework

The conceptual framework guiding this study is adapted from the Social Determinants of Health (SDH) model (World Health Organization, 2010) and the Biopsychosocial model of disease causation. It illustrates the interrelationships among demographic, socioeconomic, lifestyle, and nutritional factors influencing hypertension outcomes among adults attending Nakuru County Teaching and Referral Hospital. At the macro level, demographic and socioeconomic factors such as age, gender, education level, income, marital status, and occupation determine individuals' exposure, vulnerability, and response to hypertension. These distal determinants influence health literacy, access to healthcare, dietary choices, and lifestyle behaviors (Adebayo et al., 2019; Geldsetzer et al., 2019).

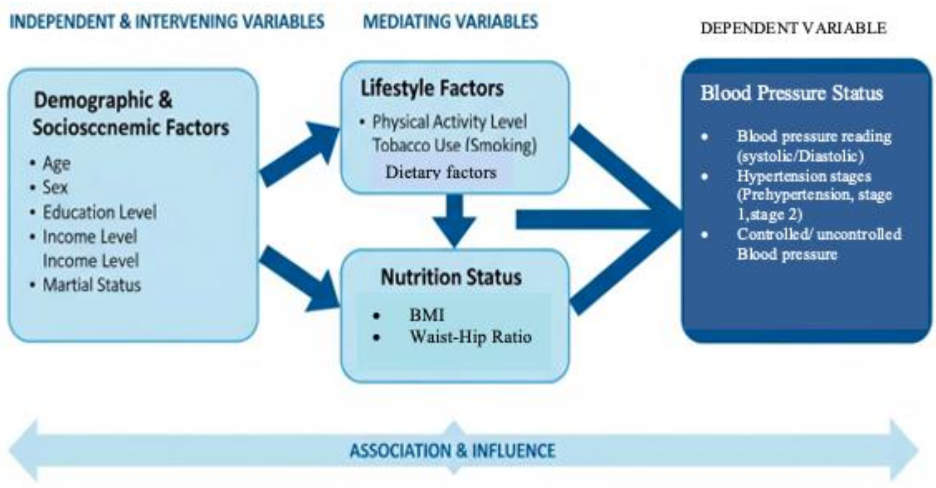
At the meso level, lifestyle factors such as dietary habits, physical activity, alcohol consumption, tobacco use, stress levels, and sleep patterns serve as intermediate pathways through which socioeconomic and demographic factors affect blood pressure regulation (Dzudie et al., 2020; Muthuri et al., 2020). For instance, low-income individuals may have limited access to healthy foods or safe spaces for exercise, increasing their risk of hypertension.

At the micro level, nutritional status, measured through anthropometric indicators (BMI, waist circumference, waist–hip ratio) and nutrient intake patterns, represents a proximal determinant that directly impacts hypertension development and progression. Both overnutrition (obesity) and undernutrition (micronutrient deficiencies) can exacerbate dysregulation of blood pressure (WHO, 2023).

These three levels of determinants ultimately influence blood pressure status (normal, pre-hypertensive, Stage I or II hypertension), reflecting the overall disease control and severity. The model posits that demographic and socioeconomic factors affect lifestyle and nutritional behaviors, which in turn influence hypertension outcomes. Feedback mechanisms also exist, where uncontrolled hypertension can reduce productivity and income, thereby perpetuating the socioeconomic burden.

Figure 1

Conceptual Framework



Source: Author(2025)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the methodology used in this study, including the research design, study population, sampling, data collection, pretesting, data analysis, and ethical considerations.

3.2 Research Design

This study adopted a descriptive cross-sectional research design. It employed quantitative methods to investigate risk factors for hypertension among adult patients attending Nakuru County Teaching and Referral Hospital, Nakuru County, Kenya. This design was considered appropriate because it enables the assessment of patients' blood pressure status and facilitates the analysis of associations between potential risk factors and the condition within a defined population at a specific point in time (Megel & Herman, 1993).

3.3 Location of the Study

The study was conducted in Nakuru County Teaching and Referral Hospital. The hospital is located in Nakuru County, which is one of the 47 counties in the Republic of Kenya. Nakuru is located at 0 ° 29’S longitude and 36 ° 02’E latitude. It began as a military hospital in 1906 during the First World War. Being a Level 5 hospital, it serves 11 sub-counties. The hospital has a bed capacity of 300 with 15 general wards. The hospital serves as a referral hospital for the South Rift Valley region, with a population of about 3.6 million across various counties. It also serves about 1000 patients with hypertension, and approximately 500 of them attend various clinics every month (Tanui and Kibiwot, 2023)

3.4 Population of the Study

This study focused on patients aged> 18 years, men and women, attending the outpatient clinic at Nakuru County Teaching and Referral Hospital. It included those who have been previously diagnosed with hypertension.

3.5 Sample Size

Sample size was calculated using the Cochran (1963) formula, as cited by Fisher et al. (1998). Since no estimate of the proportion of patients with hypertension in Nakuru County was available, the National prevalence of 23.8% reported by the Kenya Ministry of Health survey (2017) was used. The Cochran formula was then used to calculate the sample size.

$$(n) = \frac{Z^2pq}{d^2}$$

Where :

(n)=the desired sample size

Z = the standard normal deviate that provides a 95% confidence interval of (1.96)

(p)=prevalence of hypertension (23.8%)

(q)=1-p

(d)=absolute precision (error bound) (0.05)

Hence:

$(n) = \frac{1.96^2 \times 0.238 \times 0.762}{0.05^2}$=278.68

Since the population size is less than 10,000, the final sample estimate (n*f*) was calculated using the following formula:

$$(nf) = \frac{n}{1 + \frac{(n-1)}{N}}$$

Where:

(n*f)* = the desired sample size (when population is less than 10,000)

(n) = the estimated sample sizes

N = Total population; approximately 1000 patients attend Nakuru County Teaching and Referral Hospital, who are between 30 and 70 years old.

Hence:

$$(nf) = \frac{278.68}{1 + \frac{(278.68 - 1)}{1000}} = \frac{278.68}{1 + \frac{277.68}{1000}} = 218$$

A 10% attrition rate was included, hence 218 + 22 = 241 respondents. Although the researcher collected data from 215 patients, the response rate was 89.2% of the expected total study sample, with a non-response rate of 12.2%.

3.6 Recruitment Procedure

3.6.1 Sampling Procedure

Purposive sampling was used to select both the study site and participants. The Nakuru County Teaching and Referral Hospital (NCTRH) was purposively chosen because it serves as the primary referral and teaching facility in Nakuru County, providing care to a rapidly growing, diverse urban–rural population. The county has also experienced significant demographic expansion in recent years, with an increase of more than 500,000 residents between 2009 and 2019 **(**Kenya National Bureau of Statistics [KNBS], 2019).

This growth has been accompanied by a rise in lifestyle-related diseases, including hypertension, thereby making the facility a strategic location for investigating hypertension determinants in an urbanizing context. Purposive selection of the hospital was therefore justified by its large catchment area, high patient turnover, and representation of the target population for this study **(**Etikan et al., 2016; Palinkas et al., 2015**).**

Participant selection was also based on purposive sampling, as there was no dedicated hypertensive clinic within the facility. Instead, hypertensive patients were identified from the triage area, where all patients are initially assessed before being directed to the respective outpatient departments. This approach ensured that all eligible hypertensive patients, regardless of their eventual clinic destination, had an equal opportunity to participate. A list of patients attending the triage area was obtained from the facility database, and systematic sampling was then applied, selecting every third hypertensive patient who met the inclusion criteria for participation. This method provided a practical way to achieve representativeness while working within the clinical setting **(**Mostafa & Ibrahim, 2018**).**

Upon triage, patients were screened for eligibility using predefined inclusion and exclusion criteria. Those who met the inclusion criteria and gave informed consent were enrolled in the study. Participants who withdrew during the process were immediately replaced by the next eligible patient on the list to maintain the intended sample size. This procedure ensured that the final sample accurately represented the hypertensive population attending NCTRH at the time of data collection **(**Creswell & Creswell, 2018; Etikan et al., 2016**).**

3.7 Study Subjects

3.7.1 Inclusion Criteria

The participants met the following criteria to be enrolled in the study:

i. Must be aged >18 years,

ii. Should be attending the outpatient clinic at Nakuru Teaching and Referral Hospital, and
iii. Must have consented to participate in the study

3.7.2 Exclusion Criteria

The study subjects were excluded if

i. Patients aged >18 years who were critically ill
ii. Individuals who were mentally disabled

3.8 Data Collection Instrumentation

Data was collected using the WHO step-wise questionnaire. The questionnaire was designed specifically for low- and middle-income countries to support surveillance of chronic disease risk factors. The semi-structured research-administered questionnaire was completed with the aid of a trained research assistant.

The semi-structured questionnaire focused on: Demographic and socio-economic characteristics of patients, such as age, sex, education level, and level of income, among others, had dichotomous and Likert structured questions, data such as age, gender, marital status, family history of hypertension, religion, education level, source of income, and individual income. Nutrition Status captured data on weight, height, BMI, waist and hip measurements, waist-to-hip ratio, and blood pressure. The Health and Lifestyle section contained data on smoking, alcohol use, contraceptive use, and chronic diseases such as diabetes, hyperthyroidism, and renal disease in a dichotomous structure of questions.

Dietary practices included the Food Frequency Questionnaire, fruit and vegetable servings/day, and a multi-pass 24-hour recall, and the physical activity section was measured using the Global Physical Activity Questionnaire (GPAQ) (WHO, 2021).

WHO developed the tool for physical activity surveillance in countries. It collected information on sedentary behavior and physical activity across three settings or domains: work, travel to and from locations, and recreational activities. The tool assessed physical activity across three settings: work, travel to and from places, and recreational activities. The total time spent in physical activity during a typical week and the intensity of that activity were taken into account to define the activity level.

3.8.1 Pretest

A pilot study was conducted at the outpatient clinic of Naivasha level 5 health facility, a site with characteristics similar to those of the central study location. The purpose was to test the questionnaire and identify areas that required necessary adjustments in the tools and instruments before the main data collection (James and Storm 2019). The pilot's response informed modifications to wording, sequencing, and structure to enhance clarity and participant engagement.

3.8.2 Validity

Validity is the accuracy, soundness, or effectiveness with which an instrument measures what it is intended to measure (Wiersma, 1995). The tool used in this study was validated. However, comments from the experts were incorporated to improve content appropriateness and cultural sensitivity. Pre-testing of the questionnaire was also conducted at Naivasha Level 5 Hospital, a hospital with a similar background and dietary practices to those of the target population. This process helped confirm face and content validity of the instrument.

3.8.3 Reliability

Reliability of the research instruments was assessed using the internal consistency technique. Cronbach's Alpha was used to determine the instrument's internal consistency. The questionnaire met the acceptable Cronbach's $\alpha \geq 0.7$, indicating internal consistency.

3.9 Data Collection Procedure

Approval to collect the data was obtained from NACOSTI, the County Director of Health, and the medical superintendent. Research assistants with a basic degree in Nutrition were contracted to assist in the data collection. A pre-visit was conducted by the researcher and research assistants at Nakuru County Teaching and Referral Hospital before the research. An orientation was conducted to familiarize oneself with the outpatient clinic. Data collection was done daily for 25 days. The researcher reported daily to the nutritionist, who guided the collection of patient data and identified eligible patients using the inclusion and exclusion criteria. Consent was obtained from the patients before data collection.

The researcher used a semi-structured questionnaire to collect information on demographic and socio-demographic characteristics, knowledge of hypertension, and health status. The information on dietary practices was collected using a food frequency questionnaire and a 24-hour recall tool. Two non-consecutive 24-hour recalls were administered to each respondent, one on a weekday and one on a weekend day, to obtain more representative estimates of usual intake.

The second recall was obtained via a follow-up telephone interview conducted 3-7 days after the first recall. This methodology accounts for variation in nutritional habits between work and non-work days, as dietary assessment guidelines recommend (Gibson and Ferguson, 2008; FAO, 2018). This involved writing down every food or beverage consumed over the last 24 hours and probing for any forgotten snacks, fruits, or condiments. Note the time and situation of every eating event. Getting descriptions of foods, ingredients, ways of cooking, and the size of a portion in terms of standard household measures and food pictures. Re-read the entire recall to the respondent to ensure it is complete and accurate.

The Physical activity was collected using the GPAQ. Information on smoking and alcohol intake was collected using the questionnaire. The nutrition status was then determined using BMI and waist-hip ratio. Weight was taken using a calibrated weighing scale (Seca 769) placed on a flat surface. The interviewee was expected to have minimal clothing and be barefoot. The weight was recorded on the questionnaire to the nearest 0.1 kg. Height was measured using a stadiometer on a flat, stable surface. The respondent then stood barefoot and upright with their back against a vertical flat backboard. They were expected to look directly ahead in a horizontal position. Once the correct position was achieved, the reading was taken and recorded. Waist and hip measurements were taken using a non-stretchable measuring tape following WHO standardized procedures (WHO, 2011). Waist circumference was measured at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest.

In contrast, hip circumference was recorded at the broadest part of the buttocks. Participants stood upright with feet shoulder-width apart, and measurements were taken at the end of a normal expiration without compressing the skin. All values were recorded to the nearest 0.1 cm.

The blood pressure reading was taken at triage. The measurement was taken using a calibrated digital sphygmomanometer. Participants were asked to sit comfortably, with a flat back and feet on the floor, after resting for at least 5 minutes. The arm was at the level of the heart, but there was neither clothing on it nor a surface on which it rested. A cuff was fitted on the upper arm, a good size, and the cuff bladder surrounded the arm circumference by at least 80 %. The measurement was performed twice at 1- to 2-minute intervals, and the average of the two readings was calculated. If the first two readings were more than 5 mmHg apart, the third reading was recorded, and the average of the two nearest readings was calculated**.** This process took, on average, 27 to 25 minutes. The research assistants ensured the questionnaire was fully completed before submission. The questionnaires were stored in a secure, locked place to protect the data.

The research posed no risk to the participants. To ensure data accuracy and integrity, research assistants were trained to collect accurate data. Standardized procedures were used to avert biases and variations. The principal investigator monitored the process and ensured all procedures were adhered to. All research instruments were calibrated daily before use to ensure the accuracy of the collected data. The gathered information was stored in a zipped bag to ensure the patient's privacy. All questionnaires were then stored in a lockable, fireproof cabinet to ensure the safety and confidentiality of the information.

3.10 Data Management and Analysis

Complete questionnaires were received and checked for completeness. Data was entered into Excel and then exported to Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics (means, frequencies, percentages, and standard deviations) were used to analyze data on socio-demographic characteristics, dietary practices, and nutritional status. Pearson's chi-square (χ^2) was used to test for the relationship between hypertension and categorical variables. Logistic regression was used to identify the risk factors for hypertension. P-values <0.05 were regarded as statistically significant, and p-values>0.05 were considered insignificant.

Table 1

Data analysis Matrix

Objective	Variables	Nature of Variable	Statistical Strategy
To determine the demographic and socio-economic characteristics of hypertension among adult patients attending Nakuru County Teaching and Referral Hospital.	Age sex marital Status Education level Income source Individual income Household income	Continuous Categorical	Descriptive statistics, e.g., Mean, Median, Standard deviation, %ages
What is the prevalence of hypertension among adult patients attending Nakuru County Teaching and Referral Hospital?		Categorical	Descriptive statistics, e.g., %ages
To determine the risk factors for hypertension among adult patients attending Nakuru County Teaching and Referral Hospital	Life style Alcohol intake Smoking Nutrition status Obesity Physical activity Dietary practices	Categorical	Descriptive statistics, e.g., %ages, Logistic regression

Demographic and socio-economic characteristics were analyzed using descriptive statistics, i.e., Mean, Median, Standard deviation, and %age. Data on blood pressure was analyzed by categorizing participants using standard systolic and diastolic cut-off values (Normal blood pressure of less than 120/80 mmHg, elevated blood pressure 120 to 129/ < 80 mmHg, stage 1 hypertension 130-139/80-89 mmHg and stage 2 hypertension ≥140/≥90 mmHg), according to WHO (2021) and ACC/AHA guidelines (Whelton et al, 2018). Dietary practices were analyzed using descriptive statistics, e.g., percentages. Data from the 24-hour recall were entered into NutriSurvey version 2007 to determine participants' nutrient intake of macro- and micronutrients. Nutritional status was assessed using body mass index (BMI) and waist-to-hip ratio. BMI was determined using the formula: body weight (kg)/ (height (m))^2, then classified based on the WHO (2006) classification of: (<18.5) for underweight, (18.5 - 24.9) for normal, (≥ 25- 29.9) for overweight, and (≥ 30) for obese. Waist-hip ratio was calculated by using the formula waist circumference (cm)/ hip circumference (cm), then classified according to the WHO (2008) standard (≤0.90 for men; ≤0.85 for women), increased risk (>0.90 for men; >0.85 for women), and significantly increased risk at WHR ≥1.00 (either sex).

The Pearson chi-square test was used to assess the relationship between categorical variables for those with and without hypertension. Multivariate logistic regression was used to determine the association between variables and the outcomes. The analyzed data were presented using graphical methods and frequency distribution tables.

3.11 Ethical Consideration

Permission to collect data was sought from Kabarak University Institute of Postgraduate Studies (IPGS). Ethical clearance was sought from Kabarak University Research Ethics Committee (KUREC) (Approval reference number: KUREC/001/41/07/24). Research permit was obtained from the National Commission on Science, Technology, and Innovation (NACOSTI) (Permit No.: NACOSTI/P/24/39105) to conduct the study at Nakuru County Teaching and Referral Hospital. Research authorization was obtained from the Nakuru County Director of Health. Permission was sought from the medical superintendent at PGH, Nakuru. Thereafter, an introductory letter was sent to the health facility before the study. The lead researcher obtained informed consent from the research participants before data collection. The research details were explained to the participants before recruitment. Any prospective participant who declined was excluded from the study, and the participants were assured of confidentiality. The data was stored on a password-protected drive accessible only by the investigator.

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION AND DISCUSSION

4.1 Introduction

This chapter presents results on risk factors for hypertension among adult patients attending Nakuru County Teaching and Referral Hospital, using the methodology described in Chapter Three. It includes respondents' demographic characteristics and descriptive and inferential statistics, with a total of 215 respondents and a 89.2% response rate.

4.2 Socio-Demographic Characteristics of Study Participants

Table 2

Demographic and Socioeconomic Characteristics of Study Participants

		N (215)	
Variables	Category	n	%
Gender	Female	116	54.0
	Male	99	46.0
Age	18 - 29 years	4	1.9
	30 - 49 years	137	63.7
	50 - 64 years	58	27.0
	≥66years	16	7.4
Education level	No formal schooling	4	1.9
	Less than primary school	2	0.9
	Primary school completed	9	4.2
	Secondary school completed	103	47.9
	College/University completed	97	45.1
Marital Status	Never married	18	8.4
	Currently married	165	76.7
	Separated	5	2.3
	Widowed	13	6.1
	Cohabitating	14	6.5
Employment Status	Government employee	31	14.4
	Non-government employee	50	23.3
	Self-employed	83	38.6
	Homemaker	12	5.6
	Retired	16	7.4
	Unemployed	23	10.7
Household Monthly Earnings	≤ 10,000	8	3.7
	10,000 - 30,000	39	18.1
	30,001 - 50,000	59	27.4
	50,001 - 70,000	53	24.7
	≥ 70,001	35	16.3
	Don't Know	21	9.7

Table 2 shows that more than half (53.9%) of the participants were female, and 46.1% were male. The majority (63.7%) were aged 30–49 years, with only 1.9% aged 18–29 years. Almost all respondents had formal education: 47.9% completed secondary school, and 45.1% completed college/university. Most participants (76.7%) were married, and the primary form of employment was self-employment (38.6%). 27.4% reported monthly household earnings between Ksh 30,001–50,000, suggesting that the sample primarily comprised middle-income households.

4.3 Lifestyle Risk Factors: Hypertension among Adults Attending Nakuru County Teaching and Referral Hospital,

4.3.1 Alcohol Consumption

Table 3

Alcohol Consumption

		N (215)	
Variables	Category	n	%
Ever consumed alcohol	No	142	66.1
	Yes	73	34.0
Alcohol use past 12 months (n=73)	No	41	56.2
	Yes	32	43.8
Stopped drinking due to adverse health impacts or professional medical advice (n=73)	No	51	69.9
	Yes	22	30.1
Frequency of alcohol consumption in the past 12 months. (n=32)	5 - 6 days per week	3	9.4
	3-4 days per week	8	25.0
	1-2 days per week	10	31.3
	1-3 days per month	6	18.8
	Less than once a month	4	12.5
	Never	1	3.1
Alcohol consumption in the past 30 days (n=32)	No	14	43.8
	Yes	18	56.3
Consumption of untaxed or unconventional alcohol in the past 7 days (n=17)	No	15	88.2
	Yes	2	11.8
Frequency of being unable to stop drinking once started, in the past 12 months (n=32)	Weekly	1	3.1
	Less than a month	9	28.1
	Never	22	68.8
Frequency of neglecting responsibilities due to alcohol consumption in the past 12 months (n=32)	Less than a month	7	21.9
	Never	25	78.1
Frequency of needing a morning drink to recover after heavy drinking in the past 12 months (n=32)	Less than a month	7	21.9
	Never	25	78.1
Occurrence of family or partner-related issues caused by someone else's drinking in the past 12 months	Monthly	4	1.9
	Several times, but less than a month	35	16.4
	Never	175	81.8

One-third (33.9%) of participants reported ever consuming alcohol, with 43.8% of them drinking in the past 12 months. Among current drinkers, weekly consumption (1–2 days/week) was most common (31.3%), while 9.4% drank 5–6 days/week. Notably, 30.1% had stopped drinking due to health concerns or medical advice. 28.1% reported that they were unable to stop drinking, 21.9% neglected responsibilities, and 21.9% required a morning drink after heavy drinking the previous night. 18.1% of the respondents reported family or partner-related issues caused by alcohol. These findings highlight the presence of harmful alcohol use patterns in a subset of the study population, as shown in Table 4.

4.3.2 Smoking

Table 4

Smoking Behaviour

		N (215)	
Variables	Category	n	%
Current Smoker	No	211	98.1
	Yes	4	1.9
Current Daily Smoker (n=4)	No	3	75.0
	Yes	1	25.0
Smoking Cessation Attempt (Past 12 Months) (n=4)	No	2	50.0
	Yes	2	50.0
Received Smoking Cessation Advice from Healthcare Provider (Past 12 Months) (n=4)	No	1	25.0
	Yes	3	75.0
Past Tobacco Product use	No	202	94.0
	Yes	13	6.0
Ever smoked daily (n=13)	No	5	38.5
	Yes	8	61.5

Table 4 shows that smoking was an uncommon practice among the study participants. 1.9% reported as current smokers, of whom one-quarter (25.0%) smoked daily. 50% of the current smokers had attempted to quit in the past 12 months, and 75% had received cessation advice from a healthcare provider. A total of 6.0% reported past tobacco use, with 61.5% of them having ever smoked daily. These results imply that the rate of tobacco use was not high among the study sample, but amongst the individuals who smoked, some level of dependence and quitting efforts was observed.

4.3.3 Dietary Practices

Table 5

Food Frequency of Study Participants

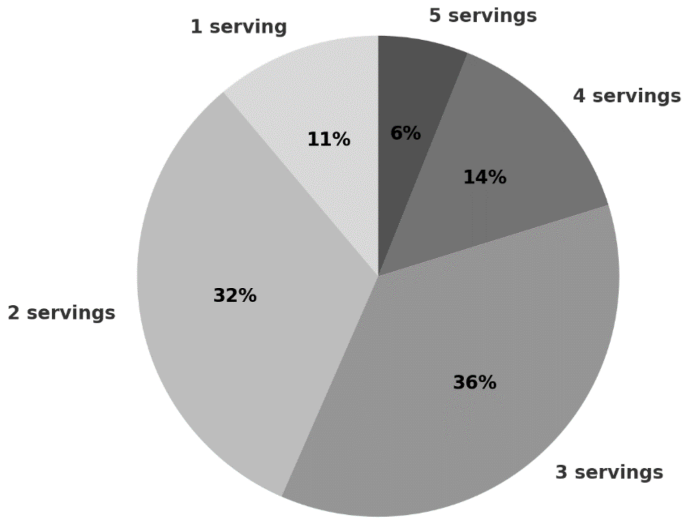
Food Group	Never	Seasonally	Once a month	Once a week	Twice a week	Everyday
	%	%	%	%	%	%
Cereals	0.2	8.7	3.7	32.1	27.5	27.7
Roots/Tubers	5.7	8.5	16.5	40.4	28.7	0.2
Vegetables	1.9	1.6	3.0	26.9	46.0	20.5
Fruits	4.2	39.2	6.1	33.4	15.9	1.2
Meat/Poultry/Offal	4.5	8.1	36.5	28.7	21.6	0.6
Fish/Seafood	2.0	10.6	26.8	28.2	31.9	0.5
Pulses/Legumes/Nuts	5.3	3.9	13.2	37.4	40.1	0.2
Milk/Milk products	0.0	0.0	0.5	7.5	2.8	89.3
Oils/Fats	2.8	5.4	3.3	13.3	12.1	63.2
Sweets/sugars	22.7	40.8	4.7	13.5	17.5	0.8

Table 5 shows that 27.7%, 89.3%, and 63.2% of participants consumed cereals, milk, and oils/fats, respectively, daily. Vegetables were consumed more regularly (20.5%) than fruits (1.2%). Fruit was primarily consumed seasonally (39.2%). Meat was consumed once a month by 36.5% of the participants, while pulses/legumes and fish were mostly consumed twice a week by 40.1% and 31.9%, respectively. 22.7% of participants never consumed sweets and sugars, and 40.8% reported seasonal intake.

4.3.4 Fruits and Vegetable Servings/Day

Figure 2

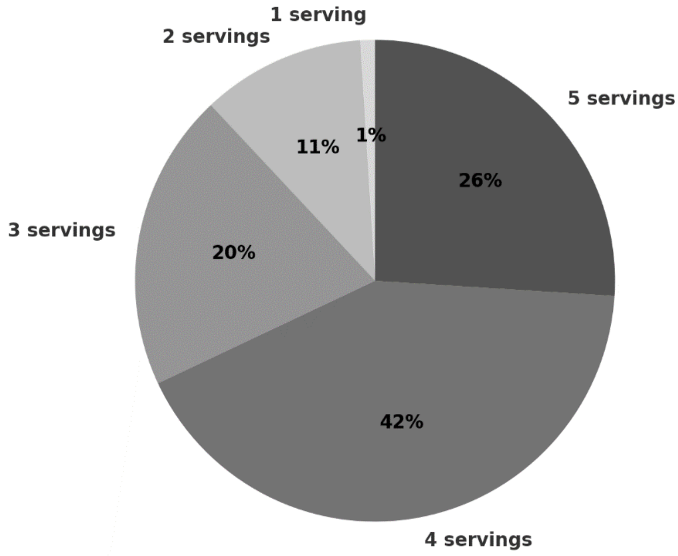
Average Daily Fruit Servings Among Participants



Most of the participants consumed 2–3 servings of fruit daily (32% and 36%, respectively). Only 6% attained the recommended five servings per day, while 11% consumed just one serving, as shown in Figure 3.

Figure 3

Average Daily Vegetables Servings among Participants



The majority of participants consumed 4–5 servings of vegetables daily, 42% and 26%, respectively. A smaller proportion consumed three servings (20%), two servings (11%), or only one serving (1%). These findings indicate that vegetable consumption was more consistent and closer to recommended levels, as shown in Figure 4.

4.3.5 24-Hour Recall

Table 6

Mean Energy and Macronutrient Intake Among Study Participants

Nutrient	Participants' intake (Mean ± SD)		RDA		Adequate (%)	
	Male	Female	Male	Female	Male	Female
Total Energy(Kcal)	1,890 ± 510	1,720 ± 480	2,500	2,000	11.0	8.2
Protein (g)	57.8 ± 18.9	53.2 ± 18.0	60	50	65.5	61.7
Fat (g)	61.2 ± 22.0	54.0 ± 19.8	≤83	≤67	58.0	54.2
Carbohydrate (g)	276 ± 74	255 ± 70	313	250	46.0	41.7
Fiber (g)	20.2 ± 7.0	17.5 ± 6.1	≥30	≥25	28.4	24.7

Note: RDA adopted from the *World Health Organization (WHO) and Food and Agriculture Organization (FAO) Human Energy and Protein Requirements Report (2004)* and the *Institute of Medicine Dietary Reference Intakes (2006)*.

Adequacy (%)=RDA /Mean daily intake×100

Table 6 shows that the average energy intake was below the RDA, with men consuming 1,890 ± 510 kcal (75.6% of the RDA) and women consuming 1,720 ± 480 kcal (86.0% of the RDA). Carbohydrate adequacy was 46.0% in males and 41.7% in females. Protein intake was suboptimal, with adequacy rates of 65.5% for males and 61.7% for females, and fat adequacy of 58.0% for males and 54.2% for females, respectively. Dietary fiber intake was insufficient, with adequacy of 28.4% for males and 24.7% for females.

Table 7

Mean Micronutrient Intake of Participants

Nutrient	Participants' intake (Mean ± SD)		RDA		Adequate (%)	
	Male	Female	Male	Female	Male	Female
Sodium (mg)	2,310 ± 710	2,220 ± 690	<2,000	<2,000	35.7 (safe)	38.4 (safe)
Potassium (mg)	2,540 ± 880	2,420 ± 860	≥3,510	≥3,510	20.2	19.4
Calcium (mg)	805 ± 270	790 ± 265	1,000-1,200	1,000-1,200	24.1	22.0
Magnesium (mg)	250 ± 80	230 ± 72	400–420	310–320	31.3	29.5
Iron (mg)	12.1 ± 3.9	10.8 ± 3.7	8	18 (19–50) 8 (≥51)	68.4	48.5
Zinc (mg)	7.9 ± 2.4	7.3 ± 2.1	11	8	44.3	41.0
Vitamin A (µg RAE)	640 ± 245	610 ± 225	900	700	38.2	35.9
Vitamin C (mg)	67 ± 25	62 ± 24	90	75	45.2	40.1
Folate (µg)	300 ± 95	280 ± 88	400	400	32.8	29.6
Vitamin B6 (mg)	1.2 ± 0.4	1.1 ± 0.4	1.3–1.7	1.3–1.5	52.0	47.1
Vitamin D (µg)	5.1 ± 2.1	4.7 ± 2.0	15–20	15–20	6.1	5.0

Note: RDAs and Recommended Nutrient Intakes (RNIs) adopted from *WHO/FAO Vitamin and Mineral Requirements in Human Nutrition (2nd ed., 2004)* and the *Kenya Food Composition Tables (2018)*. Adequacy (%)=RDA/Mean daily intake×100

Table 7 shows that sodium intake was high, exceeding the RDA of 2,000mg/day, with only 35.7% of males and 38.4% of females falling within safe levels. 20.2% of males and 19.4% of females met the RDA of potassium (3,510 mg). Calcium (24.1% for males and 22.0% for females) and magnesium (31.3% for males and 29.5% for females) intakes were also suboptimal, with fewer than one-third of participants meeting the adequacy criteria. Iron intake was 68.4% in males and 48.5% in females, indicating adequacy. Zinc intake was similarly low, with fewer than half of both males (44.3%) and females (41.0%) reaching recommended levels. Vitamin D intake was inadequate, with only 6.1% of males and 5.0% of females achieving adequacy.

4.3.6 Salt Intake

Table 8

Behavioural and Perceptual Patterns Related to Salt

		N (215)	
Variables	Category	N	%
Frequency of adding salt or salty sauce to food during or before eating	Always	1	0.5
	Often	26	12.1
	Sometimes	129	60.0
	Rarely	54	25.1
	Never	5	2.3
Frequency of adding salt or salty seasonings during cooking or food preparation at home	Always	70	32.6
	Often	94	43.7
	Sometimes	41	19.1
	Rarely	10	4.7
The frequency of consuming processed foods high in salt	Often	11	5.1
	Sometimes	139	64.7
	Rarely	59	27.4
	Never	6	2.8
Perceived amount of salt or salty sauce consumed	Too much	14	6.5
	Just the right amount	176	81.9
	Too little	20	9.3
	Far too little	4	1.9
	Don't know	1	0.47
Importance of reducing salt intake in one's diet	Very important	153	71.2
	Somewhat important	59	27.4
	Not at all important	3	1.4
Belief that excessive salt consumption poses health risks	No	10	4.7
	Yes	205	95.4
Limits consumption of processed foods	No	53	24.7
	Yes	162	75.4
Look at the salt or sodium content on food labels	No	207	96.3
	Yes	8	3.7
Buys low salt/sodium alternatives	No	199	92.6
	Yes	16	7.4
Uses spices other than salt when cooking	No	122	56.7
	Yes	93	43.3
Avoids eating foods prepared outside of the home	No	113	52.6
	Yes	102	47.4
Do other things specifically to control salt intake	No	160	74.4
	Yes	55	25.6

The findings showed that 60.0% sometimes added salt or salty sauces to food at the table (60.0%), while a quarter (25.1%) rarely added salt or salty sauces. 2.3% and 0.5% never or always added salt or salty sauces during or before eating. 43.7% and 32.6% reported adding salt often or always, respectively, during cooking or food preparation at home, while 4.7% reported rarely adding salt. The majority, 64.7% reported consuming processed foods high in salt. 71.2% of the participants considered reducing salt intake essential. Almost all participants (95.4%) acknowledged that excessive salt consumption poses health risks. 75.4% reported limiting consumption of processed foods, although very few (3.7% and 7.4%) reported checking sodium content on food labels and buying low-salt alternatives, respectively. 43.3% reported using spices other than salt when cooking, and 47.4% avoided eating foods prepared outside the home. However, a large proportion (74.4%) reported not taking any other steps to control salt intake, while only 25.6% reported taking additional steps.

4.3.7 Physical Activity

Table 9

Engagement in Vigorous- and Moderate-Intensity Work Activity

Variable	Category	N (215)	
		n	%
Work involves vigorous-intensity activity for ≥10 minutes	No	196	91.2
	Yes	19	8.8
Number of days performing vigorous-intensity work per week (n=19)	4 days	1	5.3
	5 days	1	5.3
	6 days	15	79.0
	7 days	2	10.5
Minutes spent on vigorous-intensity work per day	Mean ± SD; Mode; Range	168 ± 235; Mode = 6; Range = 5–600	
Engagement in moderate-intensity work activities for ≥10 minutes	No	130	60.5
	Yes	85	39.5
Number of days performing moderate-intensity work per week (n=85)	0 days	1	1.2
	3 days	9	11.0
	4 days	10	11.8
	5 days	34	40.0
	6 days	25	29.4
	7 days	6	7.1
Hours spent on moderate-intensity work per day	Mean ± SD; Mode; Range	4.29 ± 2.58; Mode = 5; Range = 0–10	

Table 9 shows that 8.8% of participants engaged in vigorous-intensity work, with most (78.9%) and 10.5% reporting activity 6–7 days per week, respectively. The mean duration of vigorous-intensity work was 168 ± 235 minutes per day, ranging from 5 to 600 minutes. 39.5% of participants engaged in moderate-intensity activity. Among these, 40% involved in moderate-intensity activity 5 days per week, and 29.4% engaged in moderate-ntensity activity 6 days per week. The mean duration was 4.29 ± 2.58 hours per day.

Table 10

Walking and Cycling Habits of Study Participants

		N (215)	
Variables	Category	N	%
Walking or cycling continuously for at least 10 minutes to travel to and from places	No	95	44.2
	Yes	120	55.8
Number of days walking or cycling for at least 10 minutes continuously in a typical week (n=120)	2	6	5.0
	3	17	14.2
	4	16	13.3
	5	48	40.0
	6	26	21.7
	7	7	5.8
Minutes spent walking or bicycling for travel on a typical day	Mean ± SD; Mode; Range	46±57; Mode=30; Range=480-15	

Findings in Table 10 shows that 55.8% of participants reported walking or cycling continuously for at least 10 minutes as a means of transport. 40.0% engaged in walking or cycling on 5 days per week and 21.7% on 6 days per week. The mean daily duration was 46 ± 57 minutes.

Table 11

Participation in Vigorous- and Moderate-Intensity Sports, Recreational Activities and Sedentary Behaviour

Variable	Category	N (215)	
		n	%
Participation in vigorous-intensity sports or recreational activities for≥10 minutes	No	192	89.3
	Yes	23	10.7
Number of days of vigorous-intensity sports per week (n=23)	1 day	11	47.8
	2 days	10	43.5
	3 days	1	4.3
	4 days	1	4.3
Minutes spent on vigorous-intensity sports per day	Mean ± SD; Mode; Range	84 ± 52; Mode = 120; Range = 10–180	
Participation in moderate-intensity sports or recreational activities for≥10 minutes	No	174	80.9
	Yes	41	19.1
Number of days of moderate-intensity sports per week (n=41)	1 day	18	43.9
	2 days	13	31.7
	3 days	5	12.2
	4 days	1	2.4
	5 days	4	9.8
Minutes spent on moderate-intensity sports per day	Mean ± SD; Mode; Range	88 ± 60; Mode = 120; Range = 20–180	
Sedentary behaviour - Minutes sitting/reclining per day	Mean ± SD; Mode; Range	203 ± 155; Mode = 120; Range = 0–720	

Table 11 shows that 10.7% of participants reported engaging in vigorous-intensity sports or recreational activities, with a mean duration of 84 ± 52 minutes per day, and most (47.8% and 43.5%) reported participation on 1–2 days/week, respectively. 19.1% reported engaging in moderate-intensity recreational activity, averaging 88 ± 60 minutes/day, with 43.9% engaging once weekly. Participants spent an average of 203 ± 155 minutes per day sitting or reclining.

4.3.8 Nutrition Status

Table 12

Nutrition Status of Study Participants

Variables	Category	N (215)	
		N	%
BMI	Underweight	3	1.5
	Healthy weight	35	17.6
	Overweight	92	46.2
	Class I obesity	54	27.1
	Class II obesity	14	7.0
	Class III obesity (severe obesity)	1	0.50
Waist circumference	Not at risk of chronic disease	59	29.8
	Increased risk of chronic disease	45	22.7
	Significantly increased risk of chronic disease	94	47.5
	Mean ± SD	92±12.6	

Findings in Table 12 indicate that 46.2% were overweight, 34.6% were obese, and 17.6% had a healthy weight. Waist circumference results showed that 22.7% and 47.5% had increased or significantly increased risk of chronic disease, respectively. The mean waist circumference was 92 ± 12.6 cm, highlighting a high prevalence of central obesity in the study population.

4.4 Blood Pressure Status of Hypertension

Table 13

Blood Pressure Categories, Cut-off Values, and Distribution by Sex

BP Category	BP Range (Systolic/Diastolic, mmHg)	Male (n=99)		Female (n=116)		Total (N=215)	
		n	%	n	%	n	%
Normal	<120 / <80	4	4.0	7	6.0	11	5.1
Elevated	120–129 / <80	17	17.2	23	19.8	40	18.6
Stage 1 Hypertension	130–139 / 80–89	54	54.5	59	50.9	113	52.6
Stage 2 Hypertension	≥140 / ≥90	24	24.2	27	23.3	51	23.7

Among the 215 participants, the general prevalence of hypertension (combined Stage 1 and Stage 2) was 76.3%. More than half (52.6%) had stage 1 hypertension, 23.7% had stage 2 hypertension, while 18.65% and 5.1% had elevated and normal blood pressure, respectively. The distribution between males and females was 54.5% male and 50.9% female with Stage 1 hypertension. Stage 2 hypertension was present in 24.2% of males and 23.3% of females. These findings show a high burden of hypertension among the study population, with minimal sex differences.

Table 14

Hypertension Diagnosis, Treatment, and Alternative Practices

Variable	Category	N(215)	
		n	%
History of BP measurement	No	19	8.8
	Yes	196	91.2
Told have hypertension	No	119	60.7
	Yes	77	39.3
Diagnosed within the past 12 months (n=77)	No	58	75.3
	Yes	19	24.7
On BP medication (past 2 weeks) (n=77)	No	15	19.5
	Yes	62	80.5
Ever consulted a traditional healer for BP (n=77)	No	73	94.8
	Yes	4	5.2
Current herbal/traditional remedies for BP (n=77)	No	75	97.4
	Yes	2	2.6

The findings in Table 14 indicate that 91.2% had ever had their blood pressure measured, and 39.3% reported being told they had hypertension. Among those diagnosed with hypertension, 75.3% had been diagnosed more than a year earlier, and 80.5% reported taking antihypertensive medication in the past two weeks. 5.2% reported ever consulting a traditional healer, and 2.6% reported using herbal remedies.

4.5 Relationship between Hypertension and Variables

4.5.1 Demographic and Socioeconomic Characteristics and Hypertension among Study Participants

Table 15

Relationship between Demographic and Socioeconomic Characteristics and Hypertension among Study Participants

Variable	Category	Stages of hypertension					
		Normal blood pressure n(%)	Elevated blood pressure n(%)	Stage 1 hypertension n (%)	Stage 2 hypertension n(%)	X^2 (df)	p-value
Age Groups	18 - 29 years	0 (0.0)	1(2.7)	3 (2.6)	0 (0.0)	20.953 (9)	0.013*
	30 - 49 years	10 (90.9)	30 (81.1)	72 (63.2)	25 (47.2)		
	50 - 64 years	0 (0.0)	5 (13.5)	33 (29.0)	20 (37.7)		
	66+ years	1 (9.1)	1 (2.7	6 (5.3)	8 (15.1)		
Education Level	No formal schooling	0 (0.0)	1 (2.7)	1 (0.9)	2 (3.7)	20.233 (12)	0.063
	Less than primary school	1 (9.1)	0 (0.0)	0 (0.0)	1(1.9)		
	Primary school completed	0(0.0)	0 (0.0)	6 (5.3)	3 (5.7)		
	Secondary school completed	8 (72.7)	14 (37.8)	56 (49.1)	25 (47.2)		
	College/University completed	2 (18.2)	22 (59.5)	51 (44.7)	22 (41.5		
Marital Status	Never married	1 (9.1)	5 (13.5)	11 (9.7)	1 (1.9)	30.895 (12)	0.002*
	Currently married	5 (45.5)	27 (73.0)	87 (76.3)	46 (86.8)		
	Separated	0 (0.0)	1 (2.7)	4 93.5)	0 (0.0)		
	Widowed	1 (9.1)	2 (5.4)	4 (3.5)	6 (11.3)		
	Cohabitating	4 (36.4)	2 (5.4)	8 (7.0)	0 (0.0)		
Household monthly Earnings	≤ 10,000	0 (0.0)	2 (5.4)	5 (4.4)	1 (1.9)	34.335 (15)	0.003*
	10,001 - 30,000	7 (63.6)	5 (13.5)	24 (21.1)	3 (5.7)		
	30,001 - 50,000	2 (18.2)	15 (40.5)	30 (26.3)	12 (22.6)		
	50,001 - 70,000	0 (0.0)	7 (18.9)	26 (22.8)	20 (37.7)		
	≥70,001	0 (0.0)	4 (10.8)	19 (16.7)	12 (22.6)		
	Don't Know	2 (18.2)	4 (10.8)	10 (8.8)	5 (9.4)		

Note: patients with hypertension are statistically significant at p-value <0.05

A chi-square test of independence was performed to examine the relationship between socio-demographic factors and hypertension stages. The results showed a statistically significant relationship between hypertension and age (χ^2 = 20.95, p = 0.013), marital status (χ^2 = 30.90, p = 0.002), and household monthly earnings (χ^2 = 34.34, p = 0.003). There was no significant correlation with level of education (χ^2 = 20.23, p = 0.063).

4.5.2 Relationship between Lifestyle Factors and Hypertension

Table 16

Relationship between Fruit and Vegetable Servings and Hypertension among Study Participants

Variable		Stages of hypertension					
		Normal blood pressure	Elevated blood pressure	Stage 1 hypertension	Stage 2 hypertension		
		n %	N %	N %	N %	X^2 (df)	p-value
Average daily fruit servings	1	2 (33.3)	5 (21.7)	7 (8.5)	4 (8.5)	14.928 (12)	0.245
	2	2 (33.3)	6 (26.1)	31 (37.8)	12 (25.5)		
	3	1 (16.7)	6 (26.1)	29 (35.4)	21 (44.7)		
	4	1 (16.7)	6 (26.1)	9 (11.0)	6 (12.8)		
	5	0(0.0)	0 (0.0)	6 (7.3)	4 (8.5)		
Average daily vegetable servings	1	0 (0.0)	1 (5.0)	0 (0.0)	0 (0.0)	37.203 (12)	0.000*
	2	2(100.0)	3 (15.0)	9 (12.0)	2 (4.4)		
	3	0 (0.0)	7 (35.0)	15 (20.0)	6 (13.3)		
	4	0 (0.0)	7 (35.0)	36 (48.0)	17 (37.8)		
	5	0 (0.0)	2 (10.0)	15 (20.0)	20 (44.4)		

*Statistically significant at p-value <0.05

Table 16 findings show no significant relationship between the number of daily fruit servings and hypertension stage (χ^2 = 14.93, p = 0.245). However, an important relationship was identified for daily vegetable servings (χ^2 = 37.20, p < .001).

Table 17

Relationship between Salt-Related Dietary Practices and Hypertension among Study Participants

Variable	Category	Stages of hypertension: Normal blood pressure n(%)	Elevated blood pressure n(%)	Stage 1 hypertension n (%)	Stage 2 hypertension n (%)	X^2 (df)	p-value
Frequency of Adding Salt to Food	Always	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.9)	26.023 (12)	0.011*
	Often	0 (0.0)	4 (10.8)	18 (15.8)	4 (7.6)		
	Sometimes	8 (72.7)	29 (78.4)	69 (60.5)	23 (43.4)		
	Rarely	3 (27.3)	4 (10.8)	23 (20.2)	24 (45.3)		
	Never	0 (0.0)	0 (0.0)	4 (3.5)	1 (1.9)		
Limiting Processed Food Consumption	No	6 (54.6)	10 (27.0)	33 (29.0)	4 (7.6)	14.885 (3)	0.002*
	Yes	5 (45.5)	27 (73.0)	81 (71.1)	49 (92.5)		
Checking Sodium Content on Food Labels	No	11 (100.0)	37 (100.0)	111 (97.4)	48 (90.6)	7.061 (3)	0.070
	Yes	0 (0.0)	0 (0.0)	3 (2.6)	5 (9.4)		
Buys low salt/sodium alternatives	No	11 (100.0)	35 (94.6)	109 (95.6)	44 (83.0)	9.655 (3)	0.022*,
	Yes	0 (0.0)	2 (5.4)	5 (4.4)	9 (17.0)		
Use of Non-Salt Spices in Cooking	No	10 (90.9)	21 (56.8)	68 (59.7)	23 (43.4)	9.47 (3)	0.024*
	Yes	1 (9.1)	16 (43.2)	46 (40.4)	30 (56.6)		
Avoidance of Foods Prepared Outside the Home	No	10 (90.9)	25 (67.6)	63 (55.3)	15 (28.3)	22.672 (3)	0.000*
	Yes	1 (9.1)	12 (32.4)	51 (44.7)	38 (71.7)		
Other Salt-Reduction Practices	No	10 (90.9)	32 (86.5)	90 (79.0)	28 (52.8)	18.605(3)	0.000*
	Yes	1 (9.1)	5 (13.5)	24 (21.1)	25 (47.2)		

*Statistically significant at p-value <0.05

The results indicate that several practices were significantly related to hypertension status. The frequency of adding salt or salty sauce to food (χ^2=26.023, p=0.011), limiting the consumption of processed food (χ^2=14.885, p=0.002), buying low-salt alternatives (χ^2=9.655, p=0.022), using spices other than salt during cooking (χ^2=9.47, p=0.024), avoiding foods prepared outside the home (χ^2=22.672, p<0.001), and taking other actions to reduce salt intake (χ^2=18.605, p<0.001) was significantly related to hypertension. In contrast, checking food labels for salt or sodium content was not statistically associated with hypertension (p=0.070).

Table 18

Relationship between Physical Activity and Hypertension among Study Participants

Variables		Stages of hypertension					
		Normal blood pressure	Elevated blood pressure	Stage 1 hypertension	Stage 2 hypertension		
		n (%)	n (%)	n (%)	n (%)	X^2 df	p-value
Work involves vigorous-intensity activity for at least 10 minutes	No	7 (63.6)	32 (86.5)	104 (91.2)	53 (100.0)	16.488 (3)	0.001*
	Yes	4 (36.4)	5 (13.5)	10 (8.8)	0 (0.0)		
Walking or cycling continuously for at least 10 minutes to travel to and from places	No	3 (27.3)	19 (51.4)	57 (50.0)	16 (30.2)	7.819 (3)	0.050*
	Yes	8 (72.7)	18 (48.7)	57 (50.0)	37 (69.8)		

*Statistically significant at p-value <0.05

Table 18 shows a significant relationship between hypertension and engagement in vigorous-intensity work for at least 10 minutes (χ^2 = 16.488, p = 0.001) and walking or cycling continuously for at least 10 minutes for travel purposes (χ^2 = 7.819, p = 0.050).

4.5.3 Nutrition Status and Hypertension

Table 19

Relationship between Body Mass Index (BMI) and Hypertension among Study Participants

Variables		Stages of hypertension					
		Normal blood pressure	Elevated blood pressure	Stage 1 hypertension	Stage 2 hypertension		
		n (%)	n (%)	n (%)	n (%)	X^2 (df)	p-value
BMI	Underweight	0 (0.0)	1 (3.1)	1 (0.9)	1 (2.0)	38.140 (15)	0.001*
	Healthy weight	4 (36.4)	7 (21.9)	15 (14.2)	9 (18.0)		
	Overweight	7 (63.6)	24 (75.0)	46 (43.4)	15 (30.0)		
	Class I obesity	0 (0.0)	0 (0.0)	37 (34.9)	17 (34.0)		
	Class II obesity	0 (0.0)	0 (0.0)	7 (6.6)	7 (14.0)		
	Class III obesity	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.0)		

*Statistically significant at p-value <0.05

The findings in Table 19 indicate a significant relationship between BMI and hypertension ($\chi^2 = 38.140$, $p = 0.001$).

4.5.4 Risk Factors Associated with Hypertension

Table 20

Factors Associated with Hypertension

Variable	Category	COR (95% CI)	p-value	AOR (95% CI)	p-value
Age	<35	Ref	–	–	–
	Age 35–44	1.42 (0.74–2.72)	0.287	1.21 (0.59–2.47)	0.596
	Age 45–54	2.95 (1.45–6.02)	0.003patients with hypertension	2.67 (1.19–6.00)	0.017*
	Age ≥55	4.15 (1.89–9.13)	<0.001patients with hypertension	3.78 (1.59–8.99)	0.003*
Gender:	Female	Ref	–	–	–
	Male	1.33 (0.74–2.37)	0.340	1.29 (0.68–2.45)	0.434
Employment	Government employee	Ref	–	–	–
	Non-government employee	0.51 (0.25–1.05)	0.067	1.06 (0.36–3.08)	0.922
	Self-employed	1.19 (0.67–2.12)	0.550	1.67 (0.64–4.39)	0.295
	Homemaker	2.78 (0.85–9.09)	0.091	3.47 (0.77–15.58)	0.104
	Retired	6.48 (2.01–20.91)	0.002patients with hypertension	3.26 (0.69–15.32)	0.135
	Unemployed (able to work)	0.44 (0.14–1.35)	0.151	0.80 (0.18–3.55)	0.772
Alcohol use:	No	*Ref*	–	–	–
	Yes	3.25 (1.55–6.83)	0.002patients with hypertension	2.91 (1.32–6.44)	0.008*
Smoking	No	*Ref*	–	–	–
	Yes	2.89 (1.38–6.06)	0.005patients with hypertension	2.67 (1.18–6.03)	0.019*
Vigorous Physical Activity	<3 days/week	*Ref*	–	–	–
	≥3 days/week	0.82 (0.45–1.48)	0.509	0.91 (0.47–1.76)	0.789
Moderate Physical Activity	<3 days/week	*Ref*	–	–	–
	≥3 days/week	0.92 (0.50–1.70)	0.788	1.03 (0.53–2.01)	0.927
Other chronic condition	No	*Ref*	–	–	–
	Yes	2.42 (1.18–4.96)	0.016patients with hypertension	2.35 (1.07–5.16)	0.034*
Average daily fruit servings	1 serving	*Ref*	–	-	–
	2–3 servings	1.89 (0.89–3.99)	0.095	1.76 (0.82–3.80)	0.144

Variable	Category	COR (95% CI)	p-value	AOR (95% CI)	p-value
	4–5 servings	2.55 (1.08–6.00)	0.033patients with hypertension	2.41 (1.02–5.70)	0.045*
Average daily vegetable servings	1–2 servings	1.00 (Ref)	–	1.00 (Ref)	–
	3 servings	2.01 (0.87–4.63)	0.103	1.88 (0.80–4.41)	0.143
	4–5 servings	3.45 (1.37–8.70)	0.009patients with hypertension	3.12 (1.20–8.08)	0.020*
BMI:	Healthy weight	Ref	–	–	–
	Underweight	0.92 (0.25–3.34)	0.902	0.95 (0.25–3.55)	0.939
	Overweight	2.14 (1.11–4.12)	0.023patients with hypertension	2.01 (1.02–3.97)	0.044*
	Class I obesity	3.26 (1.54–6.91)	0.002patients with hypertension	3.05 (1.39–6.70)	0.005*
	Class II obesity	4.18 (1.40–12.49)	0.011patients with hypertension	3.99 (1.28–12.45)	0.017*
	Class III obesity (severe obesity)	6.25 (0.38–102.5)	0.198	5.89 (0.35–99.3)	0.217
Waist circumference	Not at risk of chronic disease	Ref	–	–	–
	Increased risk of chronic disease	2.42 (1.18–4.96)	0.016patients with hypertension	2.21 (1.01–4.83)	0.048*
	Greatly increased risk of chronic disease	3.88 (2.01–7.49)	<0.001patients with hypertension	3.55 (1.78–7.07)	<0.001*

Note: *Statistically significant at p-value <0.05; COR = Crude Odds Ratio; AOR = Adjusted Odds Ratio; Ref = reference category; CI = confidence interval.

Table 20 presents the results of the multivariable logistic regression analysis conducted to determine independent predictors of hypertension among the study participants. The model adjusted for potential confounders, including age, gender, employment status, physical activity level, alcohol use, smoking status, body mass index (BMI), waist circumference, presence of other chronic conditions, and daily intake of fruits and vegetables. These variables were selected based on their known association with both hypertension and lifestyle exposures reported in prior literature.

After adjustment, several factors were significantly associated with hypertension. Participants aged 45–54 years were 2.67 times more likely (AOR = 2.67; 95% CI: 1.19–6.00; $p = 0.017$), and those aged 55 years and above were nearly four times more likely (AOR = 3.78; 95% CI: 1.59–8.99; $p = 0.003$) to have hypertension compared to those under 35 years of age. Alcohol users were almost three times more likely (AOR = 2.91; 95% CI: 1.32–6.44; $p = 0.008$), and smokers were more than twice as likely (AOR = 2.67; 95% CI: 1.18–6.03; $p = 0.019$) to be hypertensive.

The odds of being hypertensive were also doubled by the presence of other chronic conditions (AOR = 2.35; 95% CI: 1.07–5.16; $p = 0.034$). Compared to participants with a healthy weight, those who were overweight were twice as likely to have hypertension (AOR = 2.01; 95% CI: 1.02–3.97; $p = 0.044$), while participants with Class I and Class II obesity were three to four times more likely (AOR = 3.05; 95% CI: 1.39–6.70; $p = 0.005$ and AOR = 3.99; 95% CI: 1.28–12.45; $p = 0.017$, respectively). A significantly increased waist circumference was also a strong predictor (AOR = 3.55; 95% CI: 1.78–7.07; $p < 0.001$).

Interestingly, participants who reported consuming 4–5 servings of fruits or vegetables per day had significantly higher odds of hypertension, more than twice as likely (AOR = 2.41; 95% CI: 1.02–5.70; $p = 0.045$) and three times more likely (AOR = 3.12; 95% CI: 1.20–8.08; $p = 0.020$), respectively. However, gender, employment status, and physical activity level were not found to be statistically significant predictors in the adjusted model.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

The study focused on risk factors for hypertension among patients attending Nakuru Teaching and Referral Hospital. It focused on socioeconomic and sociodemographic characteristics, nutrition status, and identified risk factors for hypertension.

5.2 Socioeconomic and Demographic Characteristics

This study found that most participants were women, mainly middle-aged (30–49 years)**,** with at least secondary education**,** married, and either formally or informally employed. These patterns have important implications for how hypertension is detected and managed in Nakuru County.

More than half of the respondents were female (54.0%)**,** which is consistent with other facility-based studies in sub-Saharan Africa that have reported a higher proportion of women among clinic attendees with hypertension (Gebreyohannes et al., 2019; Obeng, 2023; Obi et al., 2025). This likely reflects the fact that women tend to have better health-seeking behavior than men (Geldsetzer et al., 2019). In contrast, community-based surveys in Kenya and neighbouring countries often show a higher prevalence of undiagnosed and untreated hypertension among men (Mohamed et al., 2018a; Lutambi et al., 2025; Kato et al., 2023). This suggests that our clinic-based sample may underrepresent hypertensive men and highlights a critical gap in engaging men in screening, diagnosis, and long-term follow-up, increasing their risk of silent complications such as stroke and heart failure.

The study also showed that 63.7% of participants were middle-aged (30–49 years)**.** This supports the observation that the burden of non-communicable diseases, including hypertension, is increasingly affecting younger, working-age adults in sub-Saharan Africa, driven by rapid urbanization, dietary change, and sedentary lifestyles (Zhou et al., 2021; Obeng, 2023). Working-age adults face multiple psychosocial pressures that can elevate blood pressure beyond the effects of biological and lifestyle factors alone. Chronic stress arising from work demands, financial strain, and family responsibilities has been linked to increased sympathetic activity, hormonal dysregulation, and sustained blood pressure elevation **(**Spruill, 2010; Landsbergis et al., 2013**).** Evidence shows that job strain and low workplace control significantly increase the risk of hypertension, particularly among adults aged 25–55 years, who are often balancing employment and household responsibilities **(**Nyberg et al., 2015; Kivimäki et al., 2012**).**

Research also demonstrates that financial stress and economic pressure contribute to higher hypertension prevalence and poorer blood pressure control in younger and middle-aged adults **(**Hicken et al., 2014**).** This shift challenges the traditional view of hypertension as primarily a disease of old age. The growing burden among economically active adults raises concern about the broader economic and productivity losses associated with early morbidity and premature hypertension-related deaths **(**Bloom et al., 2011**).**

Most respondents (about 90%) had at least secondary or higher education. This may indicate that people with more education are more likely to be diagnosed, possibly because they have better health literacy and greater awareness of when and where to seek care. Similar patterns have been reported in other sub-Saharan African studies (Gafane-Matemane et al., 2025; Gatimu & John, 2020). Those with little or no education may be underrepresented in clinic-based studies due to cost barriers, lack of awareness, or difficulty understanding health information, leading to delayed diagnosis until complications occur (Baah, 2024). In contrast, high-income countries with universal health coverage and systematic screening tend to show fewer disparities in hypertension diagnosis by education level (Mackenbach et al., 2018).

Marriage was also common among participants, with 76.7% being married. This finding aligns with reports that people living with chronic illnesses often have partners who encourage clinic attendance and treatment adherence through social and emotional support. However, this also means that unmarried, separated, or widowed individuals may have less support and may be underrepresented in facility-based samples. Other studies have also shown that marriage can be associated with shared unhealthy behaviours such as poor diet, low physical activity, and exposure to financial and relational stress, which may increase hypertension risk. Therefore, the high proportion of married participants in this study should not be automatically interpreted as a protective factor, but rather as a demographic lens through which to view the epidemic.

Regarding economic status, many participants were employed, either formally or informally, with household incomes in the lower-middle to middle range. About 38.6% were self-employed, a group that may have irregular income and limited health insurance, making them vulnerable to financial strain from lifelong medication and follow-up visits. This aligns with other Kenyan studies showing that informal employment is associated with catastrophic health expenditures and poor adherence to long-term treatment (Ng'ambi et al., 2022; Mulupi et al., 2025). In addition, around 10.7% were unemployed, reinforcing that hypertension affects all socioeconomic groups and is not only a disease of the wealthy. The ongoing cost of managing hypertension in low-income households can force families to make trade-offs between spending on health, food, and other basic needs, contributing to the broader economic burden of NCDs in low-resource settings (Murphy et al., 2020; Gouda et al., 2019).

5.3 Lifestyle Factors for Hypertension

5.3.1 Alcohol Use

The findings indicated that 34.0% of the study participants have ever taken alcohol, which is lower compared to the general population estimates in Kenya, which is often 50%-60% lifetime consumption (Kendagor et al., 2018). This deviation would be expected in a clinical group, which might be because of a sick-quitter effect or successful medical counselling leading to quitting following a diagnosis, as was observed in 30.1% of the participants who ever drank and resigned because of health reasons. Nonetheless, 15.0% of the current alcohol users is alarming. This coincides with a study that was carried out in Ghana among hypertensive clinic patients and reported 18.0% of the patients as active drinkers (Obeng, 2023), but lower than in some of the developed countries. As an example, a survey conducted by the NHANES revealed that over half of the hypertensive patients are taking alcohol at present (Fan et al., 2025). This difference may be attributed to various drinking patterns, in which developed nations show higher prevalence and a propensity toward low rates of heavy, sporadic drinking as compared to selected parts of Africa.

The findings pointed out that the frequency of current drinkers in the study was 5-6 days a week at 9.4% which is appalling and almost equal to harmful use patterns as described by WHO. About 21.9%, indicating that they had to have a morning drink, is a typical symptom of alcohol addiction, and is positively associated with high alcohol tolerance and withdrawal. It is a current trend and a powerful cause of hypertension, as chronic and excessive drinking raises the peripheral vascular resistance and activates the sympathetic nervous system (Cecchini et al., 2024). A meta-analysis conducted by Roerecke et al. (2018) supports this finding. It has been proven that heavy drinking (>30g/day) is a direct predictor of the incidence of hypertension, and no safe levels of alcohol on hypertension exist.

Alcohol and hypertension, on the other hand, are not always consistent, and some studies show that the relationship is more intricate. One of the studies indicated that moderate to low alcohol consumption, particularly red wine use, may be associated with a lower risk of cardiovascular events in contrast to no alcohol consumption (van-de-Luitgaarden et al., 2022). This distinction is significant for perspective. This protective effect is highly controversial and is confounded by lifestyle attributes, which are not observed individually in terms of hypertension prevalence. This tendency cannot be generalized to the behaviors of the study subjects, which are characterized by high-quantity consumption and dependency rather than low-level consumption.

The results indicate that the prevalence rate of individuals drinking in the family is 18.1% which is a sign that alcohol is a social determinant of health. It is associated with the study that indicated alcohol consumption as a predictor of intimate partner violence, reduced household income, and poor medication adhesion as finances are diverted and social support systems are destroyed (Greene, Kane, and Tol, 2017). This creates a self-perpetuating cycle where social effects of alcohol consumption destroy the pillars of proper management of chronic diseases.

5.3.2 Tobacco Use

The results show that 1.9% of the participants in the study are current smokers. Aspects of smoking as a modifiable risk factor of cardiovascular disease in this study do not appear to be apparent compared to other factors. The low prevalence rate of smoking is comparable to the trends in developed countries or other regions of the world where the prevalence of hypertension is present. In fact, the case of Europe and North America has found that the prevalence rate of current smoking in hypertensive patients was 15-25%, which the importance of tobacco as a primary co-morbid risk factor in the respective regions (CDC, 2024; Global Heart, 2025; World Population, 2025; Mills et al., 2020). The difference is even higher relative to certain Asian societies, such as in the WHO Western Pacific region, where the rate of smoking among male adults stands at 44.6% (WHO, 2024), which always manifests itself in the case of hypertension in adults.

Also, these results are in agreement with those that have been done in Sub-Saharan Africa, which have also demonstrated low prevalence of tobacco use in particular demographic groups, namely women. In Kenya, the smoking prevalence in adults is estimated at 11% of adults (men) and less than 2% (women) (WHO, 2021). The low rates of smoking patients in our study (54% of female) and among African women, the low rates of smoking were not surprising. The trend is consistent with the results of a clinical study in the area; one study in Ethiopia has found the smoking prevalence of less than 5 percent among hypertensive patients (Gebreyohannes et al., 2019), another community based survey in Malawi has found low rates of 4.8, 9.0 in men and 1.4 in women, respectively (Ng'ambi et al., 2022). Cultural and religious factors, along with Kenya's stringent tobacco control policies under the WHO Framework Convention on Tobacco Control, may account for the low tobacco use rates (Mohamed et al., 2018b).

Although the prevalence of smoking (current smokers n=4 and former smokers n=13) is low, the results demonstrated that 61.5% of former users were smoking daily on the basis that once they start using tobacco, they will be addicted and dependent. Three-quarters of the current smokers said that they had been advised to quit/avoid smoking, and half of them had attempted to quit smoking in the past year. This indicates that the hospital is actively addressing tobacco use, consistent with best-practice recommendations for NCDs (Bull et al., 2020). However, the lack of absolute numbers is also an indication of an issue, since there may be trouble in providing clinical proficiency and resources to offer clinical smoking cessation. Risks of under-reporting due to the social appeal effect are also crucial since smokers are experiencing stigmatization. Besides this fact, these hospital-based respondents may not be representative of smokers who die before being diagnosed or undergoing treatment of the chronic hypertension or succumb to an acute cardiovascular incident.

5.3.3 Dietary Practices

According to the findings, 6% of the participants consumed 5 or more servings of fruit per day, which is shocking and a modifiable risk factor in the management of blood pressure. This inadequate intake of fruits is everyday in Sub-Saharan Africa, where cost, seasonal availability, and the perception of fruits as a luxury rather than a staple are likely limiting factors. A systematic review of dietary habits found that fruit intake is consistently lower than recommended levels, including among individuals with diet-sensitive chronic conditions such as hypertension (Mensah et al., 2021). This trend differs from that in developed countries, where overall availability is better, but it still falls short of the recommendations. For instance, data obtained from the Centers for Disease Control and Prevention (CDC) point out that almost 12% of adults consumed the daily fruit recommendation in the United States, which, though low, is still twice as high as the prevalence of fruit servings among the study participants (Lee-Kwan et al., 2017).

However, the study showed a high intake of vegetables, with 68% of participants consuming 4 or more servings/day. This is an important finding, since non-starchy vegetables are very high in potassium and dietary nitrates, which are key for vasodilation and blood pressure control. This amount is higher than what is reported in studies conducted in similar settings. A community-based study conducted in Uganda reported that three servings/day of vegetables were consumed by less than 20% of adults (Kato et al., 2023), and a national survey done in Kenya reported 60% of the study participants consumed vegetables daily, with data on servings being scarce (Kenya National Bureau of Statistics, 2019). The high intake of vegetables (servings/day) by the study participants may be due to traditional leafy vegetables being cheap and widely consumed in the region, and, secondly, to patients with hypertension receiving dietary counselling to increase vegetable intake.

The 5-a-day recommendation, which is usually encouraged globally, can be both idealistic and unaffordable for many individuals in low-income settings. The high cost of fruits is one of the barriers. A study conducted in Kenya on the economic accessibility of healthy diets found that a diet based on WHO guidelines was unaffordable for a significant proportion of the population, with fruits contributing substantially to the cost (Willett et al., 2019). This suggests that low fruit intake (servings/day) is not a choice but rather a consequence of economic constraints. Moreover, some participants may be inclined to over-report socially desirable behaviours, such as vegetable intake.

Findings show that cereals, dairy, and fats were consumed daily by 27.7%, 89.3%, and 63.2% of the study participants, respectively. The daily intake of oils and fats is one of the primary concerns as it is the direct cause of increased dietary energy content, which enables weight gain and dyslipidemia, which are significant predictors of hypertension and resistance to treatment. The change in nutritional habits toward high-fat and refined carbohydrates in urban and peri-urban settings in Sub-Saharan Africa, driven by urbanization, food marketing, and lifestyle changes (Haggblade et al., 2016). The high intake of milk, although reflective of pastoral activity in the Nakuru region, is a valuable source of calcium and protein; excessive consumption of full-fat dairy products also leads to an increase in saturated fat intake, which is directly associated with adverse cardiovascular outcomes (Taormina, Unger, & Kraft, 2024).

The most critical result is the difference between the intake of vegetables and fruits. While 20.5% of participants reported daily vegetable intake, only 1.2% reported daily fruit intake. Fruits were more often consumed seasonally (39.2%), a trend that underscores their status as non-staple foods, which are significantly limited by cost, supply, and perceptions as optional foods. Such a fruit-vegetable divide is a consistent feature in Sub-Saharan Africa, with vegetables such as sukuma wiki being part of the diet. At the same time, fruits are seen as luxury items or occasional snacks (Mensah, 2021). However, this trend is in contrast with global dietary guidelines, including the WHO recommendations and EAT-Lancet Commission, which stresses daily consumption of fruits as a source of potassium, polyphenols, fiber, and antioxidants, which are key in endothelial functioning and blood pressure regulation (Willett et al., 2019; Jankovic et al., 2015). The low daily intake of fruit by the study participants is a significant overlooked chance of non-pharmacological management of hypertension.

The consumption trend of protein sources indicates a practical balance among cost, cultural preferences, and nutritional benefits. Occasional intake of meat and poultry (36.5% of participants consume it once a month) underscores economic constraints. This is, however, compensated for nutritionally by the high intake of pulses/legumes and fish (40.1% and 31.9%, respectively, consumed twice a week), which is favourable for cardiovascular health. Legumes are linked to better blood pressure control because they contain fiber, magnesium, and potassium, while fish contains omega-3 fatty acids, which have anti-inflammatory and vasodilatory effects (Schwingshackl et al., 2017). These align with the Dietary Approaches to Stop Hypertension (DASH) diet, which highlights this as the primary source of protein (Pilla et al., 2025). Additionally, 22.7% and 40.8%

of participants do not or seasonally consume sweets and sugar, respectively, which is a positive sign because high intake is an independent risk factor for hypertension and cardiometabolic disease through insulin resistance and uric acid-elevating pathways (Janzi et al., 2025).

Inadequate energy intake, with a mean of 1,890 ± 510 kcal and 1,720 ± 480 kcal for men and women, respectively. This caloric deficit contrasts with the high prevalence of overweight and obesity (80.8%) reported in the study population. This contrast is an indicator of dietary under-reporting, a limitation of the self-reported dietary assessment method (Archer, Marlow & Lavie, 2018). A study using doubly labeled water reported that individuals, particularly obese individuals, underreport their energy intake by 20-50% (Mehranfar et al., 2024). This systematic bias suggests that the proper caloric intake among the study participants is higher than reported, and the probable source of extra energy is high-energy-dense foods through snacking or additional cooking fats and sugars, which are easily forgotten in a 24-hour recall (Batista et al., 2021).

The findings indicate that less than one-third of participants met the RDA of dietary fiber. A mean of 17-20 g/day, which is lower than the 25-38 g/day recommended for cardiovascular metabolic benefit. This insufficiency is a statistical outcome, but a key changeable risk factor for hypertension. The cardioprotective effect of dietary fiber is well established through various mechanisms. Fiber gives satiety and delays gastric emptying, aiding in weight management- an essential aspect of blood pressure control (Reynolds et al., 2020). Gut microbiota metabolizes fermentable fiber to short-chain fatty acids (SCFA). Animal and human studies show that SCFA are signaling molecules that bind to receptors in the kidneys and blood vessels, regulating renin secretion and enhancing vasodilation, thus lowering blood pressure (Nogal, Valdes, & Menni, 2021; Li & Zhang, 2023). The low fiber intake among the study participants deprives patients of antihypertensive effects and instead contributes to a gut environment that may further worsen inflammation and hypertension.

Inadequate intake of protein and carbohydrates leads to a diet low in both quality and quantity. Although the correlation between total protein and blood pressure is nonlinear, the suboptimal intake is probably due to the lack of lean protein foods and plant-based proteins (e.g., pulses, legumes), which are also the constituents of the evidence-based DASH (Dietary Approaches to Stop Hypertension) diet (Pilla et al., 2015). Equally, inadequate carbohydrate intake may be due to a lack of whole grains and worsening fiber deficiency. It may indicate a diet lacking essential micronutrients such as magnesium and potassium, which are key to vascular health. The general trend is toward a poor-quality diet, which does not provide the substrates needed to sustain endothelial function and vascular tone.

Another key result is the high sodium consumption (mean 2,310 mg for males, 2,220 mg for females), exceeding the recommended 2,000 mg/day and placing one-third of participants within the safe range. This is a primary risk factor for hypertension because excessive intake causes fluid retention and peripheral vascular resistance. This is in line with the global trend; a systematic review of sodium intake estimated the average intake to be well above the WHO recommendation, which is influenced by significant consumption of commercial salt, salty condiments, and processed foods (Yang et al., 2024). To add to this, sodium excess is accompanied by a drastic reduction in potassium intake, with fewer than 20% of participants meeting the recommended 3,510 mg/day. An elevated sodium-to-potassium ratio is a stronger predictor of hypertension and cardiovascular issues than either alone; potassium is vital for vasodilation and counteracting the effects of sodium (Jackson et al., 2018).

Findings also show inadequate intake of other key minerals for vascular and blood pressure control, such as magnesium (≤31.3% adequacy) and calcium (≤24.1% adequacy). These minerals are responsible for the contraction of vascular smooth muscle and the function of endothelial cells by serving as cofactors in enzyme reactions. The deficiency has been associated with augmented vascular resistance and hypertension in different populations (DiNicolantonio, O'Keefe, & Wilson, 2018). The low intake of Vitamin D (≤6.1% adequacy) is a key finding, as current evidence continues to associate Vitamin D deficiency with activation of the renin-angiotensin-aldosterone system (RAAS) and consequent increases in blood pressure (Jiang et al., 2024). Inadequate Vitamin C and folate intake also indicates a lack of nutritional variety and an insufficiency of fruits and vegetables rich in antioxidants, exposing individuals to the risk of oxidative stress, a known cause of endothelial dysfunction.

5.3.4 Salt Intake

The findings on salt-related behaviors and perceptions among participants reveal a critical, widely perceived disconnect: a high level of theoretical knowledge does not translate into stable, protective behaviors, particularly at the household level. This discrepancy between cognition and behavior significantly hinders the effective management of hypertension and is the target of various approaches in managing NCDs worldwide (Kehinde, 2022).

Results indicated that 95.4% of respondents recognized the health risks of excessive salt intake, and 71.2% considered the reduction very important. This aligns with a study in Ethiopia, which found that a high level of awareness of the adverse effects of salt did not correspond to reduced intake (Girma et al., 2025). Such a high level of understanding may be indicative of effective national health promotion campaigns, but it also points to their weakness in altering ingrained behaviors. 76.3% of the study participants always or often add salt to food during cooking. This points to the cultural and taste preference for salty food as significant factors capable of transcending health knowledge (Santos et al., 2019). Acquisition of a salt taste preference is a lifelong habit that is hard to change and thus requires active, ongoing behavioral interventions (Bawajeeh et al., 2020).

In addition, 81.9% of the respondents reported consuming an adequate amount of salt, whereas the 24-hour recall reports otherwise. The impression of personal adequacy is common and a significant barrier to behavior change worldwide; individuals who do not perceive their own behavior as problematic are not encouraged to change it (Bhana, Utter, & Eyles, 2018). This indicates a lack of personal internalization of general health messages, which is giving many patients a false sense of security.

Further, the findings show that 3.7% of participants read food labels to assess salt/sodium content, and 7.4% purchased low-sodium alternatives, indicating a significant gap in patient empowerment. This inadequate use of food labels is also a widespread problem in both high- and low-income countries. Yet, it is particularly prominent in countries with low nutrition literacy and where packaging warning labels are not mandatory (Trijsburg et al., 2021). Additionally, 43.3% and 74.4% of the study participants used non-salt spices for flavor and did not engage in other specific actions, respectively, indicating a lack of practical cooking skills and alternatives. A study reported that explaining to patients the use of more herbs and spices is unproductive without demonstration and practice (Hasan et al., 2019).

5.3.5 Physical Activity

The results indicated that 8.8% and 39.5% of the participants engaged in vigorous-intensity activity or moderate-intensity activity, respectively, and participated for extended periods, with a mean of approximately 4.3 hours/day. This trend of occupational physical activity (OPA) is common in most low- and middle-income countries (LMICs), as their economies are still primarily based on agriculture and manual labor (Bucciarelli et al., 2023). Similarly, more than half of the participants (55.8%) engaged in active transport (walking or cycling) with a mean of 46 minutes a day. This is a high level of active transport compared with levels in high-income countries, and it is a strong source of habitual activity (Ding et al., 2016). But the health consequences of OPA are complicated. Even though it plays a role in energy expenditure, other studies have reported a physical activity inconsistency in which high levels of OPA are occasionally linked to greater rather than less cardiovascular risk, possibly because high levels of OPA are deemed more lengthy, static, and sometimes stressful relative to dynamic leisure-time physical activity (Coenen et al., 2020).

In contrast, 10.7% and 19.1% of study participants engaged in vigorous or moderate-intensity recreational activities, respectively. This indicates a strict division between activities performed solely because of need and those done for health, suggesting that leisure time is not generally seen as an opportunity to engage in structured activity. This is a significant problem, as LTPA has been associated with reduced hypertension and cardiovascular mortality rates, is voluntary, allows for controlled intensity, and enhances cardiorespiratory fitness (Cheng et al., 2018). This LTPA deficiency in Sub-Saharan Africa is widespread across activity-based reports worldwide, and it is suggested that insufficient recreational activity contributes significantly to the overall burden of physical inactivity in the region (Bucciarelli et al., 2023).

Furthermore, findings that participants spent an average of more than three hours per day sitting or in a recumbent position worsen the already low levels of intentional exercise. This is particularly true given that excessive sedentary time is associated with poor cardiovascular health and all-cause mortality, even among those who adhere to moderate-to-vigorous physical activity guidelines (Ekelund et al., 2019). Low LTPA and high sedentary time contribute to a metabolic dual burden that may aggravate hypertension in the study population.

Findings also show that 82.0%, 87.6% and 88.8% of participants were advised to start or engage more in physical activity, reduce salt intake and reduce weight respectively, clearly indicating that the health care providers at the health facility actively incorporates the role of lifestyle modification in the practice, which is consistent with Kenyan and WHO NCD management guidelines (Mbau et al., 2021). Yet, there may be a severe discrepancy in the quality of such advice. General advice like 'do more activity' is less effective than targeted, more precise, and practical counselling, such as providing a written set of instructions on frequency, intensity, time, and type (FITT principle) of physical activity (Kettle et al., 2022). The low LTPA even after high rates of counseling indicates that patients might not be knowledgeable, resourceful, motivated, or socially supported to put this general instruction into a sustainable action.

5.3.6 Nutrition Status

Interestingly, 80.8% of the participants were found to be overweight (46.2%) or obese (34.6%), which is significantly higher than the estimates in the country. In comparison, the Kenya STEPwise survey for NCDs reported prevalences of 27% in men and 52% in women aged 18-69 years, with higher prevalence in urban areas (Mbau et al., 2021). The high rate among the study participants indicates that excess weight is a problem that disproportionately affects those with high blood pressure, and is in synergy with other diseases. This correlates with the general pathophysiology of the disease, in which obesity facilitates hypertension through volume overload from sodium retention, hyperactivity of the sympathetic nervous system, and insulin resistance, leading to endothelial dysfunction (Hall et al., 2015). The fact that Class I (27.1%) and Class II/III (7.5%) obesity are the most prevalent, in turn, is alarming since these groups are characterized by a higher risk of cardiovascular mortality as well as resistance to antihypertensive treatment (Bhaskaran et al., 2018).

Findings on waist circumference reveal yet another dismal metabolic risk profile than BMI. 70.2% of the study participants had waist circumferences that denoted a risk of chronic disease. Such a high incidence of central obesity is significant because visceral adipose tissue is a highly active endocrine gland that releases pro-inflammatory cytokines and free fatty acids, which directly affect vascular inflammation, oxidative stress, and the formation of atherosclerotic plaques (Neeland et al., 2019). The average waist circumference of 92 cm is significantly higher than the action thresholds set by the International Diabetes Federation for sub-Saharan Africa (≥94 cm in men, ≥80 cm in women) (Ekoru et al., 2018). This shows that visceral adiposity is a more powerful predictor of hypertension and cardiovascular events than overall obesity across various ethnic groups (Ross et al., 2020).

These findings should be interpreted as an effect of the obesogenic environment in the past sections. A high daily intake of oils and fats, combined with a low intake of fruits and vegetables, results in an energy-dense, nutrient-poor diet. This dietary pattern, combined with the high levels of sedentary behavior and minimal leisure-time physical activity observed in this study's participants, creates a conducive environment for positive energy balance and the deposition of fat in the abdominal area. The apparent contradiction between high obesity and reportedly inefficient caloric intake is a classic characteristic of dietary self-reporting, with a bias toward under-reporting energy intake, especially snacks and foods with high energy density, which is common among obese individuals (Subar et al., 2015).

5.4 Blood Pressure Status

The findings indicate a prevalence of hypertension stages 1 and 2 of 76.3%, showing an overwhelming burden of NCDs in this clinical setting. The study was conducted in a hospital setting, capturing the sicker population that seeks treatment and does not reflect the prevalence in the general population. However, this percentage highlights the huge burden the management of hypertension has on the Kenyan healthcare system.

Results according to Table 2 indicate that more than half (52.6%) of the participants had stage I hypertension. These results are in agreement with global statistics from the Lancet Commission on hypertension that emphasize that there is a considerable population of people with an early stage of hypertension globally, which creates a vital intervention opportunity before progressing to more complex and severe illness (WHO, 2023). The overall prevalence of 76.3% is significantly higher than in developed countries. For instance, according to the National Health and Nutrition Examination Survey (NHANES) in the United States, the prevalence of hypertension, stages 1 and 2, is approximately 45-50%, significantly lower than in other countries (Ostchega et al., 2020). This discrepancy indicates a higher burden of clinically manifested illness in this setting and possible variations in risk factors at the community level, in screening, and in the stage at which patients seek health care.

The prevalence of hypertension in the study was on the higher end at 76.3%, though consistent with studies done in Ghana and Ethiopia that reported hypertension prevalence of 71% and 68% among adult outpatients, respectively (Obeng, 2023; Gebreyohannes et al., 2019). The marginally higher prevalence in this study could be explained by regional differences in risk factors or by differences in the pathways patients take to referral centers such as Nakuru County Teaching and Referral Hospital.

Another key finding from the study was the slight difference in hypertension prevalence between males and females. The prevalence of stage 2 hypertension among males and females, 24.2% and 23.3%, respectively, was almost equal, which further defies the historical pattern of male predispositions to cardiovascular risk. According to the WHO (2023), women are increasingly burdened with the disease due to risk factors associated with their lifestyles and increased life expectancy, hence a reduction in the gender gap prevalence of hypertension globally. Community-based surveys conducted in Kenya and Tanzania reported a higher prevalence of undiagnosed and untreated hypertension among men; this could explain why hospital-based participants in this study were equal, suggesting higher health-seeking behavior among women and thus a greater likelihood of being diagnosed and captured in clinical studies. (Mochamah et al., 2021; Lutambi et al., 2025).

5.3 Risk Factors Associated with Hypertension

In this study, age was the most consistent predictor of hypertension. In the stage-specific analysis, the proportion of patients with stage 1 or stage 2 hypertension increased progressively from the 30- to 49-year group to the 50- to 64-year and ≥66-year groups ($\chi^2 = 20.953$, $p = 0.013$). In the adjusted regression model, the odds of hypertension were 2.67 (95% CI: 1.19–6.00) for participants aged 45 to 54 years and 3.78 (95% CI: 1.59–8.99) for those aged ≥55 years relative to individuals younger than 35 years. This graded association is biologically plausible, as vascular remodeling, arterial stiffening, endothelial dysfunction, and diminished baroreceptor sensitivity that accompany aging elevate systemic vascular resistance and predispose to hypertension (Castelli et al., 2023;

Sun, 2015). Cumulative exposure to behavioral and metabolic risk factors, including excessive dietary sodium intake, adiposity, physical inactivity, and alcohol consumption, tends to intensify with advancing age, thereby magnifying susceptibility to hypertension (Zhang et al., 2023).

The present findings are consistent with previous evidence from Kenya and other sub-Saharan African settings. For instance, Olack et al. (2015) found that in Kenya, adults aged ≥50 years had almost a fourfold increased likelihood of hypertension compared to those below 30 years. Likewise, the Kenya STEPwise Survey by Mwangi et al. (2020) found that age was the strongest determinant of hypertension, with prevalence increasing after age 40. Similar trends have been reported elsewhere in the region: Mohamed (2021) in Ghana recorded that hypertension prevalence doubled between the 35- 44 and ≥55-year categories, while studies conducted in Nigeria and South Africa have consistently shown exponential increases in hypertension with age (Adeloye et al., 2015; Osunkwo et al., 2020). These findings are consistent with global evidence from the Framingham Heart Study, which indicated that the lifetime risk of developing hypertension exceeds 90% among those who reach middle age (Vasan et al., 2022).

From a population health perspective, these results reinforce the conceptual framework of the epidemiological transition in sub-Saharan Africa, where the burden of disease is shifting from infectious to chronic non-communicable conditions. Increasingly, mid-to-older adults are bearing the most significant burden of cardio-metabolic diseases (Jones-Jack, 2016). Within the Nakuru context, the predominance of hypertension among adults aged ≥45 years is likely a reflection of urbanization, changing dietary patterns, and lifestyle modifications that accelerate cardiovascular risk accumulation.

Two methodological considerations strengthen the validity of the current findings. First, the age effect remained statistically significant following multivariable adjustment, thereby suggesting independence from potential confounders such as gender and employment status. Second, the observed effect sizes were moderate to large, with confidence intervals that did not cross the null value, thereby reinforcing the robustness of the association. Nevertheless, one methodological limitation concerns the inconsistent categorization of age across analyses: Table 2 utilized 18–29, 30–49, 50–64, and ≥66-year bands, whereas Table 3 employed <35, 35–44, 45–54, and ≥55 years. Although both approaches converge on the same substantive conclusion, using harmonized age categories or, preferably, modeling age as a continuous variable (e.g., using restricted cubic splines) would yield more precise estimates and mitigate the risk of residual misclassification bias. The findings underscore the importance of prioritizing systematic blood pressure screening, counseling, and early intervention among adults aged ≥45 years, with heightened emphasis on those aged ≥55 years. In addition, they highlight the need for age-sensitive preventive strategies that integrate lifestyle modification, regular follow-up, and targeted health promotion within primary and tertiary care settings in Kenya.

Although females constituted a slight majority of the study participants (54%), gender was not a significant independent predictor of hypertension after adjustment (AOR 1.29; 95% CI 0.68–2.45). This finding suggests that, within this clinic-based population, sex-related differences in hypertension prevalence were minimal after accounting for age and employment. Similar null associations have been reported in several studies conducted in sub-Saharan Africa (Adeloye et al., 2015; Opoku et al., 2020), where gender differences in hypertension prevalence often diminish after adjustment for lifestyle factors such as alcohol consumption, diet, and physical activity. However, other studies have reported significant gender effects, with men generally exhibiting higher prevalence and poorer control of hypertension, primarily attributed to higher rates of smoking, alcohol use, and lower health-seeking behavior (Kayima et al., 2017; Ogedegbe et al., 2014).

The clinical setting may partly explain the lack of association in this study, as men in some African contexts tend to underutilize preventive health services and only present when symptomatic, thereby reducing observable differences at the facility level. Hypertension prevention and management strategies in Nakuru should remain gender-inclusive rather than disproportionately targeted to one sex. Nevertheless, interventions should still consider the broader social context, particularly the well-documented barriers to men's health-seeking behaviors, which may delay diagnosis and treatment. A gap remains in understanding how gender interacts with other social determinants, such as occupation and household roles, to influence hypertension risk and care pathways in Kenyan populations.

In the current study, no significant association between hypertension and educational attainment was found, either in bivariate χ^2 tests ($p = 0.063$) or in multivariable analysis. However, the regression coefficients were not fully presented in the results. The absence of association may reflect the high educational attainment in this sample, where 93% of participants have completed at least secondary school. This forms a kind of ceiling that diminishes variability and masks gradients that might otherwise be seen in more heterogeneous populations. In many settings, low levels of education have been associated with increased risk of hypertension because such individuals may have low health literacy, reduced access to health information, and a lesser ability to navigate healthcare systems (Du et al., 2018; Halladay et al., 2017). By contrast, in urbanized African populations, studies report weak or inconsistent associations between education and hypertension, especially when other socioeconomic status factors are in preeminence, such as income and occupation (Nayha, 2018; Sliwa et al., 2016). The apparent lack of significance does not mean that education has no effect; instead, this participant sample was not diverse enough to yield differences in this respect. In the future, studies in Kenya should therefore use more granular measures of education, such as years of schooling or functional literacy, to more validly capture the role of education.

Alcohol use remained an independent predictor of hypertension after adjustment (AOR ≈ 2.9), consistent with biologically plausible mechanisms, such as sympathetic activation, impaired bar reflex function, endothelial injury, and increased caloric intake leading to weight gain. The strength of association, which persists from the crude to the adjusted models, suggests that the effect is not fully explained by confounding factors such as age, sex, or adiposity (Fall et al., 2015; Pfannenberg et al., 2010). Yet two caveats temper causal inferences. First, alcohol was captured as a dichotomy ("Yes/No") rather than dose-response (grams ethanol per week) or pattern (binge vs regular moderate intake), which limits assessment of thresholds and nonlinear risk. Second, social desirability and recall bias may differentially misclassify exposure among diagnosed hypertensives, biasing estimates in either direction (Xie and Wang, 2020). Programmatically, these data support routine alcohol screening (e.g., AUDIT-C), brief interventions, and, where indicated, facilitated referral to treatment embedded in NCD clinics.

Smoking showed a similar independent association, AOR ≈ 2.7. Even with the low current smoking prevalence in larger participants, the observed effect size is compatible with the potent pressor and atherogenic properties of tobacco exposure. Similar to alcohol, the binary exposure likely conceals significant heterogeneity; pack-years, current intensity, and smokeless tobacco use were not captured. Nonetheless, the direction and magnitude are coherent with global evidence. In practice, integrating systematic tobacco-use documentation, quit plans, and pharmacotherapy where available - nicotine replacement/varenicline - into hypertension care pathways is warranted; given the small absolute number of smokers, this would be operationally feasible and high yield at the individual level.

The anthropometric findings are strong and internally coherent. Compared with a healthy weight, overweight doubled the odds of hypertension (AOR ≈ 2.0), class I obesity tripled them (AOR ≈ 3.1), and class II obesity nearly quadrupled them (AOR ≈ 4.0). In parallel, central adiposity, indexed by waist circumference, demonstrated a graded association, with AORs ≈ 2.2 and 3.6 for the "increased" and "greatly increased" risk categories, respectively. These results are biologically compelling: visceral adiposity contributes to insulin resistance, hyperinsulinemia, sympathetic nervous system activation, renin-angiotensin-aldosterone system upregulation, and sodium retention, each of which elevates blood pressure. From an analytic standpoint, waist circumference likely captures risk more proximally than BMI. Because BMI and waist are correlated (Gierach et al., 2014), multicollinearity and overadjustment are concerns if both are included in a single model; the reported table suggests they were modeled separately, which is appropriate for exposition but should be clarified in the methods. Clinically, the data support routine waist measurement and prioritization of weight management (targets of 5-10% loss) as a core element of BP control, coupled with sodium reduction and structured physical activity.

The presence of "other chronic conditions" approximately doubled the odds of hypertension, AOR = 2.35. Two mechanisms may operate concurrently. First, shared risk factors of adiposity, diet, and inactivity link hypertension with diabetes, dyslipidemia, and other metabolic disorders (Bozkurt et al., 2016). Second, surveillance bias inflates associations: those with chronic conditions interact more with the health system and are more likely to have their blood pressure screened and diagnosed as hypertensive (Kim & Radoias, 2018). Distinguishing these requires longitudinal data and, best of all, more granular categorization of comorbidities to separate metabolic from non-metabolic conditions. The practical implication, however, is clear: integrated NCD care, including coordinated BP-glucose-lipid assessment, ASCVD risk estimation, and harmonized pharmacotherapy, is indicated.

In bivariate analyses, vigorous-intensity work was associated with lower hypertension stages ($p = 0.001$), and active transport was marginally associated ($p \approx 0.050$), consistent with the hypothesized protective gradient driven by physiological mechanisms of increased vascular compliance, autonomic balance, and insulin sensitivity. However, these associations require cautious interpretation since occupation type is likely to be correlated with income, age, and diet, and active transport may operate as a proxy for urban form and socioeconomic status; the severity of disease may influence reported behavior, for example, those with stage 2 may self-limit their exertion once they have been diagnosed. Including an adjusted ordinal regression of age, sex, BMI, income, and comorbidities would help clarify independence. From a public health perspective, the fact that leisure-time activity is scarce yet work/transportation activity bears much of the burden argues for built and transport policies that preserve and promote incidental movement, predictable, safe sidewalks, cycling lanes, last-mile connectivity, alongside short, structured activity prescriptions suitable for adults with hypertension. For example, 30-45 minutes of moderate activity most days is tailored to the comorbidity profile.

After adjustment, physical activity proxies showed no significant associations; neither "vigorous ≥3 days/week" nor "moderate ≥3 days/week" reduced odds of hypertension. Several explanations are plausible: the exposure variables are crude, likely misclassifying intensity and volume; they also ignore critical domains (leisure, occupational, and transport) and total weekly metabolic equivalent minutes. Moreover, reverse causation may operate in the opposite direction, with already hypertensive (or multimorbid) individuals reporting increased activity in response to medical advice and thus attenuating actual protective effects. Residual confounding by age, occupation type, and adiposity may obscure associations. Future analyses using continuous activity minutes, domain-specific measures, and sedentary time, ideally corroborated by accelerometry in subparticipants, would provide more accurate estimates. Notwithstanding null associations here, prescribing safe, progressive aerobic and resistance activity is an evidence-based cornerstone of BP management.

Hypertension stage was also statistically associated with several self-reported salt-reduction behaviors, including limiting processed foods (p=0.002), using non-salt spices (p=0.024), and avoiding food prepared outside the home (p<0.001); "other" salt-control actions were also more common among stage 2 participants. This is paradoxical and consistent with treatment confounding: advanced cases are given more intensive counselling, which may change their behaviour after disease progression (Durham, 2018).

Two implications follow. First, awareness is high, but execution is partial, especially for skills such as label reading and substituting low-sodium products, which require availability, price parity, and consumer literacy (Yin et al., 2021). Second, to achieve meaningful reductions in sodium intake, structural measures-vendor product reformulation, mandatory sodium labeling, and procurement standards for public institutions-should complement individual counseling (Ide et al., 2020). In the clinical setting, pragmatic tools such as salt spoons, recipe cards emphasizing spice mixes, and brief training on label reading can bridge the gap between intention and action. For measurement, spot urinary sodium or repeated 24-hour urine collections, while logistically demanding, would strengthen future evaluations of sodium reduction.

Average daily vegetable servings were strongly associated ($p<0.001$). Higher portions ≥ 4–5/day were most common among those with stage 1–2 hypertension. Again, interpretation should emphasize reverse causality: more advanced cases are more likely to have received and acted upon dietary advice. The key epidemiologic lesson is that post-diagnosis behavioral adoption can bias cross-sectional associations between "healthy behaviors" and disease severity (Tollosa et al., 2020; Xiang, 2015). What is needed are longitudinal designs or instruments, such as validated food-frequency questionnaires with time anchors, or even biomarkers, like urinary potassium, which would help disentangle cause from consequence.

The most counterintuitive result was the positive correlation with hypertension of fruit (AOR=2.41, p=0.045) and vegetable intakes (AOR=3.12, p=0.020). Indeed, this does not mean a causal, harmful effect. This is rather a great example of diagnostic bias and behavior change. Hypertensive patients are universally recommended to adopt a healthier diet rich in fruits and vegetables, according to the DASH (Dietary Approaches to Stop Hypertension) diet (Pilla et al., 2021). Hence, more advanced or diagnosed patients are more likely to report higher intake because they have consciously modified their diet under medical guidance. Because of this so-called sick-quitter effect or diagnostic fasting, this is a common confounding factor in cross-sectional nutritional epidemiology (Giovannucci et al., 2022; Hebert et al., 2023). This interpretation is supported by our data, which indicates that patients in higher stages of hypertension are much more likely to have received and followed dietary advice from their healthcare provider.

Third, residual confounding: total energy intake, sodium consumption, and food preparation methods (e.g., vegetables cooked with salted stock, coconut cream, or ghee) were not modeled simultaneously and may offset the expected BP benefits of plant foods. In addition, higher fruit/vegetable intake could proxy for higher overall food security and income, which in this dataset correlated with more advanced hypertension stages in bivariate analyses-again, a likely artifact of care pathways and selection into tertiary services. The analytic implication is to avoid causal interpretation of these diet coefficients; a better approach would be to instrument for pre-diagnosis diet (or use longitudinal diet data), include sodium and total energy as covariates, and consider substitution models (e.g., replace refined grains or processed meats with vegetables).

Two cross-cutting methodological issues are worthy of emphasis: First, temporality exposures and the outcome were measured concurrently. For behaviors that are modifiable in response to diagnosis (diet, activity, salt use), cross-sectional associations are intrinsically vulnerable to reversal of cause and effect. This limits the ability to infer etiologic roles from statistically significant AORs in a treatment-rich environment. Secondly, model specification and reporting-while Table 22 presents adjusted odds ratios, it is unclear which covariates were included in the base model beyond those shown. Age and sex are the most fundamental confounders for virtually all risk factors in hypertension epidemiology (Mills et al., 2020); they should be retained regardless of statistical significance, and their coefficients reported for transparency. Additional good practice would include model fit-e.g., AUROC/C-statistic, calibration-Hosmer-Lemeshow or calibration plots, multicollinearity diagnostics-variance inflation factors, especially for BMI vs waist, and a sensitivity analysis using ordinal logistic regression for hypertension stages rather than a binary outcome.

From a service-delivery perspective, the convergent signals around alcohol, smoking, adiposity, and central obesity point to clear, actionable levers. Embedding brief alcohol/tobacco interventions into routine hypertension care, standardization of weight and waist measurement at every visit, offering structured skills-based counseling (meal planning, salt substitution with spice mixes, label-reading micro-lessons), and supporting adherence through task-shared follow-up (nurse/CHW contacts, synchronized refills, fixed-dose combinations) will form a cohesive package likely to reduce both incidence and progression. Given the high prevalence of multimorbidity, an integrated cardiometabolic clinic model with co-located lipid and glucose testing, ASCVD risk scoring, and statin allocation where indicated would increase efficiency and clinical impact.

At the population level, the paradoxical diet findings should refocus attention on the food environment rather than solely on individual knowledge. Ensuring the availability and affordability of unsalted, minimally processed foods; incentivizing vendors to reduce sodium in prepared dishes; mandating clear front-of-pack labeling; and stabilizing fruit supply across seasons (cold chain, dried/frozen options) are structural measures that align with and amplify clinical advice. Similarly, preserving incidental physical activity through safe walking/cycling infrastructure and workplace movement prompts is likely to be more sustainable for middle-aged adults with multimorbidity than reliance on leisure-time sport alone.

Finally, these results outline several research priorities. Longitudinal follow-up is required to test whether reductions in alcohol consumption, smoking cessation, and sustained weight loss are associated with measurable BP improvement in this setting and to quantify effect sizes under real-world constraints. Objective exposure assessment-urinary sodium/potassium for salt, accelerometry for activity, and standardized 24-hour dietary recalls-reduce misclassification. Analyses that address confounding by indication, such as propensity scores or inverse probability weighting, may help separate treatment-driven behavioral changes from etiologic relationships. The clarification of these pathways would also sharpen both policy and clinical strategies to curb the substantial burden of hypertension evident in this population.

5.5 Conclusions

This study examined sociodemographic, lifestyle, and nutritional factors associated with hypertension among 215 adult outpatients at Nakuru County Teaching and Referral Hospital. The findings show that in this clinic population, hypertension is concentrated among middle-aged adults, particularly those aged 30–49 years, with the strongest independent associations observed in the 45–54 years and ≥55 years age groups. Most participants were women, married, and had at least a secondary education, indicating that hypertension in this setting affects economically active**,** relatively educated adults, rather than being limited to the very old or those with low literacy.

Dietary assessment revealed significant nutritional concerns. Although cereals, fats, and milk were commonly consumed, the daily intake of fruits and vegetables was low, and many participants reported only seasonal consumption of these foods. The 24-hour recall data showed that energy and dietary fibre intake were below recommended levels, while sodium intake exceeded the safe upper limit**.** Several key micronutrients were also inadequate on average, including potassium, calcium, magnesium, zinc, vitamin A, vitamin C, folate, vitamin B_2, and, especially, vitamin D, suggesting that many hypertensive patients may have poor overall diet quality in addition to high salt intake.

Nutritional status and body composition were strongly linked to hypertension. A substantial proportion of participants were overweight or obese, and many had increased or significantly increased waist circumference, indicating central adiposity. In the multivariable model, being overweight or obese, having a vastly increased waist circumference, being aged 45–54 years or 55 years and above**,** using alcohol**,** and having another chronic condition all independently increased the odds of hypertension. Interestingly, participants who reported consuming 4–5 servings of fruits or vegetables per day also had higher odds of hypertension, which is most likely explained by reverse causality, where already diagnosed patients attempt to improve their diet after medical advice. Gender, employment status, and physical activity were not significant independent predictors after adjustment.

In conclusion, among adult outpatients in Nakuru County Teaching and Referral Hospital, hypertension is strongly associated with middle and older age (especially 45 years and above), alcohol and tobacco use, excess body weight, central obesity, coexisting chronic disease, high sodium intake, and multiple micronutrient inadequacies. These findings show the need for context-specific interventions in Nakuru County, including targeted screening of middle-aged working adults, integrated counselling on salt reduction and weight management, and nutrition services that address not only energy balance but also sodium, potassium, calcium, magnesium, vitamin D, and other micronutrient gaps. Strengthening such clinic- and community-based strategies could help reduce the growing burden of hypertension and its complications in Nakuru and similar urbanizing settings in Kenya.

5.6 Recommendations

5.6.1 Recommendations for Study Participants

Based on the findings of this study, several practical recommendations can be made for adults living with, or at risk of, hypertension in Nakuru County:

Improve dietary practices and reduce salt intake

Participants should be encouraged to:

- Reduce the amount of salt added during cooking and avoid routinely adding salt at the table.
- Check the nutrition label for sodium/salt information before purchasing packaged foods.
- Choose products with lower sodium content where possible.
- Use simple rules, such as avoiding products where salt or sodium appears among the first ingredients.
- Increase daily consumption of locally available fruits, vegetables, legumes, and whole grains to help address low intakes of potassium, fibre, calcium, magnesium, zinc, vitamins A and C.

Work towards achieving and maintaining a healthy weight.

Given the strong association between overweight/obesity, increased waist circumference, and hypertension, participants should be advised to:

- Monitor their weight and waist circumference regularly.
- Gradually reduce the portion sizes of energy-dense foods and fried foods.
- Replace refined carbohydrates with whole grains and include more legumes and vegetables in meals.

Reduce alcohol consumption and stop smoking.

As alcohol use and smoking were significant predictors of hypertension, individuals should be supported to:

- Limit or altogether avoid alcohol intake.

- Stop smoking, and where possible, seek assistance through cessation support or counselling services.

Increase Physical Activity

Although physical activity did not emerge as a strong independent predictor in the adjusted model, regular movement remains essential for cardiovascular health. Participants, especially those aged 30–49 years, should be encouraged to:

- Engage in at least 150 minutes of moderate-intensity activity (such as brisk walking or cycling) or 75 minutes of vigorous-intensity activity per week.

5.6.2 Recommendations for Policy and Practice

i. Strengthen community-based hypertension screening programs: The Ministry of Health and county governments should enhance outreach programs targeting early detection and management of hypertension, particularly among adults aged 40 years and above.
ii. Integrate nutrition education into primary healthcare: Hospitals and health centers should include dietary counseling services emphasizing salt reduction, weight management, and healthy lifestyle practices as part of hypertension management protocols.

5.6.3 Recommendations for Further Research

The findings and limitations of this study point to several areas where additional research is needed:

i. Explore the relationship between work-related stress and hypertension

   Future studies should investigate how occupational and psychological stress, particularly among adults aged 30–49 years, contributes to hypertension and poor blood pressure control. Mixed-methods or longitudinal designs could provide deeper insight into how stress, workload, job insecurity, and financial pressures interact with lifestyle factors such as alcohol use, diet, and physical inactivity.

ii. Conduct community-based studies on hypertension and its determinants.

Because this study was facility-based, community studies are needed to:

a. Estimate the true prevalence of hypertension in the general population, including men and individuals with lower education or income who may not attend clinics.

b. Examine differences in risk factors between clinic attendees and those who remain undiagnosed or untreated in the community to understand who is being missed by the current health system.

iii. Investigate hypertension and nutritional status among the elderly using age-adjusted BMI and other measures.

Future research should specifically focus on adults aged 65 years and above, using:

a. Age-adjusted BMI cut-offs and additional anthropometric measures, such as mid-upper arm circumference or body composition assessments.

b. Detailed exploration of how age-related changes in body composition, dietary intake, and micronutrient status relate to hypertension and other non-communicable diseases.

iv. Use a Diet Quality Questionnaire (DQQ) to better characterize community dietary patterns.

To complement the 24-hour recall and food frequency findings from this study, community-based research could:

a. Apply a standard Diet Quality Questionnaire (DQQ) to assess overall diet quality in the broader population.

b. Explore how diet quality scores relate to blood pressure, micronutrient adequacy, and other cardiometabolic risk factors in Nakuru County.

v. Examine perceptions of smoking and other sensitive behaviors.

The very low proportion of participants reporting current smoking, despite known smoking prevalence in similar populations, suggests possible underreporting. Further research should therefore:

a. Explore how perceptions, stigma, and cultural norms around smoking (and possibly alcohol use) influence self-reporting in clinical and community settings.

b. Use qualitative or mixed-methods approaches to understand why some individuals may choose not to disclose smoking status, and how this affects the accuracy of behavioural risk factor data in hypertension research.

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APPENDICES

Appendix 1: Consent Form

1. Introduction

You are invited to participate in this research study being undertaken by the above-listed investigators. This form will help you gather information about the study so you can decide whether to participate voluntarily. You are encouraged to ask any questions regarding the research process, as well as any benefits or risks that you may accrue by participating. After you have been adequately informed about the study, you will be requested to either agree or decline to participate. Upon agreeing to participate in the study, you will be further asked to affirm that by appending your signature/thumbprint on this form. Accepting or declining to participate in this study does not in any way waive the following rights, which you're entitled to:

a) Voluntary participation in the study;

b) Withdrawing from the study at any time without the obligation of having to explain and

c) Access to services which you're entitled to

A copy of this form will be provided to you for your records

Should I continue YES/NO __________

This study has been reviewed and approved by Kabarak University Research Ethics Committee (KUREC)

What is the Purpose of the Study? The main reason(s) for conducting this study are to answer the following questions:

1. What are the demographic and socioeconomic characteristics of hypertensive adult patients attending Nakuru County Teaching and Referral Hospital?
2. What is the prevalence of hypertension among adult patients attending Nakuru County Teaching and Referral Hospital?
3. What are the risk factors of hypertension among adult patients attending Nakuru County Teaching and Referral Hospital?

(To answer these research questions, you are requested to answer question(s) voluntarily and/or accept some procedures performed on you.)

Who can Take Part in the Study?

All individuals aged 30-70 years visiting the outpatient department

All individuals aged 30-70 years who consent to take part in the study

This is what is going to happen once you have agreed to participate in the survey:

- The interview is expected to take 30 minutes
- You will be assisted in filling out the form by a qualified, trained research assistant. The questions will be asked in a private place where you will feel comfortable. In case there is any question you feel uncomfortable responding to, you will not be coerced into responding.

The questions will be on the following areas:

- Demographic and socio-demographic Characteristics
- Dietary intake
- Physical Activity

Third, after the interview, the following procedures will be done

The data collected will be stored safely.

The analysis will be conducted to understand the objectives

The findings will be published for academic purposes

Privacy & Confidentiality Privacy is the right of an individual to have some control over how their personal information/data is collected, used, and/or disclosed. Confidentiality is the duty to ensure information (data) is kept secret only to the extent possible/ reasonable.

In case you aren't comfortable answering any of the questions during the interview because of feeling embarrassed or uncomfortable, it will be within your rights to decline. Otherwise, every measure has been taken to ensure that the interview is conducted in a private area with minimal to no interference so that you feel comfortable as a whole as a result of finding an answer to the research question.

I have comprehensively read the consent form, or/the information has been comprehensively read to me by the researcher. I understand what the study is about, and all the questions and concerns I had have been addressed clearly and concisely. The study benefits and foreseeable risks have been explained to me. I totally understand that my decision to participate in this study is voluntary, and I have the right to withdraw at any point during the study.

I freely consent to participate in this study.

Signing this form does not in any way imply that I have given up the rights I am entitled to as a participant.

I agree to participate in this research YES___________ NO____________

Participant's Signature/Thumb print________________ Date _______________

Appendix II: Questionnaire

PART 1: Demographic Information		
CORE: Demographic Information		
Question	**Response**	**Code**
Sex (*Record Male / Female as observed)*	Male 1 Female 2	C1
What is your date of birth? *Don't Know 77 77 7777*	└─┴─┘ └─┴─┘ └─┴─┴─┴─┘ *If Known, Go to C4* dd mm year	C2
How old are you?	Years └─┴─┘	C3
EXPANDED: Demographic Information		
What is the **highest level of education** you have completed?	No formal schooling 1 Less than primary school 2 Primary school completed 3 Secondary school completed 4 High school completed 5 College/University completed 6 Postgraduate degree 7 Refused 88	C5
What is your *ethnic group* background?	[*Kalenjin]* 1 [*Kikuyu]* 2 [*Dholuo]* 3 Refused 88	C6
What is your **marital status**?	Never married 1 Currently married 2 Separated 3 Divorced 4 Widowed 5 Cohabitating 6 Refused 88	C7
Which of the following best describes your **main work** status over the past 12 months?	Government employee 1 Non-government 2 Self-employed 3 Non-paid 4 Student 5 Homemaker 6 Retired 7 Unemployed (able to 8 Unemployed (unable to 9	C8

	Refused 88	
How many people older than 25 years, including yourself, live in your household?	Number of people └─┴─┘ *If Not Known, Go to C11*	C9

Step 1 :Behavioral Measurements

Expanded: Demographic Information, Continued		
Question	**Response**	**Code**
Over the past year, can you tell me what the household's average earnings have been? *(RECORD ONLY ONE, NOT ALL 3)*	Per week └─┴─┴─┴─┴─┴─┴─┘ *Go to T1*	C10a
	OR per month └─┴─┴─┴─┴─┴─┴─┘ *Go to T1*	C10b
	OR per year └─┴─┴─┴─┴─┴─┴─┘ *Go to T1*	C10c
	Refused 88	C10d
Can you give an estimate of the household income if I read you some options? Is it *[INSERT QUINTILE VALUES IN LOCAL CURRENCY]* *(READ OPTIONS)*	≤ Quintile (Q) 1 1 More than Q 1, ≤ 2 More than Q 2, ≤ 3 More than Q 3, ≤ 4 More than Q 4 5 Don't Know 77 Refused 88	C11

CORE: Tobacco Use		
Now I am going to ask you some questions about tobacco use.		
Question	**Response**	**Code**
Do you **currently** smoke any **tobacco** products, such as cigarettes, cigars, or pipes? *(USE SHOWCARD)*	Yes 1 No 2 *If No, go to T8*	T1
Do you currently smoke tobacco products **daily**?	Yes 1 No 2	T2
How old were you when you **first started** smoking?	Age (years) Don't know 77 └─┴─┘ *If Known, go to T5a/T5aw*	T3
Do you remember how long ago it was? *(RECORD ONLY 1,*	In Years └─┴─┘ *If Known, go to T5a/T5aw*	T4a

NOT ALL 3) *Don't know 77*	OR in Months	|__|__| *If Known, go to T5a/T5aw*	T4b
	OR in Weeks	|__|__|	T4c
		DAILY↓ WEEKLY↓	
On average, **how many** of the following products do you smoke **each day/week?** *(IF LESS THAN DAILY, RECORD WEEKLY)* *(RECORD FOR EACH TYPE, USE SHOWCARD)* *Don't Know 7777*	Manufactured cigarettes	|__|__|__|__| |__|__|__|__|	T5a/T5aw
	Hand-rolled cigarettes	|__|__|__|__| |__|__|__|__|	T5b/T5bw
	Pipes full of tobacco	|__|__|__|__| |__|__|__|__|	T5c/T5cw
	Cigars, cheroots, cigarillos	|__|__|__|__| |__|__|__|__|	T5d/T5dw
	Number of Shisha sessions	|__|__|__|__| |__|__|__|__|	T5e/T5ew
	Other	|__|__|__|__| |__|__|__|__| *If Other, go to T5other, else go to T6*	T5f/T5fw
	Other (please specify):	|__|__|__|__|__|__|	T5other/ T5otherw
During the past 12 months, have you tried to **stop smoking**?	Yes No	1 2	T6
During any visit to a doctor or other health worker in the past 12 months, were you advised to quit	Yes No No visit during the past 12 months	1 *If T2=Yes, go to T12; if* 2 *If T2=Yes, go to T12; if* 3 *If T2=Yes, go to T12; if T2=No, go to T9*	T7
In the past, did you **ever smoke** any tobacco products? *(USE SHOWCARD)*	Yes No	1 2 *If No, go to T12*	T8
In the past, did you **ever** smoke **daily**?	Yes No	1 *If T1=Yes, go to T12, else go to T10* 2 *If T1=Yes, go to T12,*	T9

Core: Alcohol Consumption

The next questions ask about the consumption of alcohol.

Question	**Response**		**Code**
Have you ever consumed any alcohol such as beer, wine, spirits or *[add other local examples]*? *(USE SHOWCARD OR SHOW EXAMPLES)*	Yes No	1 2 *If No, go to A16*	A1
Have you consumed any alcohol within the **past 12 months**?	Yes No	1 *If Yes, go to A4* 2	A2
Have you stopped drinking due to health reasons, such as a negative impact on your health or on the advice of your doctor or other health worker?	Yes No	1 *If Yes, go to A16* 2 *If No, go to A16*	A3
During the past 12 months, **how frequently** have you had at least one standard alcoholic drink? *(READ RESPONSES, USE SHOWCARD)*	Daily 5-6 days per week 3-4 days per week 1-2 days per week 1-3 days per month Less than once a month Never	1 2 3 4 5 6 7	A4
Have you consumed any alcohol within the **past 30 days**?	Yes No	1 2 *If No, go to A13*	A5
During the past 30 days, on how many **occasions** did you have at least one standard alcoholic drink?	Number Don't know 77	└─┴─┘ *If Zero, go to A13*	A6
During the past 30 days, when you drank alcohol, how many **standard drinks on average** did you have during one drinking occasion? *(USE SHOWCARD)*	Number Don't know 77	└─┴─┘	A7
During the past 30 days, what was the **largest number** of standard drinks you had on a single occasion, counting all types of alcoholic drinks together?	Largest number Don't Know 77	└─┴─┘	A8
During the past 30 days, how many times did you have **six or more** standard drinks in a single drinking occasion?	Number of times Don't Know 77	└─┴─┘	A9
During each of the **past 7 days**, how many standard drinks did you have each day? *(USE SHOWCARD)* *Don't Know 77*	Monday	└─┴─┘	A10a
	Tuesday	└─┴─┘	A10b
	Wednesday	└─┴─┘	A10c
	Thursday	└─┴─┘	A10d
	Friday	└─┴─┘	A10e
	Saturday	└─┴─┘	A10f
	Sunday	└─┴─┘	A10g

CORE: Alcohol Consumption, continued			
I have just asked you about your consumption of alcohol during the past 7 days. The questions were about alcohol in general, while the following questions refer to your consumption of homebrewed alcohol, alcohol brought over the border/from another country, any alcohol not intended for drinking, or other untaxed alcohol. Please only			
Question	**Response**		**Code**
During the **past 7 days**, did you consume any **homebrewed** alcohol, any alcohol **brought over the border/from another country**, any alcohol **not intended for drinking,** or other **untaxed** alcohol? *[AMEND ACCORDING TO LOCAL CONTEXT]* *(USE SHOWCARD)*	Yes No	1 2 *If No, go to A13*	A11
On average, **how many standard drinks** of the following did you consume **during the past 7 days**? *[INSERT COUNTRY-SPECIFIC EXAMPLES]* *(USE SHOWCARD)* *Don't Know 77*	Homebrewed spirits, e.g., moonshine	└─┴─┘	A12a
	Homebrewed beer or wine, e.g., beer, palm, or fruit wine	└─┴─┘	A12b
	Alcohol was brought over the border/from another country.	└─┴─┘	A12c
	Alcohol is not intended for drinking, e.g., alcohol-based medicines, perfumes, aftershaves.	└─┴─┘	A12d
	Other untaxed alcohol in the country	└─┴─┘	A12e

EXPANDED: Alcohol Consumption			
During the **past 12 months,** how often have you found that you were not able to stop drinking once you had started?	Daily or almost daily Weekly Monthly Less than monthly Never	1 2 3 4 5	A13
During the **past 12 months,** how often have you failed to do what was normally expected from you because of drinking?	Daily or almost daily Weekly Monthly Less than monthly Never	1 2 3 4 5	A14
During the **past 12 months,** how often have you needed a first drink in the morning to get yourself going after a heavy drinking session?	Daily or almost daily Weekly Monthly Less than monthly Never	1 2 3 4 5	A15
During the **past 12 months**, have you had family problems or problems with your partner due to **someone else's** drinking?	Yes, more than monthly Yes, monthly Yes, several times but less than monthly Yes, once or twice No	1 2 3 4 5	A16

CORE: Diet		
The following questions ask about the fruits and vegetables that you usually eat. I have a nutrition card here with examples of local fruits and vegetables. Each picture represents the size of a serving. As you answer these questions, please think of a typical week in the last year.		
Question	**Response**	**Code**
In a typical week, on how many days do you **eat fruit**? *(USE SHOWCARD)*	Number of days Don't Know 77	
How many **servings** of fruit do you eat on **one** of those days? (*USE SHOWCARD)*	Number of servings └─┴─┘ Don't Know 77	
In a typical week, on how many days do you **eat vegetables**? *(USE SHOWCARD)*	Number of days Don't Know 77	D3
How many **servings** of vegetables do you eat on one of those days? *(USE*	Number of servings └─┴─┘ Don't know 77	D4
1.5 Dietary salt		
With the following questions, we would like to learn more about salt in your diet. Dietary salt includes ordinary table salt, unrefined salt such as sea salt, iodized salt, salty stock cubes and powders, and salty sauces such as soy sauce or fish sauce (see showcard). The following questions are about adding salt to food right before you eat it, how food is prepared in your home, eating processed foods that are high in salt, such as [insert country-specific examples], and controlling your salt intake. Please answer the questions, even if you consider yourself to be on a low-salt diet.		
How often do you **add salt or a salty sauce, such as soy sauce, to your food right before you eat it, or as you eat** it? *(SELECT ONLY ONE)* *(USE SHOWCARD)*	Always 1 Often 2 Sometimes 3 Rarely 4 Never 5 Don't know 7	D5
How often is **salt, a salty seasoning, or a salty sauce added** in cooking or preparing foods in your household?	Always 1 Often 2 Sometimes 3 Rarely 4 Never 5 Don't know 7	D6
How often do you eat **processed food high in salt**? By processed food high in salt, I mean foods that have been altered from their natural state, such as packaged salty snacks, canned salty foods including pickles and preserves, salty food prepared at a fast-food restaurant, cheese, bacon, and processed meat [add country-*specific examples]*. *[INSERT EXAMPLES]*	Always 1 Often 2 Sometimes 3 Rarely 4 Never 5 7 Don't know 7	D7
How much salt or salty sauce do	Far too much 1	D8

you think you consume?	Too much 2 Just the right amount 3 Too little 4 Far too little 5 Don't know 7	

EXPANDED: Diet		
Question	**Response**	**Code**
How important is it to you to lower **the salt** in your diet?	Very important 1 Somewhat important 2 Not at all important 3 Don't know 77	D9
Do you think that too much salt or salty sauce in your diet could cause a **health problem**?	Yes 1 No 2 Don't know 77	D10
Do you do any of the following regularly to **control your salt intake**? *(RECORD FOR EACH)*		
Limit consumption of processed foods.	Yes 1 No 2	D11a
Look at the salt or sodium content on food labels	Yes 1 No 2	D11b
Buy low-salt/sodium alternatives.	Yes 1 No 2	D11c
Use spices other than salt when cooking	Yes 1 No 2	D11d
Avoid eating foods prepared outside of the home	Yes 1 No 2	D11e
Do other things specifically to control your salt intake	Yes 1 *If Yes, go* No 2	D11f
Other (please specify)	└─┴─┴─┴─┴─┴─┴─┘	D11other

CORE: Physical Activity		
Next, I will ask you about the time you spend on different types of physical activity in a typical week. Please answer these questions, even if you do not consider yourself physically active. Think first about the time you spend doing work. Think of work as the things that you have to do, such as paid or unpaid work, study/training, household chores, harvesting food/crops, fishing or hunting for food, and seeking employment. *[Insert other examples if needed]*. In answering the following questions, 'vigorous-intensity activities' are activities that require hard physical effort and cause significant increases in breathing or heart rate; 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.		
Question	**Response**	**Code**
Work		
Does your work involve vigorous-intensity activity that causes significa	Yes 1 No 2 *If No, go to P 4*	
In a typical week, on how many days do you do vigorous-intensity activities as part of your	Number of days └─┘	
How much time do you spend doing vigorous-intensity activities at work on a typical day?	Hours: minutes └─┴─┘ : └─┴─┘ hrs mins	P3 (a-b)

Does your work involve moderate	Yes 1 No 2 *If No, go to P 7*	P4
In a typical week, on	Num ber of └─┘	P5
How much time do you spend doing moderate -intensity activities at work on a typical day?	Hour s: minu tes └─┴─┘ : └─┴─┘ hrs mins	P6 (a-b)
Travel to and from places.		
The following questions exclude the physical activities at work that you have already mentioned. Now, I would like to ask you about your usual way of traveling to and from places. For example: to work, to shop, to the market, to a place of worship. *[Insert other examples if needed]*		
Do you walk or use a bicycle *(pedal cycle)* for at least 10 minutes continuously to get to and from places?	Yes 1 No 2 *If No, go to P 10*	P7
In a typical week, on how	Num ber of days └─┘	P8
How much time do	Hour s: minu └─┴─┘ : └─┴─┘	P9 (a-b)

you spend walking or bicycling for travel on a typical day?	tes └┘ hrs mins	

CORE: Physical Activity, Continued		
Question	**Response**	**Code**
Recreational activities		
The following questions exclude the work and transport activities that you have already mentioned. Now I would like to ask you about sports, fitness, and recreational activities (leisure), *[Insert relevant terms]*.		
Do you do any vigorous-intensity sports, fitness, or recreational *(leisure)* activities that cause significant increases in breathing or	Yes 1 No 2 *If No, go to P 13*	P10
In a typical week, on how many days do you do vigorous-intensity sports, fitness, or recreational *(leisure)* activities?	Number of days └┘	P11
How much time do you spend engaging in vigorous-intensity sports, fitness, or recreational activities on a typical day?	Hours: minutes └┴┘ : └┴┘ hrs mins	P12 (a-b)
Do you do any moderate-intensity sports, fitness, or recreational *(leisure)* activities that cause a slight increase in breathing or heart	Yes 1 No 2 *If No, go to P16*	P13
In a typical week, on how many days do you do moderate-intensity sports, fitness, or recreational *(leisure)* activities?	Number of days └┘	P14
How much time do you spend doing moderate-intensity sports, fitness, or recreational *(leisure)* activities on a typical day?	Hours: minutes └┴┘ : └┴┘ hrs mins	P15 (a-b)

EXPANDED: Physical Activity		
Sedentary behaviour		
The following question is about sitting or reclining at work, at home, getting to and from places, or with friends, including time spent sitting at a desk, sitting with friends, traveling in a car, bus, or train, reading, playing cards, or watching television, but does not include time spent sleeping. *[INSERT EXAMPLES] (USE SHOWCARD)*		
How much time do you usually spend sitting or reclining on a typical day?	Hours: minutes └─┴─┘ : └─┴─┘ hrs mins	P16 (a-b)

CORE: History of Raised Blood Pressure		
Question	**Response**	**Code**
Have you ever had your blood pressure measured by a doctor or other health worker?	Yes 1 No 2 *If No, go to H6*	H1
Have you ever been told by a doctor or other health worker that you have raised blood pressure or hypertension?	Yes 1 No 2 *If No, go to H6*	H2a
Were you first told in the past 12 months?	Yes 1 No 2	H2b
In the past two weeks, have you taken any drugs (medication) for raised blood pressure prescribed by a doctor or other health worker?	Yes 1 No 2	H3
Have you ever seen a traditional healer for raised blood pressure or hypertension?	Yes 1 No 2	H4
Are you currently taking any herbal or traditional remedies for your raised blood pressure?	Yes 1 No 2	H5

CORE: History of Diabetes		
Have you ever had your blood sugar measured by a doctor or other health worker?	Yes 1 No 2 *If No, go to H12*	H6
Have you ever been told by a doctor or other health worker that you have raised blood sugar or diabetes?	Yes 1 No 2 *If No, go to H12*	H7a

Were you first told in the past 12 months?	Yes 1 No 2	H7b
In the past two weeks, have you taken any drugs (medication) for diabetes prescribed by a doctor or other health worker?	Yes 1 No 2	H8
Are you currently taking insulin for diabetes, as prescribed by a doctor or other health professional?	Yes 1 No 2	H9
Have you ever seen a traditional healer for diabetes or raised blood sugar?	Yes 1 No 2	H10
Are you currently taking any herbal or traditional remedies for your diabetes?	Yes 1 No 2	H11

CORE: History of Raised Total Cholesterol		
Question	**Response**	
Have you ever had your cholesterol (blood fat levels) measured by a doctor or other health professional?	Yes 1 No 2 *If No, go to H17*	H12
Have you ever been told by a doctor or other health worker that you have high cholesterol?	Yes 1 No 2 *If No, go to H17*	H13a
Were you first told in the past 12 months?	Yes 1 No 2	H13b
In the past two weeks, have you taken any oral treatment (medication) for raised total cholesterol prescribed by a doctor or other health	Yes 1 No 2	H14
Have you	Yes 1	H15

ever seen a	N 2	
Are you currently taking any herbal or	Y 1 N 2	H16

CORE: History of Cardiovascular Diseases		
Have you ever had a heart attack or chest pain from heart disease	Yes 1 No 2	H17
Are you currently taking aspirin regularly to prevent or treat heart	Yes 1 No 2	H18
Are you currently taking statins (Lovastatin/Simvastatin/Atorvastatin	Yes 1 No 2	H19

CORE: Lifestyle Advice		
Question	**Response**	**Code**
In the past 12 months, have you visited a doctor or other health care provider?	Yes 1 No 2 *If No and C1=1, go to M1* *If No and*	H20
1.5 During any of your visits to a doctor or other health worker in the past 12 months, were you advised to do any of the following? *(RECORD FOR EACH)*		
Quit using tobacco or don't start.	Yes 1 No 2	H20a
Reduce salt in your diet.	Yes 1 No 2	H20b
Eat at least five servings of fruit and/or vegetables each day	Yes 1 No 2	H20c
Reduce fat in your diet.	Yes 1 No 2	H20d
Start or do more physical activity.	Yes 1 No 2	H20e
Maintain a healthy body weight or lose weight	Yes 1 No 2	H20f
Reduce sugary beverages in your diet.	Yes 1 *If C1=1 go to M1* No 2 *If C1=1 go to M1*	H20g

Step 2 Physical Measurements

CORE: Blood Pressure		
Question	**Response**	**Code**
Interviewer ID	└─┴─┴─┘	M1
Device ID for blood pressure	└─┴─┘	M2
Cuff size used	Small 1 Medium 2 Large 3	M3
Reading 1	Systolic (mmHg) └─┴─┴─┘	M4a
	Diastolic (mmHg) └─┴─┴─┘	M4b
Reading 2	Systolic (mmHg) └─┴─┴─┘	M5a

	Diastolic (mmHg) └─┴─┴─┘	M5b
Reading 3	Systolic (mmHg) └─┴─┴─┘	M6a
	Diastolic (mmHg) └─┴─┴─┘	M6b
During the past two weeks, have you been treated for raised blood pressure with drugs (medication)	Yes 1 No 2	M7
CORE: Height and Weight		
For women: Are you pregnant?	Yes 1 *If Yes, go to M 16* No 2	M8
Interviewer ID	└─┴─┴─┘	M9
Device IDs for height and weight	Height └─┴─┘ Weight └─┴─┘	M10a M10b
Height	in Centimetres (cm) └─┴─┴─┘ . └─┘	M11
Weight *If too large for scale 666.6*	in Kilograms (kg) └─┴─┴─┘ . └─┘	M12
CORE: Waist		
Device ID for the waist	└─┴─┘	M13
Waist circumference	in Centimetres (cm) └─┴─┴─┘ . └─┘	M14

B. Nutrition Assessment

Nutrition Assessment: Anthropometry and Biochemical					
1. Weight	Measurer 1	__ __ __ Kg	2. Height	Measurer 1	__ __ __ cms
	Measurer 2	__ __ __Kg		Measurer 2	__ __ __ cms
	Measurer 3	__ __ __Kg		Measurer 3	__ __ __cms
	Average	__ __ __Kg		Average	__ __ __cms
3. BMI	__ __ . __				

C. Dietary Practices

	Food Frequency Questionnaire						
	Type of food	**Every day (0)**	**Once a week (1)**	**Twice a week (2)**	**Once a month (3)**	**Seasonally (4)**	**Never consumed (5)**
	Vegetables						
4.	Spinach						
5.	Pumpkin leaves						
6.	Carrots						
7.	Tomatoes						
8.	Cabbage						
9.	Kales						
Fruits							
10.	Ripe bananas						
11.	Oranges						
12.	Pineapple						
13.	Mangoes						
Pulses and legumes							
14.	Beans						
15.	Ndengu						
16.	Lentils						
Animal products							
17.	Beef						
18.	Poultry						
19.	Fish						
20.	Milk						
Cereals and cereal products							
21.	Ugali						
22.	Chapati						
23.	Maize						
24.	Wholemeal bread						
Roots and tubers							
25.	Sweet potatoes						
26.	Irish potatoes						
27.	Arrowroot						
	Fats and oils						

	Food Frequency Questionnaire						
	Type of food	**Every day (0)**	**Once a week (1)**	**Twice a week (2)**	**Once a month (3)**	**Seasonally (4)**	**Never consumed (5)**
28.	Margarine						
29.	Cooking oils						
Sugar and honey							
30.	Cake						
31.	Biscuits						
32.	Honey						

A. **24 Hour Recall**

	24-Hour Recall				
	Name of Food	Food description	Household Amount	Amount (g/mL)	Preparation/ ingredients
Breakfast					
Snack					
Lunch					

	24-Hour Recall				
	Name of Food	Food description	Household Amount	Amount (g/mL)	Preparation/ ingredients
Snack					
Supper					
Others Specify					

	24-Hour Recall				
	Name of Food	Food description	Household Amount	Amount (g/mL)	Preparation/ ingredients

Appendix III: NACOSTI Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **974220**

Date of Issue: **16/August/2024**

RESEARCH LICENSE

This is to Certify that Ms.. Winnie Jelagat Jelagat of Kabarak University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nakuru on the topic: Risk factors for hypertension among adults attending Nakuru Level 5 Hospital, Nakuru Kenya for the period ending : 16/August/2025.

License No: **NACOSTI/P/24/39105**

974220

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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See overleaf for conditions

Appendix IV: Evidence of Conference Participation

TENP/RPND/2025/001

The Eldoret National Polytechnic

P. O. BOX 4461 - 30100 Eldoret Tel: 0738092126/0797222666

Email: info@tenp.ac.ke

Certificate of Participation

is awarded to

Winnie Moimet

for presenting a paper entitled: -

Dietary practices and risk of hypertension among adults attending level 5 hospital, Kenya a cross-sectional study

During the 14TH Annual International Conference on ***'Competences In Applied Research, Science And Innovation For Sustainable Development'*** Held at The Eldoret National Polytechnic on **15th to 16th October 2025**

Principal

Coordinator Research & Development

This certificate is issued without any alteration whatsoever

Appendix V: List of Publication

AJND Reports
African Journal of Nutrition and Dietetics

https://doi.org/10.58460/ajnd.v4i03.176

RESEARCH ARTICLE

Dietary Practices and Risk of Hypertension among Adults Attending Nakuru Level 5 Hospital, Kenya: A Cross-Sectional Study

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To read this paper online, please scan the QR code below:

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ABSTRACT

Hypertension is a major cause of cardiovascular morbidity and premature mortality. Statistics indicate that prevalence and gaps in awareness, treatment, and control are high in Kenya. Diet, in particular sodium and potassium balance, general quality, and intake of fruits and vegetables, is a preventive and controlling factor that can be manipulated. The study was a descriptive cross-sectional study among adults. A total of 215 respondents were selected through systematic random sampling. A semi-structured questionnaire was used to measure the frequency and daily servings of fruits and vegetables, as well as salt-related behaviors. A 24-hour recall was used to assess the intake of macro- and micronutrients. The analysis of data was done using SPSS v26 and descriptive statistics and chi-square tests on associations. Among 215, only 5.1% had normal BP; 18.6% elevated; 52.6% stage 1; 23.7% stage 2. Vegetables were eaten most days; fruit 3–4 days/week; daily fruit was rare. Portions favored vegetables (4–5/day) over fruit (2–3/day). Energy and fibre were low; ~half exceeded fat ceilings. Mean sodium exceeded targets (men 2,310 mg; women 2,220 mg); potassium adequacy ~20%. About 76% often/always added salt during cooking; ~13% added at the table; label reading 3.7% and low-sodium purchases 7.4%. Fruit days/week ($p=0.001$), vegetable servings/day ($p<0.001$), and several salt-related practices ($p\leq0.024$) associated with stage. Conclusion: Hypertension is a high burden, and the dietary habits of the study participants are low fibre, excess sodium, low potassium, and key micronutrient consumption mixed with a high dietary intake of vegetables and low frequency of fruits. Recommendations: Push high-fibre foods that contain high potassium (leafy greens, legumes, whole grains, an apple a day); introduce systematic deficit of sodium (measured salt, less use of stock cubes/processed foods, label literacy); part of clinic workflow integration (minimal diet screening, counselling); and food-environment support (canteen defaults, access to produce).

Keywords: *Hypertension; Dietary practices; Fruit and vegetable intake; Sodium–potassium balance; Kenya.*

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