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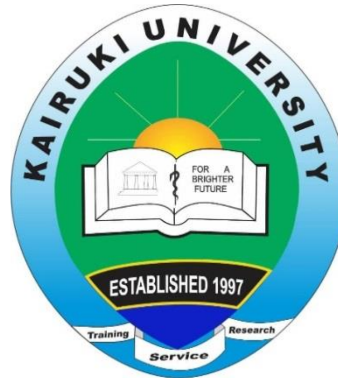

LEFT VENTRICULAR HYPERTROPHY AMONG HYPERTENSIVE ADULTS ATTENDING CARDIAC CLINICS IN PUBLIC REGIONAL REFERRAL HOSPITALS IN DAR ES SALAAM

BY

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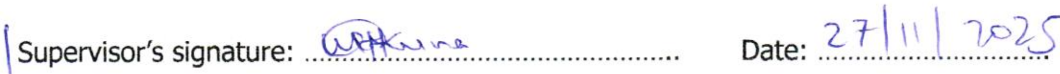
A dissertation submitted in (partial) fulfillment of the requirements for the degree of Master of Medicine (Internal Medicine) at Kairuki University

2025

CERTIFICATION

It is hereby certified that the undersigned have read and hereby recommends acceptance by Kairuki University, of an MMED dissertation proposal titled: **'LEFT VENTRICULAR HYPERTROPHY AMONG HYPERTENSIVE ADULTS ATTENDING CARDIAC CLINICS IN PUBLIC REGIONAL REFERRAL HOSPITALS IN DAR ES SALAAM'** in partial fulfillment of the requirements for the issuance of an ethical clearance for the research study in partial fulfillment of the degree of Master of Medicine in Internal Medicine.



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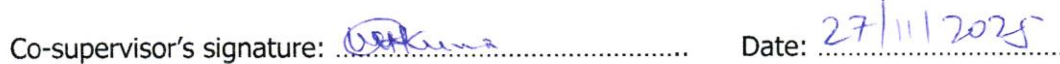

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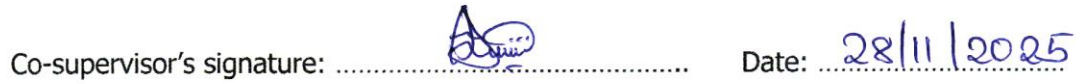

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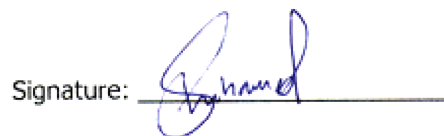
Signature:    Date: 28/11/2025

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SUMMARY

Left ventricular hypertrophy (LVH) is becoming a significant clinical concern worldwide due to the increasing prevalence of hypertensive heart disease. It serves both as an adaptive response to increased blood pressure and as a pathological consequence of hypertension. The likelihood of developing LVH rises with worsening hypertension, higher BMI, and older age. A study by Ruilope et al. found LVH in 20% of mildly hypertensive patients, increasing to nearly 100% in those with a hypertensive crisis.

LVH is a strong predictor of cardiovascular disease and mortality, particularly in hypertensive patients. However, research on its prevalence among adult hypertensives in Tanzania lacks key data on distribution and risk factors. While echocardiograms and electrocardiograms can detect LVH, electrocardiographic studies remain limited in Tanzania. This gap raises concerns about how well current research supports patient management. Therefore, this study aims to bridge the knowledge gap by identifying predictors and risk factors for LVH.

ABSTRACT

Background: Tanzania is undergoing a rapid demographic and epidemiologic transition process. Cardiovascular diseases and in particular hypertensive heart disease are among the commonest and most rapid growing health insults in Tanzania's morbidity statistics. There are however gaps in literature on predictors and pathophysiological mechanisms of hypertensive heart diseases in Tanzania.

Objective: To determine the proportion of left ventricular hypertrophy and its associated predictors and risk factors among adult patients with hypertension attending cardiac clinics in public regional referral hospitals in Dar es Salaam, Tanzania.

Research question: What is the distribution of left ventricular hypertrophy among adult with hypertension attending Dar es Salaam regional referral hospitals?

Methodology: A cross-sectional descriptive hospital-based study conducted at public regional referral hospital in Dar es Salaam city. Adults with electrocardiographic and echo-based evidence of left ventricular hypertrophy was the study population. Simple random sampling method was used to get the representative sample for the study. Prevalence of left ventricular hypertrophy was the outcome/dependent variable. Data were collected using structured questionnaires, physical examinations, electrocardiography (ECG), echocardiography (ECHO), and lipid profiling. Echocardiographic LVH was defined as interventricular septal or left ventricular posterior wall thickness ≥11 mm in diastole. A binary multivariable logistic regression model was used to derive statistical findings in data. Unless otherwise stated, an α-level of 5% will be used to limit type 1 error rates in findings. All participants signed a written informed consent prior to inclusion into the study.

Results: A total of 280 patients with hypertension participated in this study. The mean age was 61.2 years SD 13.9 years. Majority of the study participants were female 78.9%. 162 participants (57.9%) were found to have LVH on echocardiographic examination. On Multivariate logistic regression analysis study participants with Age ≥65years (OR) 3.1 (CI) 1.6-5.96, waist circumference ≥ 40 inches (OR) 2.4 (CI) 1.2-5.1 had significant positive association with LVH. Adherence to antihypertensive medications had 96% protection against developing LVH. As an individual risk Triglycerides ≥1.7mmol (OR) 1.84 (CI) 1.04-3.26 had positive association with LVH. Amongst the study participants found to have positive LVH 14.6% had heart failure, 9.6% had AFIB, 2.5% had PAC, 4.6% had PVC, 17.9% has LBBB, 4.6% had RBBB, 4.6% had 1st degree heart block, 1.8% had 3rd degree heart block, 10.7% had tachycardia, 4.6% had bradycardia.

Conclusion: Left ventricular hypertrophy was highly prevalent among hypertensive patients in this study, affecting more than half of the participants. Advanced age (≥65 years), increased waist circumference, and elevated triglyceride levels were independently associated with LVH, highlighting the role of both metabolic and demographic factors in cardiac remodeling. Strong adherence to antihypertensive therapy demonstrated a significant protective effect against LVH, emphasizing the importance of sustained blood pressure control. Patients with LVH also exhibited notable rates of cardiac arrhythmias and conduction abnormalities, underscoring the clinical burden and potential complications associated with LVH. Strengthening strategies for early detection, risk-factor modification, and medication adherence may help reduce the development and consequences of LVH among hypertensive individuals.

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ABBREVIATIONS

ACC	American College of Cardiology
AHA	American Heart Association
BMI	Body Mass Index
ECG	Electrocardiography
ECHO	Echocardiography
HDL-C	High Density Lipoprotein Cholesterol
HIV	Human Immunodeficiency Virus
IgG	Immunoglobin G
IREC	Institutional Research Ethics Committee
IVS	Interventricular septum
KU	Kairuki University
LDL-C	Low Density Lipoprotein Cholesterol
LVH	Left Ventricular Hypertrophy
LVPW	Left ventricular posterior wall
M-mode	Motion mode
NCDs	Non-Communicable Diseases
S.D.	Standard Deviation
S.L	Sokolow-Lyon (criteria)
T.G	Triglycerides
WHO	World Health Organization

OPERATIONAL DEFINITIONS

Left ventricular hypertrophy: It refers to abnormal increase in the mass of the left ventricular myocardium caused by a chronically increased workload on the heart which may be directly due to hypertension such that in diastole the left ventricular posterior wall thickness and the interventricular septal thickness grows to become ≥11mm [1,2,3].

Hypertension: is diagnosed if systolic blood pressure readings is ≥140 mmHg and/or diastolic blood pressure is ≥ 90 mmHg on at least two separate readings on different days[4].

CHAPTER ONE

1.0 INTRODUCTION

Tanzania is undergoing a rapid demographic and epidemiologic transition process [5,6,7]. An increase in NCDs in Africa, including Tanzania; in particular hypertension and its cardiac and renal complications. Cardiovascular disease, in particular hypertensive heart disease, is one among leading causes of morbidity and mortality in Tanzania[8]. Insufficient information is available on predictors and characteristics of pathophysiological mechanisms associated with hypertensive heart disease in Tanzania[9,10,11,12]. Thus, this study aims to characterize predictors and risk factors of left ventricular hypertrophy among adults with hypertension attending regional referral hospitals in Dar es Salaam.

1.1 Background

Left ventricular hypertrophy

Left ventricular hypertrophy is a condition defined by an increase in left ventricular mass, either due to an increase in wall thickness or due to left ventricular cavity enlargement, or both[13]. In cases of hypertensive heart disease, the variant of hypertrophy is normally concentric in nature, and measured when in diastole left ventricular posterior wall thickness and the interventricular septal thickness become ≥11mm[1,2,3]. In almost all cases, left ventricular wall thickness occurs in response to pressure overload, and chamber dilatation occurs in response to the volume overload[13]. There are a number of clinical pathological conditions associated with left ventricular hypertrophy, even though hypertensive heart disease is the commonest cause. Other conditions include essential hypertension, athletic heart with physiological left ventricular hypertrophy, hypertrophic cardiomyopathy (with/out flow obstruction), dilated cardiomyopathy, aortic

regurgitation, renal artery stenosis, coarctation of aorta as well as infiltrative cardiac processes (amyloidosis, Danon disease)[13]. Left ventricular hypertrophy has been found in between 15-20% of the general population[13]. Left ventricular hypertrophy as a result of hypertensive disease is concentric hypertrophy[14]. It has also been postulated to be commoner among Africans than other races[15]. It is still questionable to what extent left ventricular hypertrophy affects commonly among adult community members in Tanzania, and in particular Dar es Salaam. Also, little is known about predictors as well as risk factors of this risky marker associated with hypertension.

Epidemiology

There were 18.6 million hypertensive heart disease cases in 2019 globally[16]. It was an estimated increase of about 6.5% from the 1990 figures[16]. Besides, the highest increase were reported to be from high-middle socio-demographic index countries (average prevalence rate of 14.6%)[16]. On predictive factors associated with prevalence of hypertension at population level, age was among significant factors, as it tends to peak at age range 70-74 years for both sexes and declined immediately thereafter[16]. Hypertensive heart disease was found to be more common in men aged 65-79 years and women aged 70-84 years[16]. Risk factors for hypertensive heart disease at global level included high BMI (40.5% in 2019 up from 25.5% in 1990), high sodium diets (16.3%), with alcohol use (9.5%) emerging as a significant risk factor, surpassing lead exposure (9.3%) [16]. However, these data were unlikely to be representative in most African regions, since there was insufficiency of data availability.

The most recent data from Europe revealed at least 22% of people aged 15 years and above had high blood pressure[17]. Among the EU countries, the highest burden was reported from Croatia (37%), Latvia and Hungary (both at 32%)[17]. In contrast, the lowest burden of hypertension in the EU was reported from Ireland (12%) followed by Luxembourg, Romania and

the Netherlands (all tallied at 16%)[17]. Hypertension was reported to be more prevalent among women than men (23%) in 2019[17]. The highest share of women with high blood pressure in the EU were reported from Croatia (38%), Latvia (37%) and Hungary (34%)[17]. On the contrary, the highest shares of men with high blood pressure in the EU were reported from Croatia (36%), Hungary (29%) and Finland (18%)[17].

The most recent comprehensive report on hypertension from Africa revealed the age-standardized prevalence rate in ranges from 19.3% in rural Nigeria to 38.0% in urban Namibia[18]. Accordingly, the age-standardized prevalence of hypertension was 19.3% (95% C.I.: 17.3% - 21.3%) in rural Nigeria, 21.4% (95% C.I.: 19.8% - 23.0%) in rural Kenya, 23.7% (95% C.I.: 21.3% - 26.2%) in urban Tanzania and 38.0% (95% C.I.: 35.9% – 40.1%) in urban Namibia[18]. The findings were from multi-national cross-sectional survey that aimed at assessing prevalence and determinants of blood pressure in four sub-Saharan Africa population[18]. The surveys were done in Kwara state, Nigeria; Nandi district, Kenya; Dar es Salaam, Tanzania and Greater Windhoek, Namibia[18]. Within a final sample size of 5500 households, 9857 non-pregnant adults were eligible for analysis on hypertension[18]. Of those, 7568 respondents ≥ 18 years were included[18]. Age and BMI was the most significant predictor of hypertension across all age groups[18]. The effects of age and BMI on blood pressure was different between men and women[18]. Among studied hypertensives, the proportion with grade 2 (≥160/100 mmHg) or grade 3 (≥ 180/110 mmHg) hypertension ranged between 29.2% in Namibia to 43.3% in Nigeria[18]. Obesity prevalence (BMI ≥ 30kgm^{-2}) ranged from 6.1% (Nigeria) to 17.4% (Tanzania)[18].

In Tanzania, data that are nationally representative are scanty and majority aged[19]. Edwards and colleagues reported an age-standardized hypertension prevalence in Ilala was 37.3% (95% C.I.: 32.2% - 42.5%) among men and 39.1% (95% C.I.: 34.2% - 44.0%) among women and 26.3%

(95% C.I.: 22.4% - 30.4%) among men and 27.4% (95% C.I.: 24.4% - 30.4%) among women in Shari in the year 2000[19]. Predictive factors for hypertension in both men and women in Ilala and Shari included older age and had larger waists, waists-to-hip ratios as well as BMI[19]. Whereas blood pressures were taken at home in Ilala, the BP measurements were done at clinics in Shari[19]. Neither the risk factors nor the predictive factors were reported, it was unclear whether these data could be justifiably concluded to be nationally representative.

Several biomarkers and predictor variables have been postulated to be responsible for poor outcomes of most cardiovascular diseases, in particular hypertensive heart disease[20]. However, of all, left ventricular hypertrophy stands as the most statistically significant biomarker of both poor morbid and mortal aspects of hypertensive heart disease[20]. In Europe, the study of LVH among adult hypertensive patients revealed that the prevalence of left ventricular hypertrophy in the total population were 14.9% for men and 9.1% for women[21]. The main independent predictors of left ventricular hypertrophy were male gender, body mass index, systolic blood pressure, valvular heart disease, cardiovascular disease and antihypertensive medication[21]. Body mass index and systolic blood pressure had a strong synergistic association with left ventricular hypertrophy in men, but not in women[21]. It was a population-based sample of 3287 subjects aged 25-85 years, left ventricular mass was estimated using M-mode echocardiography[21].

A study done in Nigeria by Ngabea et al revealed that prevalence of echocardiographic based LVH among hypertensive patients was 32.4% in a study that was composed of 178 subjects with hypertension versus 89 healthy controls were compared[1]. It was concluded that the Average Left ventricular mass was greater among hypertensive patients as compared to the controls group.[1]

In rural village of Nigeria Chizindu et al. did a cross-sectional study involving 539 adults. They found that the prevalence of ECG based LVH diagnosed by the Sokolow-Lyon criterion was 16.4% with a significantly higher prevalence among males than females (20.4% in males versus

8.2% in females,).[22] Also they found that the prevalence of LVH was higher in the middle age and the elderly age group and the lowest percentage was seen at the young age population of 18-29 years in both sexes.[22] Factors such as male gender, cigarette smoking and hypertension including both systolic and diastolic blood pressures were significantly correlated with LVH.[22]

Epidemiology of left ventricular hypertrophy in Tanzanians has mainly relied to data from tertiary levels of care[9,11,12]. Point prevalence of left ventricular hypertrophy among adult Tanzanian hypertensive patients has been estimated to range from 62% - 70% in previous studies[9,11,12]. The most recent data on correlates of left ventricular hypertrophy among adults with hypertension in Tanzania revealed age, gender (female preponderance), body mass index, systolic and diastolic blood pressures, hypertension duration as well as left ventricular mass to be directly associated with the patterns of left ventricular hypertrophy in adults[12]. However, the study was performed among adults found in Northern parts of Tanzania only[12]. To what extent are those findings representable to the entire Tanzanian population remains a matter of extrapolation and therefore more studies are required.

Pathophysiology of left ventricular hypertrophy

Left ventricular hypertrophy is a physiological adaptation to compensate the heart when it faces a hemodynamic burden[23]. Technically, when the heart faces burdensome stress in its hemodynamic strategies, the following compensatory mechanisms may be called into action, namely – *the Frank-Starlin mechanism to increase cross-bridge formation*, *augment muscle mass to bear extra load* as well as *recruit neuro-hormonal mechanisms to increase myocardial contractility*[23]. It must be clear that the increase in cardiac muscle mass is always due to the hypertrophy of the existing myocytes rather than hyperplasia since cardiomyocytes become terminally differentiated soon after birth[23]. In times of pressure overload, like during a chronic

hypertensive state and/or in aortic stenosis, the parallel addition of sarcomeres causes an increase in myocyte width, which in turn increases wall thickness[23]. This remodeling results in concentric hypertrophy (an increase in the ratio of the wall thickness)[23]. As a result, chronic left ventricular pressure overload results primarily in wall thickening and concentric hypertrophy while chronic left ventricular volume overload features chamber enlargement and an eccentric pattern of hypertrophy[14].

Clinical features of hypertensive heart disease associated with left ventricular hypertrophy

The following clinical features of hypertension and/or its immediate complications have been reported before in the literature[12,24]:- chest pain - fatigue - exertional dyspnea - dizziness or fainting (syncope) - dyspnea at rest - paroxysmal nocturnal dyspnea - fast heartbeats - chest tightness.

Physical examination findings of adults with left ventricular hypertrophy

The following findings have been reported as physical examination findings have been reported to be associated with left ventricular hypertrophy among adult hypertensives[25,26]:- shifting of cardiac apex beat on palpation - sustained heave on palpation.

Diagnosis of left ventricular hypertrophy associated with hypertension

LVH can be diagnosed by echocardiography or electrocardiography.[27] Studies on diagnostic criteria of ECG reported findings remains low.,[28] one study found that echo measurements had a sensitivity of 57% for mild Left ventricular hypertrophy and 98% for moderate-to-severe left ventricular hypertrophy.[29] In comparison, the sensitivity of various ECG criteria ranged from 15%

to 35% in patients with mild left ventricular hypertrophy and from 10% to 57% among those with moderate to severe left ventricular hypertrophy compared in the same patients.[29]

Therefore, echocardiography remains more sensitive for diagnosing left ventricular hypertrophy.[28] However, it was reported that it is not easily available and commonly used in many developing countries.[23]

Left ventricular hypertrophy is diagnosed on Echo when in diastole the left ventricular posterior wall thickness or interventricular septal thickness is ≥11 mm.[3]

Complications of left ventricular hypertrophy

Patients with left ventricular hypertrophy remain asymptomatic for a few years, but disease advancement will progress to systolic or diastolic dysfunction and eventually will patient will get end stage heart failure.[24] Also hypertrophied cardiac muscle brings about a disruption in normal conduction, therefore Left ventricular hypertrophy can be lead to arrhythmias which can be fatal.[24]Furthermore, in a study by Lar et al LVH was found to be associated with larger Myocardial infarct size.[30]

Treatment of left ventricular hypertrophy among adult hypertensive patients

Treatment of hypertension in adults with or without LVH, targets multiple risk factors to improve cardiac outcomes.[31] These includes lifestyle interventions such as healthy diet, physical aerobic exercise to control obesity, smoking cessation as well as medical adherence.[31]

Data from some large comparative studies comparing antihypertensive in respect to LVH suggest that some combinations are more impactful and effective than others. To be precise, calcium channel blockers and medications that target the RAS, i.e. angiotensin-converting enzyme

inhibitors (ACEIs) and angiotensin receptor blockers (ARBs), have shown to have beneficial effects on LVH independent to control of the blood pressure.

Other studies also suggest angiotensin-1 receptor blockers had been found to be effective to reducing left ventricular hypertrophy among adults with hypertension[32,33]. Furthermore, Fagard and colleagues meta-analysis findings revealed a regression of up to 12.5% in left ventricular mass among adult hypertensives[33], Malmqvist and colleagues findings from a randomized trial revealed administration of Ibersartan had significantly reduced left ventricular mass by an average of 26 g/m^2 ($p<0.001$) at week 48 of treatment[32].

1.2 Statement of the problem

Left ventricular hypertrophy is an emerging clinical challenge in recent statistics both in developing and developed countries due to an increasing trend of more patients with hypertensive heart disease [34]. Left ventricular hypertrophy is a major form of hypertension-mediated organ damage and a strong predictor of cardiovascular morbidity and mortality. Despite its clinical importance, LVH remains under-detected in many low and middle income countries, including Tanzania, where access to routine echocardiography and optimal hypertension control is limited. Evidence from Tanzania indicates that LVH is highly prevalent among hypertensive individuals. A hospital based echocardiographic study reported that 62% of adult hypertensive patients had LVH, highlighting significant structural heart disease in this population[11]. Another Tanzanian study examining hypertensive adults at a tertiary hospital found abnormal left ventricular geometric patterns including LVH in nearly 70% of participants, reinforcing concerns about widespread structural cardiac remodeling among hypertensive patients[12]. in a study by matuja et al; young Tanzanians ≤ 45years adults who experienced first-ever stroke, 75.3% were found to have LVH[35]. Indicating a significant association of adverse

outcome of LVH. Moreover, heart failure was found to be a major clinical outcome of LVH. It was reported to affect a significant proportion of hypertensive patients with left ventricular concentric hypertrophy[36]. These findings collectively indicate that LVH poses a significant health challenge in Tanzania.

The occurrence of left ventricular hypertrophy increases with severity of hypertension, BMI, older age, larger waists, male gender, alcohol use and cigarette smoking.[16,19,37] In a study by Ruilope et al; LVH was found to range from 20% in mildly hypertensive patients and amplified to almost 100% in those with hypertensive crisis.[37]

Left ventricular (LV) hypertrophy is a strong predictor of cardiovascular morbidity and mortality in the general population, and particularly in patients with hypertension[38,39]. There is scarcity of published studies in Tanzania on clinical profile such as symptoms, physical findings, associated arrhythmias and data on heart failure as an outcome of LVH. Furthermore, there is also insufficiency of data on risk factors like age, BMI and lipids contributing to LVH. Understanding these clinical features and risk factors will give clinicians insight in building preventive and treatment strategies such as weight reduction strategies and for patients who require intervention with medication such as lipid lowering drugs and early management of hypertension in order to prevent development and progression of LVH; which can lead to complications such as arrhythmias and heart failure[40]. Arrythmias such as atrial fibrillation can further complicate to stroke in these patients[41]. These complications not only lead to psychological and physical implications like fear and anxiety but also financial burdens on the patients and family involved as some of these patients may need regular screening for Echo and necessitate for regular medication expenses. Early detection of dyslipidemias will aid clinicians to aggressively treat the dyslipidemias in order to prevent occurrence of LVH and if present to limit its progression. Early detection of LVH aids clinicians to make early interventions and this is only possible if clinical

features and risk factors are known, despite both echocardiogram and electrocardiogram can be used to screen for left ventricular hypertrophy among adult hypertensive; there is limited data of echocardiographic studies from Tanzania[9,10,11,12]. This study will highlight on the magnitude of LVH among hypertensive patients and also aim to establish a comprehensive knowledge base on associated clinical profile and risk factors, this will enable clinicians to make preventive and targeted treatment strategies for at risk patients.

1.3 Significance of the study

The health burden of hypertensive heart disease is substantial with a point prevalence of 62% to 70% in previous studies conducted in Tanzania.[9,11,12] Left ventricular hypertrophy (LVH) is one of the most important forms of hypertension mediated organ damage and a major predictor of adverse cardiovascular outcomes, including heart failure, arrhythmias, myocardial infarction, and sudden cardiac death. LVH is also associated with high morbidity and mortality among adults. Management of complications of LVH associated with hypertension comes at a high cost. Despite being preventable and reversible in its early stages, LVH often remains underdiagnosed in many Low to mid income countries, including Tanzania, where routine echocardiographic screening is limited and hypertension control remains suboptimal. Lifestyle changes, rising obesity rates, and poor adherence to antihypertensive medications may be contributing to a growing burden of LVH, but evidence quantifying these associations in the Tanzanian context is limited. Identifying the clinical and metabolic predictors of LVH can help healthcare providers stratify high-risk patients, optimize treatment strategies, and reduce long-term cardiovascular complications.

LVH's development and its progression can be prevented by patient awareness and early detection through screening as well as lifestyle modification, such as cessation of cigarette smoking, alcohol use, physical exercise, diet modifications.[16] Early prevention and treatment will

enable avoidance of complicated outcomes such as arrhythmias and heart failure which can cause sudden death by interfering with cardiac rhythm ending up with cardiac arrest.[40] However, these morbid conditions can be delayed or prevented by lesser expensive strategies and healthy practices such as aerobic exercises, dietary changes, cigarette smoking and alcohol use cessation, control of blood pressure and lipid control.[16]

Echocardiography screening for LVH is not routinely done for hypertensive patients in our primary care setting due to financial constraints, lack of trained experts or availability of diagnostic instruments involved in diagnosing LVH, this study will highlight on the importance of regular screening and therefore advocate using Echo and ECG as a routine practice in the cardiac clinics as it enables clinicians to make evidence-based decisions in the treatment modalities. Identifying the clinical and metabolic predictors of LVH can help healthcare providers stratify high-risk patients, optimize treatment strategies, and reduce long-term cardiovascular complications. Therefore, findings of this study are expected to significantly assist clinicians in early detection of LVH development as it explores on the clinical and metabolic profile of a patient with LVH and will also contribute to essential knowledge base. If the risk factors are well understood, clinicians can collaborate more effectively with patients to develop targeted prevention and treatment strategies that will aid in reduction of morbidity and possibly mortality associated with LVH. Generating this evidence is essential for strengthening hypertension management programs, improving early detection of target-organ damage, and informing policy and clinical practice within Tanzania’s healthcare system.

1.4 Research questions

1. What is the distribution of social demographic characteristics (age, gender, level of education, income level) associated with LVH among adult hypertensives attending Dar es Salaam public regional referral hospitals 2025.
2. What is the distribution of clinical profile (symptoms, physical findings, medication types, arrythmias, heart failure) associated with left ventricular hypertrophy among adults with hypertension attending Dar es Salaam public regional referral hospitals 2025.
3. What is the distribution of risk factors (BMI, waist circumference, alcohol use, cigarette smoking, physical exercise, medication adherence, duration of hypertension, lipid profile – HDL, LDL, TGs) associated with left ventricular hypertrophy among adults with hypertension attending Dar es Salaam public regional referral hospitals 2025.

1.5 Objectives

1.5.1 Broad objective:

To determine the proportion of left ventricular hypertrophy among hypertensive adults attending cardiac clinics in public regional referral hospitals in Dar es Salaam 2025.

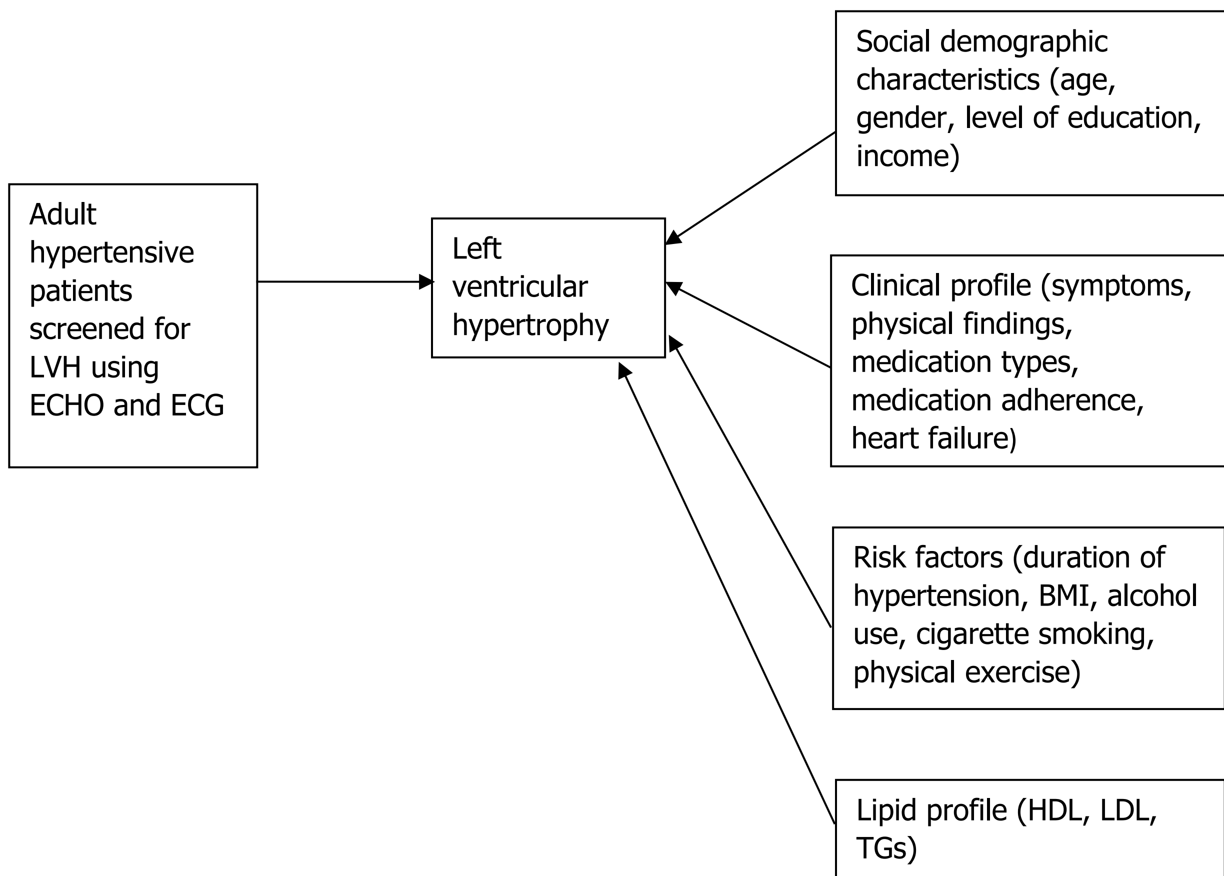
1.5.2 Specific objectives:

1. To determine the prevalence of LVH among hypertensive adults attending Dar es Salaam public regional hospitals 2025.
2. To determine the distribution of sociodemographic characteristics (age, gender, level of education, income level) associated with LVH among hypertensive adults attending Dar es Salaam public regional referral hospitals 2025.
3. To determine the frequency of clinical profile (symptoms, physical findings, medication types, Medication adherence, arrythmias, heart failure) associated with left ventricular

hypertrophy among hypertensive adults attending Dar es Salaam public regional referral hospitals 2025.

4. To determine the magnitude of risk factors (BMI, waist circumference, alcohol use, cigarette smoking, physical exercise, medication adherence, duration of hypertension) associated with left ventricular hypertrophy among hypertensive adults attending Dar es Salaam public regional referral hospitals 2025.
5. To determine the lipid profile (HDL, LDL and TGs) associated with left ventricular hypertrophy among adults with hypertension attending Dar es Salaam public regional referral hospitals 2025.

1.6 Theoretical framework/conceptual model



CHAPTER TWO

2.0 LITERATURE REVIEW

The number of individuals with LVH in hypertensive patients is rising globally, mirroring the increasing prevalence of hypertension.[38,39] There were 18.6 million hypertensive heart disease cases in 2019 globally[16]. It was an estimated increase of about 6.5% from the 1990 figures[16]. Besides, the highest increase were reported to be from high-middle socio-demographic index countries (average prevalence rate of 14.6%, 95% UI: 9.8 – 20.1)[16]. On predictive factors associated with prevalence of hypertension at population level, age was among significant factors, as it tends to peak at age range 70-74 years for both sexes and declined immediately thereafter[16]. Also the found that hypertensive heart disease were highest in men aged 65-79 years and women aged 70-84 years[16].

Prevalence estimates of left ventricular hypertrophy among adults with hypertension have been reported to be around 24% in published findings by Ching and colleagues[2]. The findings were derived out of a cross-sectional study comprising 359 patients with uncomplicated essential hypertension at a hospital primary care setting in Malaysia[2]. All subjects were reported to undergo echocardiographic imaging studies. Left ventricular hypertrophy was diagnosed when in diastole left ventricular posterior wall thickness and inter-ventricular septal thickness was ≥ 11 mm[2]. Patients who were obese and male gender had significant positive association with LVH.

Another prospective cohort study that comprised of 178 hypertensives and 89 age-and-sex matched controls were recruited at the cardiology clinic of the medical outpatient department of University of Abuja Teaching Hospital in Nigeria.[1] The study was set out to determine the prevalence of left ventricular hypertrophy among hypertensives as determined by echocardiography. Echo-based prevalence of left ventricular hypertrophy was 32.4%.[1] Subjects

with hypertension had significantly higher systolic and diastolic blood pressures than controls.[1] Furthermore, patients with hypertension had higher BMI (28.0 +/- 6.3 vs. 24.7 +/- 3.9 kgm^{-2}, p<0.001), waist circumference (93.7 +/- 10.8 vs. 91.2 +/- 9.9 cm, p=.05) as well as hip circumference (100.9 +/- 11.8 vs. 102.6 +/- 10.96cms, P=0.005)[1]

Another study done at a tertiary care level hospital in Tanzania revealed a point prevalence of left ventricular hypertrophy of about 62.1% among naïve adult hypertensives[9]. Left ventricular hypertrophy was defined in that study on the basis of either increased left ventricular mass or increased relative wall thickness[9]. Left ventricular hypertrophy was assessed using trans-thoracic 2-D echocardiographic study[9].

The most recent data on correlates of left ventricular hypertrophy among adults with hypertension in Tanzania revealed age, gender (female preponderance), body mass index, systolic and diastolic blood pressures, hypertension duration as well as left ventricular mass to be direct associated with the patterns of left ventricular hypertrophy in adults[12]. However, the study was performed among adults found in Northern parts of Tanzania only[12]. Therefore, a need for a new data representative to Dar es Salaam.

In a longitudinal study led by Dr. Johan Sundström, researchers investigated the relationship between dyslipidemia, fatty acid profiles, and the development of left ventricular hypertrophy (LVH) over a 20-year period. The findings revealed that A 1-standard deviation increase in body mass index (BMI), blood pressure (both systolic and diastolic), LDL/HDL cholesterol ratio, triglycerides, certain fatty acid levels (like saturated fatty acids or oleic acid) in the blood at age 50 was linked to a 27% to 41% higher chance of developing left ventricular hypertrophy (LVH) by age 70.[42]

Existing studies show that LVH is common among hypertensive patients globally and in Tanzania, with prevalence ranging from 24% to over 60%. Factors such as age, obesity, high

blood pressure, and dyslipidemia have been consistently linked to LVH, while newer evidence highlights the importance of triglycerides, HDL levels, and long-term metabolic changes. There is a need to do comprehensive assessment of clinical signs, arrhythmias, central obesity, lipid profiles, and medication adherence together.

This study addresses these gaps by providing updated data from Dar es Salaam regional referral hospitals and examining a wide range of sociodemographic, clinical, metabolic, and behavioral factors associated with LVH, offering a more complete understanding needed for targeted hypertension management in our setting.

Sensitivity of electrocardiography for left ventricular hypertrophy

A study from Norway that adopted the Framingham Heart population framework underwent echocardiographic study for LVH[21]. Echocardiographic LVH was detected in 290 men (14.2%) and 465 women (17.6%)[21]. Electrocardiographic features of LVH were present in 2.9% of men (60/2,042) and 1.5% of women (39/2,642)[21]. The overall sensitivity of the electrocardiographic diagnosis of LVH was 6.9%, whereas specificity was 98.8%[21]. Sensitivity of the electrocardiogram (ECG) for LVH was marginally lower in women than in men (5.6% vs. 9.0%, p = 0.075)[21]. Obesity was inversely associated with sensitivity (p less than 0.05, both sexes combined, sex-adjusted)[21]. Smoking was also inversely related to sensitivity (p = 0.001, both sexes combined, sex-adjusted)[21]. In contrast, the sensitivity of the ECG increased with age (p less than 0.001, both sexes combined, sex-adjusted)[21].

A study that assessed the sensitivity of electrocardiography in the detection of screen-positive left ventricular hypertrophy in echocardiography from Dar es Salaam revealed that out of the total, 326/425 (76.7%) participants of the original cohort had both ECG and echocardiogram measurements and were included in this analysis[10]. Echocardiographic LVH was present in

23.7% and 26.2% of men and women, respectively, while ECG-LVH was detected by S-L in 36.3% of men and 17.3% of women, and by C-P criteria in 20% of men and in 30.4% of women[21]. The sensitivity [95% CI] and specificity [95% CI] of the S-L criteria was 43.8% [26.8–62.1%] and 66.0% [55.9–74.9%] in men while it was 36% [23.3–50.9%] and 89% [82.8–93.7%] in women, respectively[21]. For the C-P criteria, the sensitivity and specificity were 43.8% [26.8–62.1%] and 87.4% [79.0–92.8%] in men and 60% [45.2– 73.3%] and 80.1% [89.7–97.8%] in women, respectively[21]. The sensitivity of the ECG to detect LVH was low in this population, but better than that found in many white populations[21]. Men and women had differences in the sensitivity of the different ECG criteria, with men performing better with S-L and women with C-P criteria[21]. These differences should be considered when including or excluding cases with ECG-LVH in our population[21].

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study design

A cross-sectional analytical hospital-based study.

3.2 Study setting

Dar es Salaam public regional referral hospitals.

Mwananyamala Regional Referral Hospital is a public health facility, located at Kinondoni Municipal Council. It serves as the highest referral facility at Kinondoni municipality. It has a total bed capacity of 240. It has several clinical departments including medicine. Medical clinics (including NCD clinics) are conducted daily from 0800hrs to 1600hrs. On average, NCD clinics' attendance is 32 per day. The dept. of Medicine at Mwananyamala Regional Referral Hospital has specialist physicians and general doctors.

Amana Regional Referral Hospital is a public health referral facility located at Ilala municipal council. It serves as the highest referral facility in Ilala municipality. It has a total bed capacity of 340. It has several clinical departments including medicine. Medical clinics (including NCD clinics) are conducted daily from 0800hrs to 1600hrs. On average, NCD clinics' attendance is 46 per day. The dept. of Medicine at Amana Regional Referral Hospital has specialist physicians and general doctors.

Temeke Regional Referral Hospital is a regional referral hospital serving the municipality of Temeke. It serves as the highest referral facility at Temeke municipality. It has a total bed capacity of 340. It has several clinical departments including medicine. There is 1 specialist physician and 6 general doctors. NCD clinics are conducted every day. On average, NCD clinics have 21 clients per day. Temeke Regional Referral Hospital has specialist physicians, residents, general doctors as well as interns.

3.3 Study population

General population

Adults with hypertension in Dar es Salaam.

Target population

Adult hypertensive patients attending NCD clinics at Dar es Salaam regional referral hospitals.

Study population

All adult hypertensive patients with clinical/radiological features of left ventricular hypertrophy at Dar es Salaam regional referral hospitals.

3.4 Sample size

Adult patients with hypertension were invited to participate and included in this study upon meeting eligibility criteria and with written informed consent.

Specifically, the minimum number of participants in this study will be obtained using a formula as per Leslie et al, in that

$$N = \frac{Z^2 P(1-P)}{E^2}$$

Whereby

N – Minimum sample size

Z – Z-score (at an alpha level of 5% = 1.96)

P - Prevalence of Echo positive LVH = 24%[43]

E – Margin of error (at alpha level = 5%)

$$N = \frac{3.84 * 0.24\,(0.76)}{0.0025}$$

N = 280

So, the minimum sample size needed to achieve the study power will be at least 280 adult patients with hypertension.

Justification of formula

A similar study was done by Ching et al on prevalence and determinants of left ventricular hypertrophy in hypertensive patients at a primary care clinic.

Thus, usage of the same sample size formula ensured adequate study power to answer the primary research question.

3.5 Sampling procedure

In this study, a simple random sampling technique was applied to get the representative regional referral hospital from the three regional referral hospitals. Random number generator technique was used where by numbers were assigned to the hospitals e.g. 1 to 3.

Thereafter random number generator using excel was generated between 1 and 3. The Hospital corresponding to the generated number was chosen.

From the respective hospital chosen by simple random sampling all hypertensive patients attending cardiac clinic using consecutive sampling were included in the study until the desired sample size was reached.

3.5.1 Inclusion criteria

I. Adult (age ≥ 18 years) patients with hypertension.

II. Dar es Salaam resident. The definition of residence will be either someone whose permanent address is Dar es Salaam or whose stay has been for ≥ 6 months consecutively in Dar es Salaam city prior to the date of interview.

3.5.2 Exclusion criteria

I. Patients with proven clinical/biochemical evidence of acute coronary syndromes

II. Patients clinically proven with aortic stenosis

3.6 Study variables

Outcome/dependent variable

Left ventricular hypertrophy

Independent variables

Demographics

(Age, gender, level of education, income level)

Clinical profile

(Symptoms, physical findings, medication types, arrythmias, heart failure)

Risk factors

(BMI, waist circumference, alcohol use, cigarette smoking, physical exercise, medication adherence, duration of hypertension, lipid profile – HDL, LDL, TGs)

3.7 Data collection

Questionnaire

In this study, we used a survey questionnaire to collect important information from participants. It included sociodemographic section; including patient's age, residential area, level of education, income level. Furthermore, there was be a section on risk factors i.e. BMI, social habits like smoking and alcohol intake and physical exercise. Also, it included section to assess the clinical profile of the patient whereby there were questions on symptoms the patient experiences, medications the patient uses and adherence the medications. Moreover, there was a section reserved for the principal investigator to record readings of Echo and ECG and lastly a section on the laboratory values for the lipid profile was provided.

ECHO (Echocardiography)

A Philips CX-50 (2009, USA) Echo machine was used to conduct the examination whereby patients were kept on left decubitus position and in parasternal long axis view using the M mode calculations of the left ventricle in particular the left ventricular posterior wall thickness in diastole and interventricular septal thickness in diastole were measured. The thickness of greater than 11mm confirmed left ventricular hypertrophy.[1,2,3]

ECG (Electrocardiography)

A Philips Tc 20 (2008, USA), 12 leads ECG machine was used to assess for the left ventricular hypertrophy. In particular, the Sokolow-Lyons criteria was used to ascertain left ventricular hypertrophy - whereby if the sum of amplitude of S wave in V1 and R wave in V6 is greater than 35mm indicated left ventricular hypertrophy.[44]

Lipid profile

Lipid profile in particular LDL-C, HDL-C, and triglycerides were analyzed using Mindray Bs 240 at Kairuki Laboratory. Sterile blood drawing techniques were used after obtaining consent from the patient and 3cc blood was collected using 5cc syringe and transferred to yellow blood collection tubes which was stored in a cold storage box at 25 ^{o} C for 5hours and then transported carefully to Kairuki hospital laboratory for analyses.

Reliability and validity of data tool

The questionnaire used in this study was carefully designed by the Principal Investigator (PI), who gathered questions from previous research after conducting a thorough review of the literature.[2,12] This approach ensured that the questionnaire was well-informed and relevant to the study's objectives.

Furthermore, the questionnaire was carefully reviewed by the supervisor, co-supervisors, and the Institutional Review Board (IRB) reviewers, all of whom are experts in Internal Medicine. Their feedback and suggestions were incorporated to refine and improve the questionnaire, ensuring its accuracy and validity for the study.

Echocardiographic and Electrocardiographic data collected by the PI was reviewed by certified Cardiologist as to ensure best quality of the data is obtained.

Moreover, a pretest was accomplished via recruiting about 10% (n=28) of the minimum sample size. The aim of pretesting was to access reliability as well as construct face validity of the tool. Specifically, reliability was summarized using Chronbachs alpha coefficient. Content validity was assessed for individual quantitative estimates via comparing their findings to the normally accepted reference standards at 95% Confidence interval. This process also helped to evaluate how reliable the tool was and refine data collection methods, ultimately strengthening the quality and accuracy of the research.

3.8 Data collection procedures

Data collection commenced firstly by recruiting research assistants from among the nursing staff members at the study site, as the study involved clinical work. Additional training was given to the nursing staffs by giving extra workshops on research goals and activities as well as providing them with a daylong training on ECG and good clinical research practice strategies. Following which the recruitment of participants which was assisted by the nurse in charge. A short briefing was given to the study participants about the study to be conducted. Written informed consent was obtained in the cardiac clinics. All adult hypertension patients recruited attending cardiac clinics at the regional hospitals were eligible to participate in this study. Hypertensive patients were recruited after being verified hypertensive from the clinical data available. A participant was

considered hypertensive if s/he meets the 2023 WHO criteria for diagnosis of hypertension. Specifically, a diagnostic cut-off for systolic reading was ≥ 140 mmHg. Likewise, a diagnostic cut-off for diastolic reading was ≥ 90 mmHg.

Written informed consent was given to those patients who were eligible for the study before including/excluding them from the study. A questionnaire form was used to collect data from study participants. A minimum of 280 adult participants with hypertension were included in this study.

Data on date of birth, gender, level of education, level of income, residence, weight (in kilogram using Seca weighing scale) as well as height (in meters) waist circumference was obtained using a measuring tape and BMI was also obtained. Other information assessed via the pre-designed clinical sheet included social history (alcohol status, smoking status, exercise status) which was inquired from each participant. Furthermore, participants were inquired about any accompanied symptoms (chest pain, fatigue, exertional dyspnea, dizziness or fainting (syncope), dyspnea at rest, paroxysmal nocturnal dyspnea, Fast heartbeats, chest tightness). Thereafter, each participant was screened by trans-thoracic echocardiography in parasternal long axis and measurements of left ventricular posterior wall and intraventricular septum dimensions during diastole were taken using the M-mode in Philips CX-50 (2009, USA) and resting electrocardiography using Mindray BeneHeart R12. Also, patients were assessed for physical findings on chest examination (Shifting of the cardiac apex and sustained heave on palpation).

Lastly, 3-6mls of blood from all hypertensive participants was drawn for lipid analysis (LDL-C, HDL-C, triglycerides) using Mindray Bs 240. Sterile blood drawing techniques were used after obtaining consent from the patient and 3-6mls blood was collected using 5cc syringe and transferred to yellow blood collection tubes which was stored in a cold storage box at 25 ^{o}C for 5 hours and then transported carefully to Kairuki hospital laboratory for analyses.

3.9 Data analysis

Immediately following each day of data collection, all data was triple entered into an Epi-Info template and cleaned (for errors – e.g. recording errors, incomplete data entry for corrections) before storage in the Principal Investigator's computer until analysis time. Data was transferred into the MS Excel file before the exploration data analysis process. This process formed the initial stages of data analysis. Specifically, during exploratory data analysis, univariate analysis (e.g. summary of important variable statistics like median age and proportion of gender by % was done to learn the general trend in data structure necessary for main data analysis). Thereafter, main data analysis was applied using a logistic regression model. Specifically, a binary multivariable logistic regression model will be applied after appropriate model validation. For the fitted binary multivariable regression models, the dependent variable (i.e. prevalence of left ventricular hypertrophy) was regressed against a set of different independent variables. Details about which independent variables were to be included in the model depended on the appropriateness of data structure concerning linear model assumption fitness. Main data analysis was done using SPSS version 23 (IBM, USA). Unless otherwise stated, an alpha level of 5% was used to disprove type 1 error in univariate findings while a p-value ≥ 0.2 was a limit for variable inclusion into the fitted binary multivariable logistic regression model.

3.10 Ethical considerations

Written informed consent was obtained from each participant before recruitment into the study. Specifically, informed consent constituted the description of the goal of the study, risks and benefits of participating in the study, a statement that participation in the study is voluntary. Data was anonymized and handled confidentially during research. Specifically, only investigators were positioned to see the raw data. The study did not cause any serious harm to the study

participants, during blood collection proper selection site was chosen, applied with tourniquet, only a small amount of blood 2cc was collected using small bore syringe. The needle was withdrawn quickly and smoothly to minimize pain and after the procedure the participant was asked to keep their arm flexed to stop the bleeding with a compression gauze. Besides, permission to conduct the study at the respective sites was sought from the medical officers in charge of the hospital site.

The ethical clearance certificate was sought from the Institutional Research Ethics Committee (IREC) of Kairuki University (KU) in Dar es Salaam, Tanzania.

CHAPTER FOUR

4.0 RESULTS

This cross-sectional clinical research study was conducted from November 2024 to July 2025, a total of 280 adults living with hypertension attending Dar es Salaam regional referral hospitals were recruited. The baseline descriptive summary statistics of study participants data are as provided in table 1 below:

Table 1: Distribution of baseline characteristics of study participants with hypertension attending Dar es Salaam regional referral hospitals for care (N=280).

Continuous	Variables	
Variable name	**Mean**	**SD**
Age (in completed years)	61.2	13.9
BMI (in kgm^{-2})	28.5	6.7
Waist circumference (in inches)	39.3	5.3
Reported income per month (in Tshs)	131,114	50,088
Systolic blood pressure (in mmHg)	151	26
Diastolic blood pressure (in mmHg)	90	15
Duration of hypertension from diagnosis (in completed years)	7.5	8.6
LDL-C (mmol/L)	3.8	1.1
HDL-C (mmol/L)	1.4	0.5
TGs (mmol/L)	1.4	0.9
LVEF (%)	61.3	12.5

Categorical	Variables	
Variable name	**Frequency**	**Proportion (by %)**
Gender		
1. Female	221	78.9
2. Male	59	21.1
Cigarette smoking status		
1. Smokers	4	1.4
2. Non-smokers	276	98.6
Alcohol status		
1. Active drinkers	15	5.4
2. Non-drinkers	251	89.6
3. Quit drinkers	14	5.0
LVH-status based on Echocardiography		
1. LVH evident	162	57.9
2. No evidence of LVH	118	42.1
LVH-status based on ECG		
1. LVH-evident	57	20.4
2. No evidence of LVH	223	79.6

From the above table 1, the mean age was 61.2 years with SD of 14. The youngest participant was 27 years old and the oldest was 100 years. Other continuous variables summary statistics included body mass index with mean 28.5 +/- 6.7 kgm^{-2}, waist circumference with mean of 39.3 +/- 5.3 inches. Systolic and diastolic blood pressure had means (+/- S.D) of 151 (+/- 26) mmHg and 90 (+/- 15) mmHg respectively. Serum lipids levels measured included LDL-cholesterol,

HDL-cholesterol and triglycerides levels with mean (+/- S.D.) of 3.8 (+/-1.1), 1.4 (+/-0.5) and 1.4 (+/-0.9) mmol/L respectively. In general, the study participants had a mean left ventricular ejection fraction of 61.3% and S.D of 12.5. Study participants also reported a mean income of around Tshs. 131,144 per month. All participants had a mean duration of hypertension from diagnosis of around 7.5 (+/- 8.6) years. Moreover, it was of interest to study investigators to assess some selected socio-demographic variables of study participants by their resultant echocardiographic-based LVH status. In this study, there was a female preponderance, where by about four-fifth of all study participants were females. Reported active smokers were rare (1.4%, n=4) as well as active drinkers (5.4%, n= 15) even though the figures for ever drinkers rise to 10.4% if quit drinkers are also included. Prevalence of left ventricular hypertrophy was about 60% on echocardiographic basis and the figures reduced to around one-fifth on resting electrocardiographic screening.

Table 2 below provided estimates of association between selected socio-demographic variables by Echocardiographic-based LVH status among study participants.

Table 2: Socio-demographic characteristics by LVH status of hypertensive adults attending Dar es Salaam regional referral hospitals (N=280).

Variable	**LVH Status on Echo**			**χ^2**	**P-**
Socio-demographic	**LVH Positive (%)**	**LVH Negative (%)**	**Total**	**(df)**	**Values**
Age					
18-44 years	11 (3.9%)	16 (5.7%)	27 (9.6%)	3.54 (1)	0.06
45-64 years	73 (26.1%)	60 (21.4%)	133(47.5%)	0.92 (1)	0.34
>65 years	78 (27.9%)	42 (15%)	120(42.9%)	4.43 (1)	**0.038**
Total	162 (57.9%)	118 (42.1%)	280(100%)		
Gender					
1. Female	123 (43.9%)	98 (35%)	221(78.9%)	2.1 (1)	0.145
2. Male	39 (13%)	20 (7.1%)	59(21.1%)	2.1 (1)	0.145
Total	162 (57.9%)	118 (42.1%)	280(100%)		
Income status					
1. Not Earning	61 (21.8%)	51 (18.2%)	112 (40%)	0.9 (1)	0.348
2. Reported to be earning income	101 (36.1%)	67 (23.9%)	168 (60%)		
Total	162 (57.9%)	118 (42.1%)	280 (100%)		
Level of education					
1. Degree holders +	5 (1.8%)	1 (0.4%)	6 (2.1%)	1.8 (2)	0.4
2. Secondary	25 (8.9%)	19 (6.8%)	44 (15.7%)		
3. Primary/No education	132 (47.1%)	98 (35%)	230(82.1%)		
Total	162 (57.9%)	118 (42.1%)	280 (100%)		

Data on estimates of the association between selected socio-demographic variables on Echocardiographic-based LVH status of study participants were obtained using likelihood ratio Chi-square test statistics and their corresponding degrees of freedom. Each socio-demographic variable was categorized accordingly in order to make logical and standard justifications. For instance, the decision to categorize actual age of participants followed the Who standard categorization for age. Of all the selected socio-demographic characteristics, age above 65 years was found to be statistically significant at 5% level with a likelihood chi-square test score of 4.43 under 1 degree of freedom.

In this study, investigators also focused on assessing clinical profiles associated with CV-pathologies by the echocardiographic based LVH-status among study participants. Estimates of association between selected symptoms and signs associated with CV-pathologies by the echocardiographic based LVH-status among study participants is as summarized in table 3 below:

Table 3: Clinical profile by LVH status of hypertensive adults attending Dar es Salaam regional referral hospitals (N=280).

Variable	LVH status on echocardiography			χ^2	P-
Clinical Features	**LVH Positive**	**LVH Negative**	**Total**	**(df)**	**value**
Chest pain					
1. **Evident**	58 (20.7%)	39 (13.9%)	97 (34.6%)	0.2	0.632
2. **Not reported**	104 (37.1%)	79 (28.2%)	183 (65.4%)	(1)	
Total	162 (57.8%)	118 (42.1%)	280 (100%)		
Fatigue					
1. **Evident**	73 (26.1%)	41 (14.6%)	114 (40.7%)	3.0	0.082
2. **Not reported**	89 (31.7%)	77 (27.5%)	166 (59.3%)	(1)	
Total	162 (57.9%)	118 (52.1%)	280 (100%)		
Shortness of breath on exertion					
1. **Evident**	21 (7.5%)	9 (3.2%)	30 (10.7%)	2.1	0.147
2. **Not reported**	141 (50.4%)	109 (38.9%)	250 (89.3%)	(1)	
Total	162 (57.9%)	118 (42.1%)	280 (100%)		
Shortness of breath at rest					
1. **Evident**	12 (4.3%)	6 (2.1%)	18 (6.4%)	0.6	0.429
2. **Not evident**	150 (53.6%)	112 (40%)	262 (93.6%)	(1)	
Total	162 (57.9%)	118 (42.1%)	280 (100%)		
Dizziness					
1. **Evident**	61 (21.8%)	35 (12.5%)	96 (34.3%)	1.95	0.162
2. **Not reported**	101 (36.1%)	83 (29.6%)	184 (65.7%)	(1)	
Total	162 (57.9%)	118 (42.1)	280 (100%)		
Fast heart beats					
1. **Evident**	104 (37.1%)	59 (21.1%)	163 (58.2%)	5.65	**0.017**
2. **Not reported**	58 (20.7%)	59 (21.1%)	117 (41.8%)	(1)	
Total					

	162 (57.9%)	118 (42.1%)	280 (100%)		
Chest tightness					
1. Evident	28 (10%)	16 (5.7%)	44 (15.7%)	0.72	0.395
2. Not reported	134 (47.9%)	102 (36.4%)	236 (84.3%)	(1)	
Total	162 (57.9%)	118 (42.1%)	280 (100%)		
Sudden shortness of breath					
1. Evident	11 (3.9%)	5 (1.8%)	16 (5.7%)	0.85	0.356
2. Not reported	151 (53.9%)	113 (40.4%)	264 (94.3%)	(1)	
Total	162 (57.9%)	118 (42.1%)	280 (100%)		
Shifting of the apex beat					
1. Evident	116 (41.4%)	1 (0.4%)	117 (41.8%)	175.7	**0.000**
2. Non-evident	46 (16.4%)	117 (41.8%)	163 (58.2%)	(1)	
Total	162 (57.9%)	118 (42.1%)	280 (100%)		
Sustained heave					
1. Evident	36 (12.9%)	0 (0%)	36 (12.9%)	43.2	**0.000**
2. Non-evident	126 (45%)	118 (42.1%)	244 (87.1%)	(1)	
Total	162 (57.9%)	118 (42.1%)	280 (100%)		

Out of all clinical features studied, fast heartbeats, shifting of the apex beat and sustained heave were found to be statistically significant at 5% level on the likelihood ratio Chi-square test statistics. Specifically, the association between LVH status on echocardiographic screening and shifting of the apex beat was estimated to have a Chi-square test score of 175.7 under 1 degree of freedom while sustained heave had an estimated Chi-square test score of 43.2 under 1 degree of freedom.

Furthermore, it was of special interest to assess the association of anti-hypertensive medication use and the resultant LVH status based on echocardiographic estimates among study participants. Table 4 below provided the summary statistics of the estimates of association between reported anti-hypertensive medication use and echocardiographic-based LVH status among adults living with hypertension attending Dar es Salaam regional referral hospitals for care:

Table 4: Anti-hypertensive medication in use by LVH status on Echocardiography of hypertensive adults attending Dar es Salaam regional referral hospitals (N=280).

Variable name	**LVH Status on Echo**			
Anti-HTN drug group	**LVH Present**	**LVH Absent**	**x^2(df)**	**P-value**
Calcium Channel Blockers	102	83	1.67(1)	0.196
Angiotensin Receptor Blockers	110	76	0.37(1)	0.541
Beta Blockers	16	11	0.02 (1)	0.876
Diuretics	78	65	1.3 (1)	0.251
ACE-inhibitors	4	2	0.2 (1)	0.655
Alpha blockers	8	3	1.09 (1)	0.297
Number of medications				
- **0**	11	7	1.74(3)	0.629
- **1**	48	35		
- **2**	45	26		
- **3**	58	50		

From the table 4 above, it was evident that none of the anti-hypertensive drug group has a statistically significant association with left ventricular hypertrophy status at 5% level.

Frequency of arrythmias based on echocardiographic status of LVH among study participants is summarized in table 5 below:

Table 5: Arrhythmias by LVH status of hypertensive adults attending Dar es Salaam regional referral hospitals 2025 (N=280).

Variable	**LVH Status on Echo**			x^2	**P-**
Arrhythmias	**LVH Positive (%)**	**LVH Negative (%)**	**TOTAL**	**(df)**	**Value**
Atrial fibrillation					
1. Present	27 (9.6%)	2 (0.7%)	29(10.4%)	20.14(1)	**0.000**
2. Absent	135 (48.2%)	116 (41.4%)	251(89.6%)		
Total	162 (57.9%)	118 (42.1%)	280(100%)		
PAC					
1. Present	7 (2.5%)	4 (1.4%)	11(3.9%)	0.15(1)	0.690
2. Absent	155 (55.4%)	114 (40.7%)	269(96.1%)		
Total	162 (57.9%)	118 (42.1%)	280(100%)		
PVC					
1. Present	13 (4.6%)	2 (0.7%)	15(5.4%)	6.19(1)	**0.013**
2. Absent	149 (53.2%)	116 (41.4%)	265(94.6%)		
Total	162 (57.9%)	118 (42.1%)	280(100%)		
LBBB					
1. Present	50 (17.9%)	8 (2.9%)	58(20.7%)	26.9(1)	**0.000**
2. Absent	112 (40%)	110 (39.3%)	222(79.3%)		
Total	162 (57.9%)	118 (42.1%)	280(100%)		
RBBB					
1. Present	13 (4.6%)	4 (1.4%)	17(6.1%)	2.75(1)	0.098
2. Absent	149 (53.2%)	114 (40.7%)	263(93.9%)		
Total	162 (57.9%)	118 (42.1%)	280(100%)		
1st Deg. Heart block					
1. Present	13 (4.6%)	1 (0.4%)	14(5%)	9.12(1)	**0.003**
2. Absent	149 (53.2%)				
Total	162 (57.9%)				

		117 (41.8%)	266(95%)		
		118 (42.1%)	280(100%)		
3rd Deg. Heart block					
1. Present	5 (1.8%)	1 (0.4%)	6(2.1%)	1.83(1)	0.176
2. Absent	157 (56.1%)	117 (41.8%)	274(97.9%)		
Total	162 (57.9%)	118 (42.1%)	280(100%)		
Tachycardia					
1. Present	30 (10.7%)	12 (4.3%)	42(15%)	3.87(1)	**0.049**
2. Absent	132 (47.1%)	106 (37.9%)	238(85%)		
Total	162 (57.9%)	118 (42.1%)	280(100%)		
Bradycardia					
1. Present	13 (4.6%)	2 (0.7%)	15(5.4%)	6.19(1)	**0.029**
2. Absent	149 (53.2%)	116 (41.4%)	265(94.6%)		
Total	162 (57.9%)	118 (42.1%)	280(100%)		

From the table 5 above, the frequency of atrial fibrillation (9.6%), premature ventricular contractions (4.6%), left bundle branch block (17.9%), 1st degree heart block (4.6%), tachycardia (10.7%), bradycardia (4.6%) was found to be statistically significant among participants with LVH among hypertensives.

Moreover, heart failure outcomes based on echocardiographic-based LVH status among study participants is as summarized in table 6 below:

Table 6: Heart Failure by LVH status of hypertensive adults attending Dar es Salaam regional referral hospitals (N=280).

Variable name	**LVH Status**			**x^2**	
	LVH Positive	**LVH Negative**	**Total**	**(df)**	**P-value**

Heart failure (LVEF < 50%)	41 (14.6%)	2 (0.7%)	43(15.4%)	27.5 (1)	**0.000**
No heart failure (LVEF ≥ 50%)	121 (43.2%)	116 (41.4%)	237(84.6%)		
Total	162 (57.9%)	118 (42.1%)	280(100%)		

Note: Chi-square statistic was estimated and reported with continuity correction.

From table 6 above, there was evidence of statistical association between left ventricular hypertrophy status and subsequent heart failure with a Chi-square test statistic of 27.5 under 1 degree of freedom.

Moreover, the magnitude of risks associated with LVH among adults living with hypertension attending Dar es Salaam regional referral hospitals for care is as provided in table 7 below:

Table 7: Risk factors associated with LVH status for hypertensive adults attending Dar es Salaam regional referral hospitals (N=280).

	LVH status on echocardiography			χ^2	
Risk Factors	**LVH Present**	**LVH Absent**	**Total**	**(df)**	**P-value**
Ageing				4.4 (1)	**0.035**
≥ 65 years	78 (27.9%)	42 (15%)	120(42.9%)		
< 65 years	84 (30%)	76 (27.1%)	160(57.1%)		
Total	162 (57.9%)	118(42.1%)	280(100%)		
Waist circumference				13.7 (1)	**0.000**
≥ 40 inches	88 (31.4%)	38 (13.6%)	126(45%)		
< 40 inches	74 (26.4%)	80 (28.6%)	154(55%)		
Total	162 (57.9%)	118 (42.1%)	280(100%)		
Alcohol drinking				0.54 (1)	0.548
Yes	18 (6.4%)	10 (3.6%)	28(10%)		
No	144 (51.4%)	108 (38.6%)	252(90%)		
Total	162 (57.9%)	118 (42.1%)	280(100%)		
Cigarette smoking				4.4 (1)	**0.036**
Yes	4 (1.4%)	0 (0%)	4(1.4%)		
No	158 (56.4%)	118 (42.1%)	276(98.6%)		
Total	162 (57.9%)	118 (42.1%)	280(100%)		
Physical exercise				3.35 (1)	0.067
Yes	144 (51.4%)	112 (40%)	256(91.4%)		
No	18 (6.4)	6 (2.1%)	24(8.6%)		
Total	162 (57.9%)	118 (42.1%)	280(100%)		
Anti-hypertensive medication adherence				85.6 (1)	**0.000**
Yes	63(22.5%)	107 (38.2%)	170(60.7%)		
No	99(35.4%)	11 (3.9%)	110(39.3%)		
Total					

	162(57.9%)	118 (42.1%)	280(100%)		
Duration of hypertension					
Newly diagnosed	19(6.8%)	21 (7.5%)	40(14.3%)	6.8 (2)	**0.028**
1-5 years	71(25.4%)	59 (21.1%)	130(46.4%)		
≥ 5 years	72(25.7%)	38 (13.6%)	110(39.3%)		
Total	162(59.9%)	118(42%)	280(100%)		
LDL-C level					
-Elevated (≥4mmol/L)	63(22.5%)	45 (16.1%)	108(38.6%)	0.016 (1)	0.898
-Normal (≤ 4mmol/L)	99(35.4%)	73 (26.1%)	172(61.4%)		
Total	162(57.9%)	118 (42.1%)	280(100%)		
HDL-C level					
-Normal (≥1.2mmol/L)	71(25.4%)	46 (16.4%)	117(41.8%)	0.66 (1)	0.417
-Low (≤1.2mmol/L)	91(32.5%)	72 (25.7%)	163(58.2%)		
Total	162(57.9%)	118(42.1%)	280(100%)		
Triglycerides level					
Elevated (≥ 1.7mmol/L)	48(17.1%)	22 (7.9%)	70(25%)	4.49(1)	**0.034**
Normal (≤ 1.7mmol/L)	114(40.7%)	96 (34.3%)	210(75%)		
Total	162(57.9%)	118(42.1%)	280(100%)		

From the above table 7, There was association between selected risk factors and left ventricular hypertrophy status on echocardiographic screening was found. Specifically, the factors of age ≥65 years, BMI ≥ 30kgm^{-2}, waist circumference ≥ 40 inches**,** cigarette use, increased duration of hypertension from diagnosis, non-adherence to anti-hypertensive medication and triglyceride ≥1.7mmol/L were all found to be statistically significant at 5% level.

Finally, it was of interest to test the association between the selected risk factors and left ventricular hypertrophy status in a linear model. Specifically, table 8 below provides estimates of both univariate and multivariable logistic regression fitted model after appropriate validation of linear model assumptions.

Table 8: Multivariable analysis of risk factors associated with left ventricular hypertrophy among hypertensive adults attending Dar es Salaam regional referral hospitals.

Risk factors	Univariate Statistics			Multivariable Statistics		
Variable name	**O.R**	**(95%C.I.)**	**p-value**	**A.O.R**	**(95% C.I.)**	**p-value**
Age **≥ 65 years** **< 65 years (ref)**	**1.7**	**(1.0 – 2.7)**	**0.037**	**3.1**	**(1.6-5.96)**	**0.001**
BMI **BMI≥ 30kgm^{-2}** **BMI<30kgm-2 (ref)**	1.96	(1.18-3.26)	0.009	1.9	(0.9-4.2)	0.102
Waist circumference **WC≥ 40 inches** **WC< 40 inches (ref)**	**2.5**	**(1.5-4.1)**	**0.000**	**2.4**	**(1.2-5.1)**	**0.02**
Duration of hypertension from Dx >5 years **≤5 years (ref)**	1.82	(1.12-2.94)	0.015	1.4	(0.8-2.7)	0.253
LDL-C level ≥4mmol/L	1.03	(0.63-1.7)	0.898			
HDL-C level	0.78	(0.45-1.36)	0.378			
Triglycerides level **TG ≥1.7 mmol/L**	1.84	(1.04-3.26)	0.037	1.99	(0.97-4.1)	0.063
Anti-hypertensive medications adherence	**0.07**	**(0.03-0.1)**	**0.000**	**0.04**	**(0.02-0.1)**	**0.000**
Cigarette smoking	1.2	(0.4 – 2.3)	0.214			

From the above table 8, it was evident that the factors of age, waist circumference, reported anti-hypertensive drugs adherence had attained statistical significance at 5% level during multivariable binary logistic regression analysis. Specifically, for multivariable binary logistic regression analysis, people aged above 65 years had a three-fold increased chances of being found with left ventricular hypertrophy compared to those whose age was less than 65 up and above all other factors in the analyzed model. Likewise, participants whose waist circumference was at least 40 inches had a 2.4-fold increased chances of being found with left ventricular hypertrophy compared to those participants whose waist circumference was less than 40 inches, all other factors in check. Moreover, participants who reported to have strict adherence to their anti-hypertensive medications were found to have 96% protective chances against left ventricular hypertrophy compared to those who were non-adherent, all other factors in check.

In contrast, during univariate analysis, factors of age, body mass index, waist circumference, duration of hypertension from diagnosis, triglyceride levels and reported anti-hypertensive drugs adherence were found to be statistically significant risks associated with left ventricular hypertrophy. Specifically, those participants aged 65 years and above had about 70% increased chances of being found with left ventricular hypertrophy compared to those aged younger than 65 years. Likewise, obese participants were found to have about 96% increased chances of left ventricular hypertrophy compared to those who were non-obese. Moreover, those participants whose waist circumference was at least 40 inches had 2.5-fold increased chances of left ventricular hypertrophy compared to those whose waist size was less than 40 inches. Participants whose duration of hypertension from diagnosis was older than 5 years had about 82% increased chances of being found with left ventricular hypertrophy compared to those whose reported duration of hypertension from diagnosis to the date of interview was at most 5 years. Participants whose serum triglycerides level was greater than 1.7 mmol/L had about 84%

increased chances of being found with left ventricular hypertrophy compared to those whose serum triglyceride levels was less or equal to 1.7 mmol/L. Lastly, those study participants who reported strict adherence to their anti-hypertensive medications were found to have about 93% protective chances against being found with left ventricular hypertrophy compared to those who were reportedly non-adherent.

CHAPTER FIVE

5.0 DISCUSSION

This study determined the prevalence, sociodemographic characteristics, magnitude of risk factors, clinical profile and lipid profile of left ventricular hypertrophy among hypertensives attending Dar es Salaam public regional referral hospitals in 2025. In this study, findings revealed about three out of every five study participants to have echocardiographic evidence of left ventricular hypertrophy. Prevalence of LVH found among hypertensives on echocardiographic examination was 57.9%. The prevalence findings of this study are similar to others studies from other countries and even Tanzania published before.[9,12,13] For instance, the meta-analysis done by Cuspidi that incorporated findings by Salles et al reported LVH prevalence of 50%[13]. In Tanzania, a study done by Chillo et al found a prevalence of 62.1% among naïve hypertensive adults attended at the national hospital[9].

Sociodemographic characteristics and their association to left ventricular hypertrophy were also analyzed in this study. Specifically, of all the factors age was found to be the most significant factor on statistical grounds. Age >65 years was found to have increased odds of 3 folds towards developing left ventricular hypertrophy compared to those who were younger than 65 years. The findings on age was similar to a report from Framingham heart study by Daniel Levy et al that showed age > 70 years had up to 4 folds higher chances of developing LVH in elderly hypertensives than in found in younger age groups[45]. This can be explained by the pathophysiologic mechanisms. With ageing process, there are significant functional and structural changes in arterial system[46,47]. In particularly arterial stiffness increases due to degeneration of elastic fibers, accumulation of collagen and calcification[47]. This leads to increased systolic blood pressure. The left ventricle then compensates for this increased after load by developing concentric LVH to maintain enough cardiac outputs. Therefore, LVH

develops[46,47]. The strong association between older age and the development of left ventricular hypertrophy highlights the need for age-specific strategies in hypertension management. Older hypertensive patients may require closer clinical monitoring, earlier echocardiographic evaluation, and more intensive blood pressure control to mitigate age-related cardiovascular structural changes.

In analysis for the clinical profile, among symptoms experienced by the participants fast heartbeats was significantly associated with LVH. On physical examination shifting of the apex beat and sustained heave were also significantly associated with LVH. These findings are in line with the established pathophysiological processes that hypertension leads to the development of LVH. Fast heartbeat occur due to conduction system remodeling in LVH[48]. A shifted apex beat implying a displaced inferiorly or laterally heart beat due to the enlarged left ventricle[26]. Likewise, a sustained heave upon palpation reflects to a forceful systolic contraction indicating an increased left ventricle mass against the increased pressure load over a prolonged duration[26,25]. These findings align with findings from a study done in Japan on evaluation of apex beat using CT scan which revealed that sustained heave and shifting of the apex beat had a sensitivity of 57% and specificity of 90% in detecting LVH[49]. The association of fast heartbeats, shifted apex beat, and sustained heave with LVH highlights the continued importance of careful physical examination in hypertensive patients. These clinical signs can serve as useful early indicators of possible structural heart changes and should prompt further confirmation with echocardiography, especially in settings where diagnostic resources are limited.

Furthermore, in this study arrhythmias were significantly associated with LVH. Specifically atrial fibrillations, PVC, 1st Degree heart blocks, LBBB, tachycardia and bradycardia were significantly associated with LVH. These findings align to findings from Framingham heart study which also

found that arrythmias were significantly associated with LVH[50]. These findings are line with the pathophysiological process that LVH leads to myocardial interstitial fibrosis and therefore remodeling of the electrical pathways in the myocardium which can lead to delays in myocardial electrical conduction e.g. In 1st degree heart blocks and LBBB. Also a reentry of the electrical impulses due to myocardial fibrosis and collagen deposition in LVH, causes prolonged electrical impulse resulting into atrial fibrillations[51]. These findings highlight the clinical significance of LVH beyond its diagnostic presence, demonstrating its association with symptomatic and potentially life-threatening electrical disturbances. Therefore, the arrhythmia burden observed reinforces the need for close monitoring and timely intervention in patients with LVH.

Moreover, in this study heart failure showed significant association with the presence of LVH as 14.6% with LVH had heart failure on echocardiographic evaluation. This finding aligns with pathophysiological processes of hypertension that leads to structural insults due to prolonged pressure and volume overload eventually impairing ventricular compliance therefore reducing the left ventricular ejection capacity over time[52,25]. These findings are similar to findings from Framingham heart study which found that participants with established diagnosis of LVH eventually developed heart failure after follow up over extended period of time[53]. Therefore, optimal blood pressure control, comprehensive risk-factor modification, and periodic cardiac evaluation should be done to reduce the likelihood of transition from LVH to symptomatic heart failure.

On multiple logistic regression model for risks associated with LVH, Waist circumference of >40 inches independently had 2.5 folds increased odds of developing LVH compared to those with <40 inches. This finding was similar to Zhang et al who found that about 2-folds increased odds of developing LVH among patients with increased waist circumference[54]. Furthermore, Stel et al,

2013 also found that patients with increased waist circumference had increased odds of developing LVH[55]. The observation can be explained by the fact that obesity is strongly linked to insulin resistance, whereby in insulin resistance, there is an increased chronic insulin secretion that leads to sodium re-absorption in the kidneys[56]. The resultant effects being elevated blood pressure, leads to increased afterload, eventually developing left ventricular hypertrophy. Likewise, insulin causes stimulation of insulin growth factors that in turns causing direct myocardial thickness[57]. Central obesity is not only a metabolic risk factor but also a significant contributor to structural cardiac remodeling. Integrating waist circumference measurement into routine clinical evaluation may therefore help clinicians identify high-risk hypertensive patients earlier, prioritize lifestyle and weight-management interventions.

Moreover, study participants with reported strict adherence to anti-hypertensive medications were independently likely to have 96% protective effects against left ventricular hypertrophy in comparison to those without strict medication adherence. This was similar to results from Tadese et al that found poor medication adherence had up to 4-folds increased chances of developing left ventricular hypertrophy[58]. Likewise, in a study by Kamasova et al, it was found that patients who were adherent to anti-hypertensive medications had less degrees of left ventricular hypertrophy compared to those without medication adherence[59]. This can be explained by the fact that non-adherence to medications leads to persistent elevated blood pressures which causes increased afterload and greater stress on the left ventricular wall, eventually that cause myocyte hypertrophy as a compensation mechanism[23]. Contemporary guidelines, including those from the European society of cardiology (ESC) and American heart association (AHA), identify medication adherence as a cornerstone of effective blood pressure control and a key determinant in preventing hypertension mediated organ damage such as LVH. The findings from this study support these recommendations by demonstrating that consistent use of

antihypertensive medications markedly reduces the structural cardiac changes associated with uncontrolled hypertension. Prioritizing strategies that improve adherence such as patient education, simplified treatment regimens and regular follow-up may therefore play a critical role in preventing LVH.

Furthermore, the study found lipid profiles in specific elevated triglycerides (>1.7 mmol/L) was found to be significantly associated with almost 2-folds increased chances towards development of left ventricular hypertrophy in univariate analysis. Moreover, HDL level had 22% protective effects even though non-significant on statistical grounds. LDL-cholesterol levels had no effects on the risk for developing left ventricular hypertrophy. The current findings are similar to findings from Japan which found that triglycerides were correlated to left ventricular hypertrophy, and increased HDL-C were inversely associated with left ventricular hypertrophy[60]. In the same Japanese study, LDL-C had no correlation with LVH[60]. Also, in another study increased triglycerides were associated with about 31% increased chances for developing left ventricular hypertrophy and in the same study, having increased HDL-C had up to 26% protective effects against developing left ventricular hypertrophy.[61] The current observations can be explained by the fact that elevated triglycerides leads to insulin resistance and furthermore increased insulin secretion that leads to increased renal sodium retention and blood volume expansion. This leads to fluid overload and greater stress on left ventricular walls, leading to hypertrophy.[57] In addition, the protective effects of HDL-C may come about by its anti-oxidative stress effects through its activity of removing oxidized lipids and reduced production of reactive oxygen species[62]. It finally protects cardiomyocytes from oxidative damages[62]. The association between elevated triglyceride levels and increased risk of LVH, together with the potential protective trend observed for higher HDL-C levels, underscores the importance of comprehensive lipid management in individuals with hypertension. Integrating triglyceride control and promotion

of healthier lipid profiles into hypertension management through lifestyle modification, weight reduction, and pharmacologic therapy when indicated may help reduce the burden of LVH and improve long-term cardiovascular outcomes.

Strength and weaknesses

The study utilized echocardiographic assessment to determine the presence of left ventricular hypertrophy, which is considered the gold standard for evaluating cardiac structural changes. This enhanced the accuracy and validity of the LVH diagnosis compared to studies relying solely on ECG criteria.

Moreover, it was comprehensive assessment of risk factors and Multiple dimensions were evaluated simultaneously including demographics, clinical profile, lipid profile. This allowed for a holistic understanding of the determinants and correlates of LVH among hypertensive patients.

In contrast, as a weakness of this study, some study participants, especially the senior citizens could not have accurately remembered past symptoms thereby their frequency likely under reported. Thus, for all practical purposes, some of the useful data relied on what was reported by respondents but through validation via available/retrievable medical records.

Conclusion

In this study About three out of every five hypertensive adults had echocardiographic evidence of left ventricular hypertrophy. Older age greater than 65years increased odds by 3 folds towards developing LVH. Waist circumference of greater than 40 inches had 2.5 folds increased odds of developing LVH. Adherence to medications had 96% protective effect against developing LVH. Increased duration of hypertension and Dyslipidemia specifically Triglycerides were independently associated to higher chances of developing LVH among hypertensive participants.

Recommendations

1. **Maintain consistent blood pressure monitoring and follow-up:**

   Patients are encouraged to check their blood pressure regularly and attend scheduled clinic visits. Early recognition of elevated readings allows for timely adjustment of therapy and better long-term control.

2. **Adhere strictly to prescribed antihypertensive medications:**

   Since medication adherence was found to be strongly protective against LVH, patients should take their medications exactly as prescribed. They should be encouraged to discuss any barriers such as side effects, cost, or forgetfulness with their healthcare providers.

3. **Seek early screening when at higher risk:**

   Patients who are older (≥65 years), have a large waist circumference, or have elevated triglyceride levels should be aware that they are at increased risk of LVH and should undergo echocardiographic evaluation when recommended.

4. **Adopt healthy lifestyle habits:**

   Patients should be encouraged to maintain a healthy weight, engage in regular physical activity, reduce dietary salt and unhealthy fats, and follow balanced nutritional plans. These changes help improve blood pressure and metabolic health.

5. **Be vigilant about symptoms of heart rhythm problems:**

   Patients with hypertension, especially those already diagnosed with LVH, should seek medical evaluation if they experience palpitations, dizziness, chest discomfort, or unexplained fatigue. Early detection of arrhythmias can prevent complications.

6. **Increase personal awareness and understanding of hypertension:**

   Patients should be educated on the importance of controlling blood pressure and understanding how lifestyle, diet, and medication adherence affect heart health. Empowering patients with knowledge can improve long-term outcomes.

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Appendices

Appendix I: Informed Consent Form (English version)

I, Dr. Sibte Mohamed Abdi, a resident in the Department of Internal Medicine, am conducting this study as part of my postgraduate research. Your participation is important in helping us gather valuable health information that will contribute to this study. Your input will be greatly appreciated.

This study aims to determine distribution, risk factors and clinical profile of adult hypertensive patients with left ventricular hypertrophy. Findings from this research will advocate for the early and periodical screening of hypertensive patients for left ventricular hypertrophy using Echo. Adult hypertensive patients who will meet inclusion criteria will be considered for this study. A questionnaire will be used to obtain social demographic data. Also, the patient will have to remove their upper clothing as expose the chest area so as to obtain Echo and ECG readings. Furthermore, blood sample will be taken to test for lipid profile of this patient. These tests will be free and the participant will not be charged. The participant is free to withdraw from this study at any point.

People to contact in case of any further concerns:

Prof Y. Mgonda, chairperson of the Department of Internal Medicine (+255754277554)

Secretary of KU-IREC: Prof. Columba Mbekenga (+255784645777)

Principal Investigator: Dr. Sibte Mohamed Abdi, Postgraduate student, Department of Internal Medicine (+255744012345)

I ……………………………………………….. Have read and have been informed of the contents of this study and do give my consent to participate in this study.

Signature of Participant……………………………………………….. Date……………………………………..

Appendix II: Fomu ya Idhini (Swahili version)

Mimi, Dkt. Sibte Mohamed Abdi, mkazi katika Idara ya Tiba ya Ndani, ninafanya utafiti huu kama sehemu ya masomo yangu ya uzamili. Ushiriki wako ni muhimu katika kusaidia kukusanya taarifa za kiafya ambazo zitachangia utafiti huu. Tunathamini sana mchango wako.

Utafiti huu unalenga kubaini usambaaji, vichocheo vya hatari, na sifa za kitabibu za wagonjwa wazima wenye shinikizo la damu (hypertension) waliogundulika kuwa na left ventricular hypertrophy (LVH). Matokeo ya utafiti huu yatasaidia kupendekeza upimaji wa mapema na wa mara kwa mara wa wagonjwa wa shinikizo la damu kwa kutumia echocardiogram (Echo) ili kutambua LVH kwa wakati.

Watu wazima wenye shinikizo la damu watakaotimiza vigezo vya kushiriki watajumuishwa katika utafiti huu. Dodoso litatumika kukusanya taarifa za kijamii na kidemografia. Pia, mgonjwa atalazimika kuvua mavazi ya juu ili kuwezesha upimaji wa Echo na ECG. Zaidi ya hayo, sampuli ya damu itachukuliwa kwa ajili ya kupima lipid profile ya mgonjwa. Vipimo vyote vitafanywa bila malipo, na mshiriki hatatozwa gharama yoyote.

Mshiriki yuko huru kujiondoa kwenye utafiti huu wakati wowote atakapoamua.

Watu wa kuwasiliana nao kwa maelezo zaidi:

Prof. Y. Mgonda – Mwenyekiti wa Idara ya Tiba ya Ndani (+255754277554)

Prof. Columba Mbekenga – Katibu wa Kamati ya Utafiti ya KU-IREC (+255784645777)

Dkt. Sibte Mohamed Abdi – Mtafiti Mkuu, Mwanafunzi wa Uzamili, Idara ya Tiba ya Ndani (+255744012345)

Mimi, …………………………………………………….., nimesoma na kuelezewa kuhusu utafiti huu na natoa ridhaa yangu kushiriki katika utafiti huu.

Sahihi ya Mshiriki: ………………………………………….Tarehe: …………………………………………

Appendix III: Questionnaire (English version)

Patient ID:…………… Centre ID ……………. Hospital:…….. Date:…./…./……….

A. SOCIODEMOGRAPHIC DATA

1. Date of birth (DD/MM/YYYY): / /

2. Date of interview (DD/MM/YYYY): / /

3. Gender: i. Female ii. Male

4. Highest level of education:

i. Postgraduate degree holder

ii. University degree holder

iii. College diploma/certificate

iv. Secondary school

v. Primary school

vi. No formal education

5. Permanent residence:

i. Ilala ii. Temeke iii. Kinondoni iv. Ubungo v. Kigamboni

6. How much do you earn in a month?

7. Do you consume alcohol?

i. Yes ii. No iii. I quit

a. If yes, for how long (state even if you quit)?

b. Which type?

c. How often

d. In what quantity?

8. History of cigarette smoking:

iii. Yes ii. No

If yes, how many sticks per day? ________

9. Do you perform physical exercise/training?

i. Yes ii. No

a. If yes, which type?

b. How often in a week?

c. For how many minutes or hours?

B: CLINICAL DATA

10. Are you a diabetes mellitus type 2 patient?

i. Yes ii: No

11. Duration of hypertension from diagnosis

12. Do you monitor blood pressure at home?

i. Yes ii. No

13. Blood pressure medication adherence

i. Yes ii. No

14. Number of blood pressure medications taken:

i. 1 ii. 2 ii. 3 or more

15. Which antihypertensive medications do you take:

16. Circle the symptoms you experience:

i. Chest pain

ii. Fatigue

iii. Shortness of breath on exertion

iv. Shortness of breath at rest

v. Dizziness

vi. Fast heart beats

vii. Chest tightness

viii. Sudden shortness of breath during sleep

C.PHYSICAL EXAMINATION

ANTHROPOMETIC MEASUREMENTS

17. Height ……………………………cm

18. Weight ……………………………kg

19. Waist circumference……………..inches

20. Blood Pressure Readings (Sitting):

21. Circle the positive physical finding.

a. Shifting of the apex beat

b. Sustained heave

D. Laboratory findings

22. Serum LDL-C: …….. (mmol/L)

23. Serum HDL-C: …….. (mmol/L)

24. Serum triglycerides: …….. (mmol/L)

E. Electrocardiographic findings

25. Sokolow-Lyon voltage based criteria:

Sv1+Rv5 = ………….

26. Is this your first time to be done ECG

a. YES

b. NO

F: Echocardiographic findings

27. Interventricular septum during diaystole………………………..mm

28. Left Ventricular Posterior wall during diaystole………………mm

29. Is this your first time to be done ECHO

a. YES

b. NO

Appendix IV: Dodoso (Swahili version)

Namba ya Mgonjwa:………….. Namba ya Kituo: ……………. Hospitali:……..

Tarehe:…./…./……….

A. TAARIFA ZA KIJAMII NA KIDEMOGRAFIA

1. Tarehe ya kuzaliwa (DD/MM/YYYY): / /

2. Tarehe ya mahojiano (DD/MM/YYYY): / /

3. Jinsia: i. Mwanamke ii. Mwanamume

4. Kiwango cha juu cha elimu:

i. Shahada ya Uzamili au zaidi

ii. Shahada ya Chuo Kikuu

iii. Diploma/cheti cha chuo

iv. Shule ya Sekondari

v. Shule ya Msingi

vi. Hakuna elimu rasmi

5. Makazi ya kudumu:

i. Ilala ii. Temeke iii. Kinondoni iv. Ubungo v. Kigamboni

6. Unapata kipato kiasi gani kwa mwezi?

7. Unatumia pombe?

i. Ndiyo ii. Hapana iii. Niliacha

a. Ikiwa ni ndiyo, kwa muda gani? (taja hata kama ulishaacha)

b. Aina gani?

c. Mara ngapi?

d. Kiasi gani?

8. Historia ya uvutaji sigara:

i. Ndiyo ii. Hapana

Ikiwa NI NDIO, ni sigara ngapi kwa siku? ___

9. Je, unafanya mazoezi ya mwili?

i. Ndiyo ii. Hapana

a. Ikiwa ndiyo, ni mazoezi ya aina gani?

b. Mara ngapi kwa wiki?

c. Kwa dakika au masaa mangapi?

B. TAARIFA ZA KITIBU

10. Je, wewe ni mgonjwa wa kisukari aina ya pili?

i. Ndiyo ii. Hapana

11. Muda wa shinikizo la damu tangu kugunduliwa

12. Unapima shinikizo la damu nyumbani?

i. Ndiyo ii. Hapana

13. Ufuasi wa matumizi ya dawa za shinikizo la damu:

i. Ndiyo ii. Hapana

14. Idadi ya dawa za shinikizo la damu unazotumia:

i. 1 ii. 2 iii. 3 au zaidi

15. Ni dawa zipi za shinikizo la damu unatumia?

16. Zungusha dalili unazozipata:

i. Maumivu ya kifua

ii. Uchovu

iii. Kukosa pumzi unapojitahidi

iv. Kukosa pumzi ukiwa umepumzika

v. Kizunguzungu

vi. Mapigo ya moyo ya haraka

vii. Kifua kubana

viii. Kukosa pumzi ghafla wakati wa usingizi

C. VIPIMO VYA KIMWILI

VIPIMO VYA ANTHROPOMETRIA

17. Urefu ……………………………cm

18. Uzito ……………………………kg

19. Upimaji wa Unene wa Kiuno……………….inches

20. Vipimo vya Shinikizo la Damu (Ukiwa umeketi):

21. Zungusha matokeo chanya ya uchunguzi wa mwili:

a. Kuhama kwa sehemu ya juu ya moyo

b. Mpigo wa moyo kwa nguvu kwa muda mrefu

D. MATOKEO YA MAABARA

22. LDL-C ya seramu: …….. (mmol/L)

23. HDL-C ya seramu: …….. (mmol/L)

24. Trigliseridi za seramu: …….. (mmol/L)

E. MATOKEO YA KIELEKTRODIAGRAMU

25. Vigezo vya voltage vya Sokolow-Lyon:

Sv1 + Rv5 = …………

26. Je, hii ni mara yako ya kwanza kufanyiwa ECG (Electrocardiogram)?

a) Ndio

b) Hapana

F: MATOKEO YA ECHOCARDIOGRAMU

27. Sehemu ya kati ya septamu ya ventrikali wakati wa diaystole: ……………………..mm

28. Ukuta wa nyuma wa ventrikali ya kushoto wakati wa diaystole: ………………....mm

29. Je, hii ni mara yako ya kwanza kufanyiwa ECHO (Echocardiogram)?"

a) Ndio

b) Hapana

Selected summary statistics

Figure 1: Prevalence of LVH among hypertensive adults attending Dar es Salaam public regional referral hospitals (N=280).

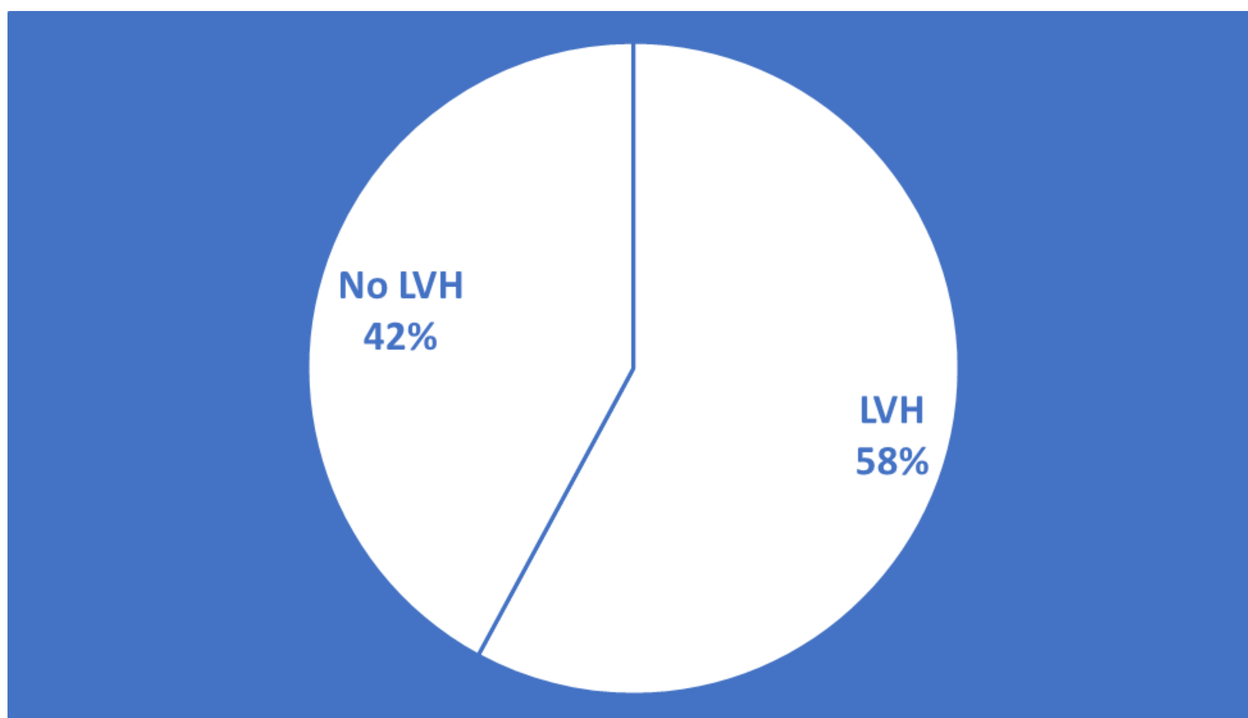


Figure 2: Distribution of LVH on the basis of actual age (in years).

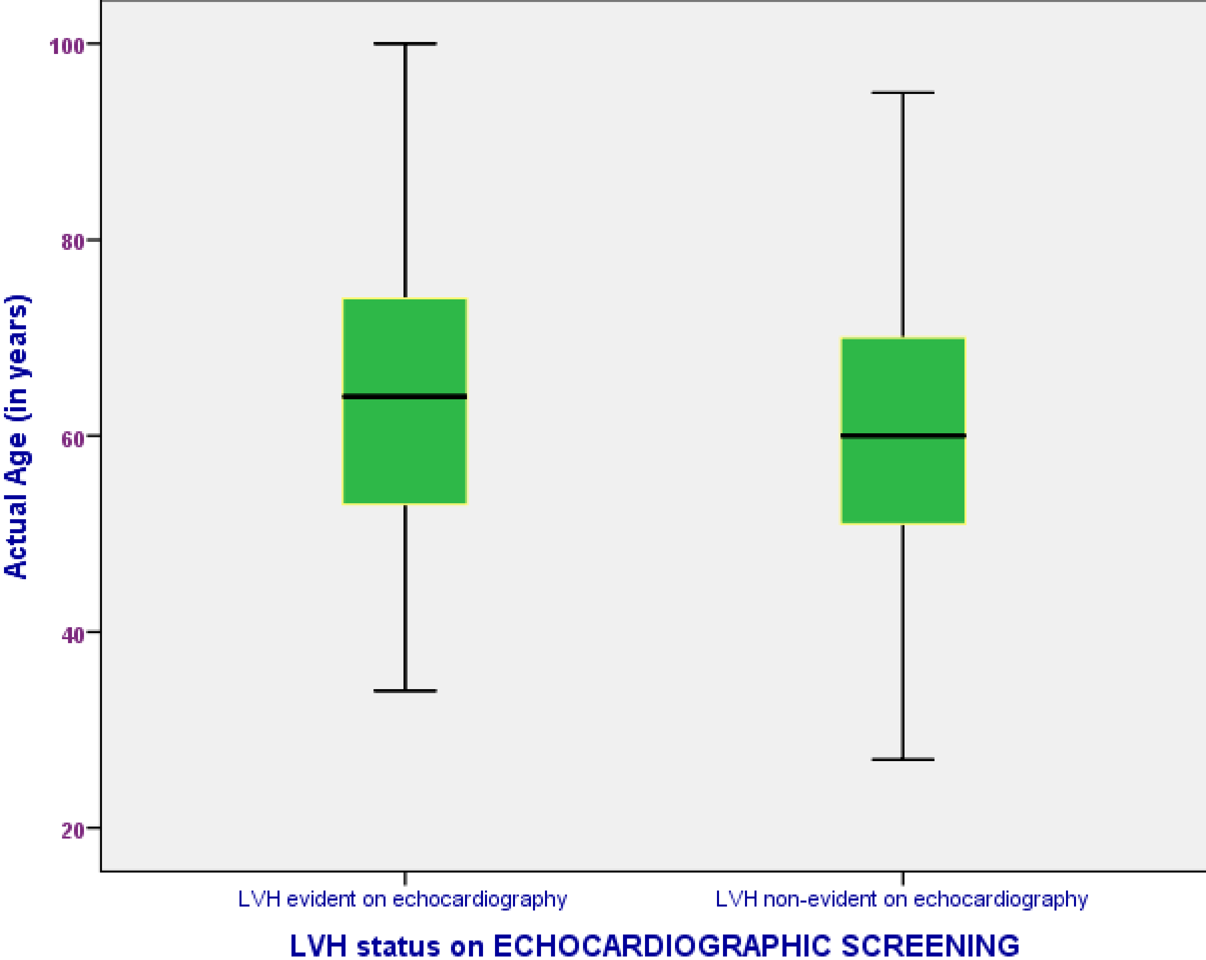


Figure 3: Distribution of participants waist circumference on the basis of echo-based LVH.

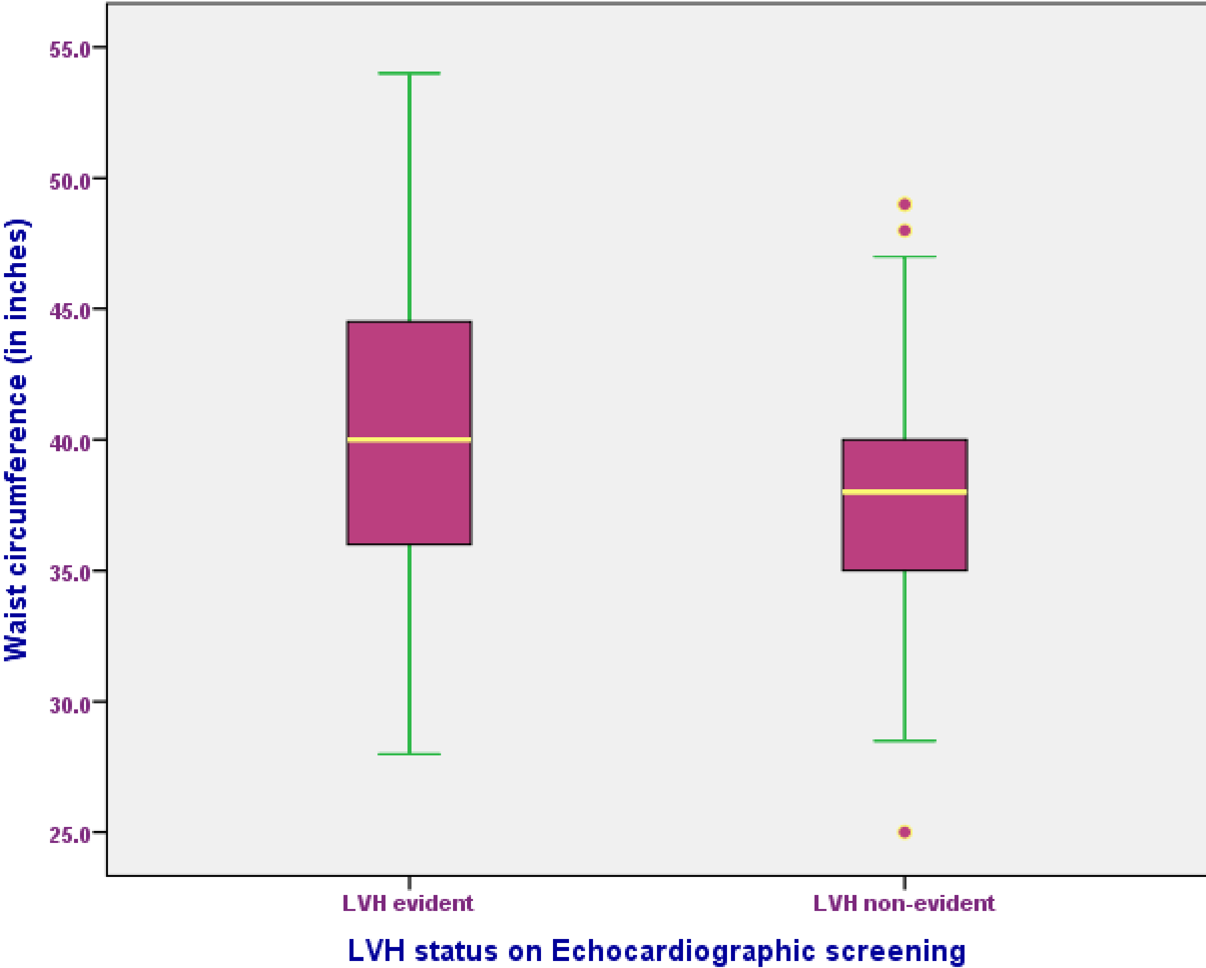


Figure 4: Distribution of reported duration of hypertension from diagnosis vs. LVH status on echocardiography.

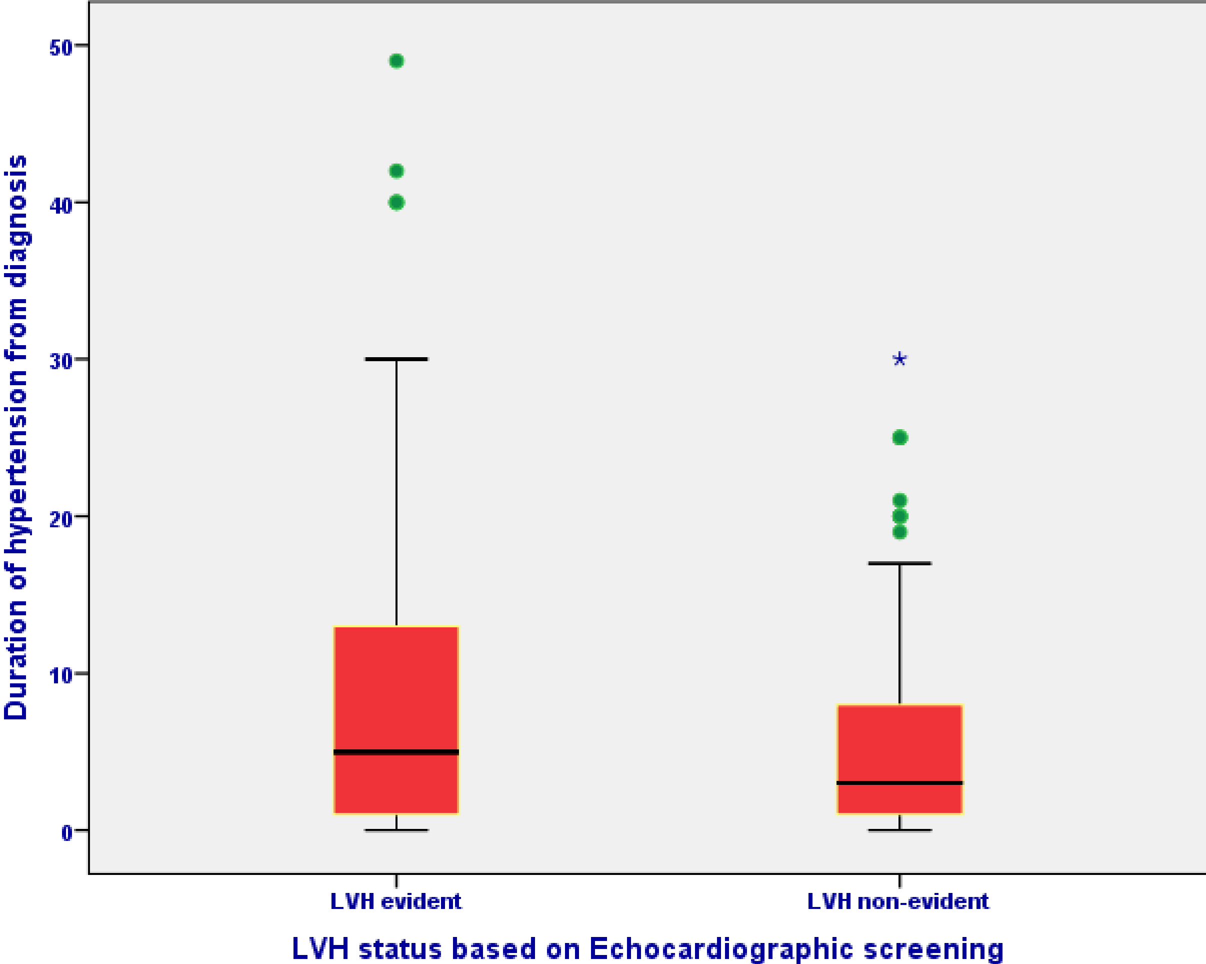


Figure 5: Distribution of reported Body Mass Index vs. LVH status on echocardiography.

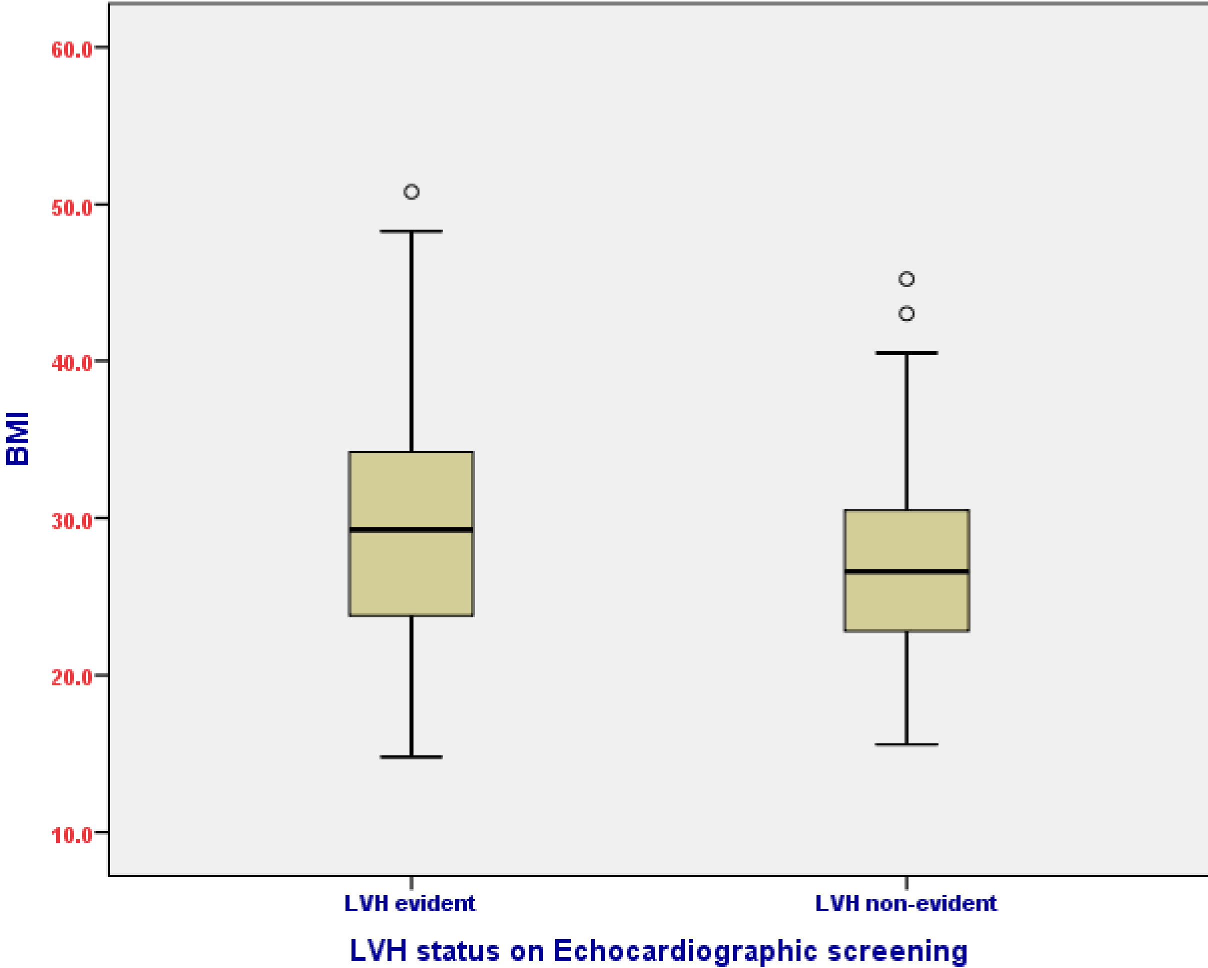


Figure 6: Distribution of serum triglyceride levels vs. LVH status on echocardiography.

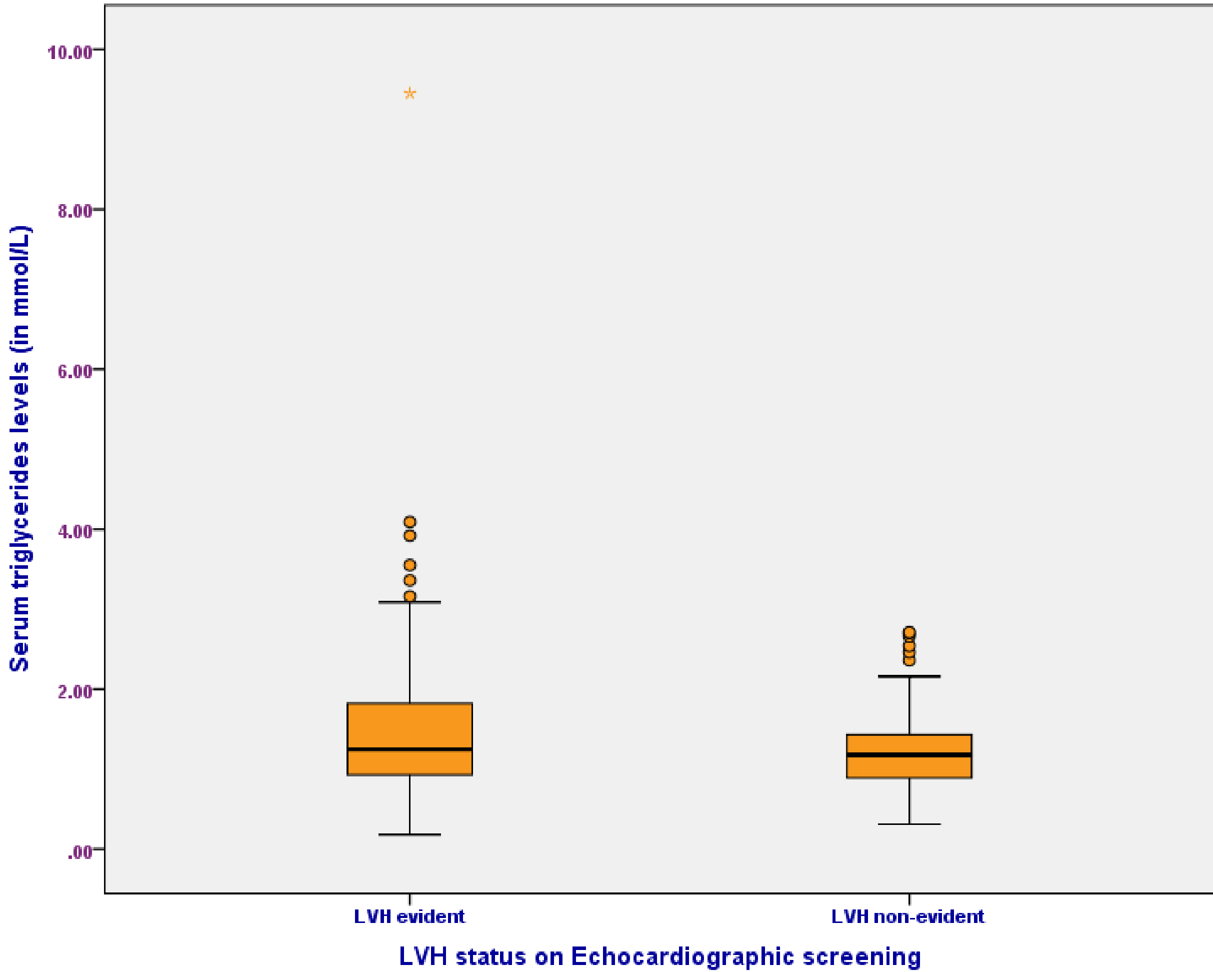


Figure 7: Distribution of Left ventricular Ejection Fraction (Heart Failure) vs. LVH status on echocardiography.

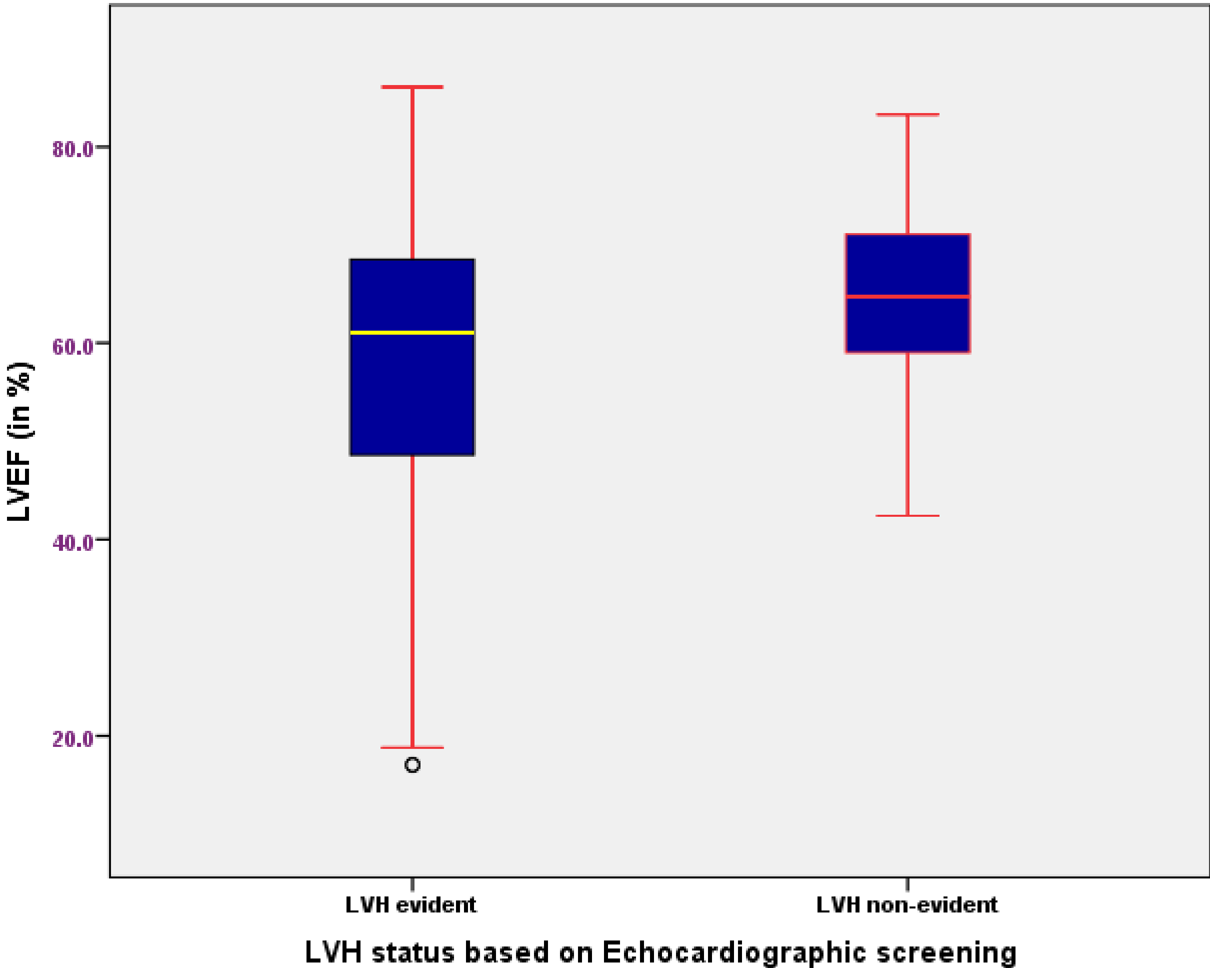
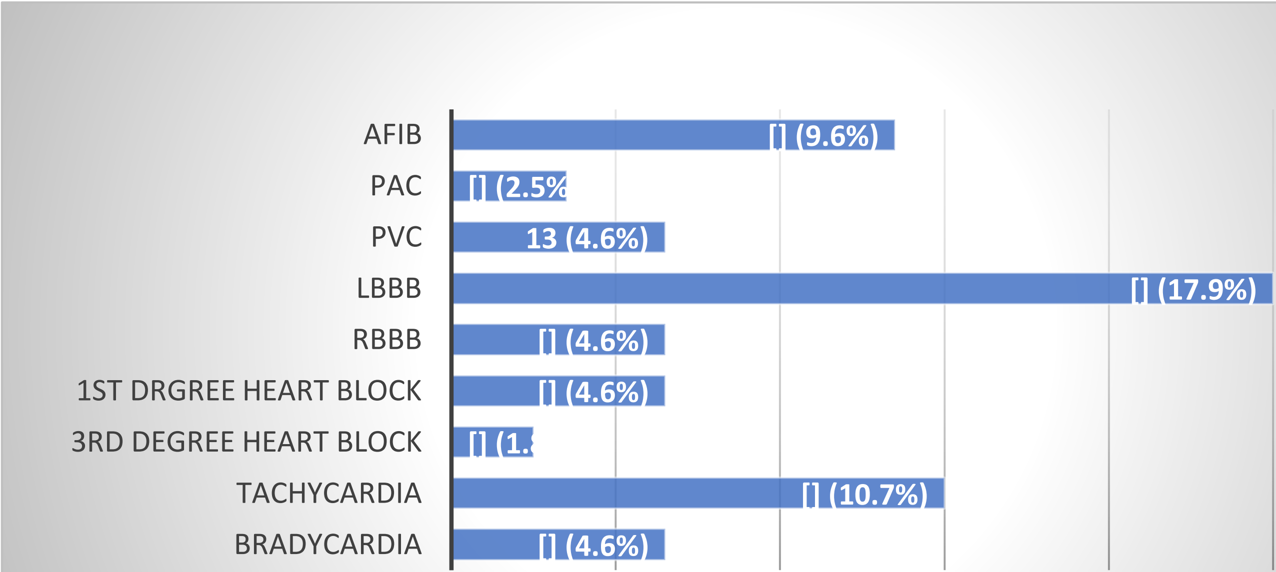


Figure 8: Frequency distribution of arrhythmias among hypertensive adults with LVH at Dar es Salaam public regional referral hospitals 2025 (N=280).



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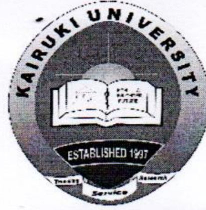

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Ref. No. KU/IREC/27.10/575 **12 June, 2025**

Dr. Sibte Abdi Mohamed,
Kairuki University,
70 Chwaku Street,
Mikocheni,
P. O. Box 65300.
Dar es Salaam, Tanzania.

RE: ETHICAL CLEARANCE CERTIFICATE FOR CONDUCTING HEALTH RESEARCH

I am pleased to inform you that the research titled: **Left Ventricular Hypertrophy among Adult Patients with Hypertension Attending Cardiac Clinics in Public Regional Referral Hospitals in Dar es Salaam (Abdi, S. M., 2025)** has been granted ethical approval.

This approval is in effect for one year from the above date.

- Any changes in the procedures should be reported to the Institutional Research Ethics Committee.
- Significant changes will require the submission of a revised request for ethical approval.
- You will be required to submit **a study progress report** every six months.

Permission to publish your findings should be sought from the National Institute for Medical Research (NIMR) before submission to a publisher and not concurrently.

CHAIR PERSON

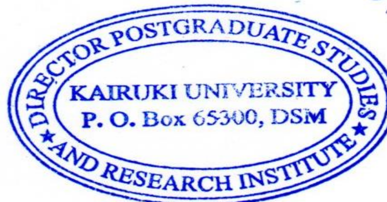
Name: Prof. Frederick Kaijage

Signature: ____________________

SECRETARY

Name: Prof. Columba Mbekenga

Signature: ____________________



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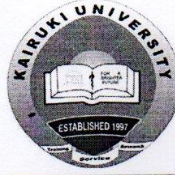

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Website: www.ku.ac.tz

Ref. No. KU/PT/30.5/594

12th June 2025

Medical Officer Incharge,

Amana Regional Referral Hospital,

Dar es Salaam.

Re: LETTER OF INTRODUCTION FOR DR. SIBTE ABDI MOHAMED (MMed Part II – INTERNAL MEDICINE).

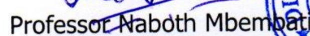
The above named is a MMed postgraduate student specialising in Internal Medicine.

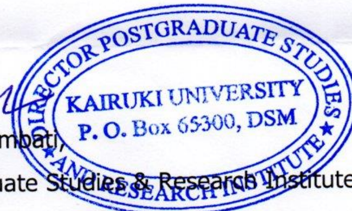
As part of fulfilling his MMed programme, he plans to undertake a study titled**, "Left Ventricular Hypertrophy among Adult Patients with Hypertension Attending Cardiac Clinics in Public Regional Referral Hospitals in Dar es Salaam".** This study was reviewed and has been granted with an ethics approval No. **KU/IREC/27.10/575** by the KU Institutional Research Ethics Committee that will be valid for one year with effect from 11th June 2025.

This letter serves to introduce **Dr. Sibte Abdi Mohamed** who will be conducting his study at your hospital, please accord him with the needed support.

Thank you for your support and cooperation in developing human resources for health in our country.

Regards,





Professor Naboth Mbembati,

Ag. Director Postgraduate Studies & Research Institute

c. c. Prof. Yassin Mgonda, Head, Department of Internal Medicine, KU

c. c. Head, Department of Internal Medicine, ARRH

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REF. NO. MoHCDGEC/ARRH/R.1/VOL IV/4

Date: **12/06/2025**

Dr. Sibte Mohamed Abdi,
Kairuki University,
DAR ES SALAAM.

Re: PERMISSION FOR DATA COLLECTION

Refer to your letter dated **12th June, 2025** which requested us to allow **you** to conduct research and collect data in our institution.

We are here to acknowledge your request with the following conditions, that she must submit the results of your research after completion of analysis in order the hospital to make use of data's to solve hospital problems.

Regards.

Dr. Rose Ntaimbuto
FOR: MEDICAL OFFICER INCHARGE
AMANA REGIONAL REFERRAL HOSPITAL

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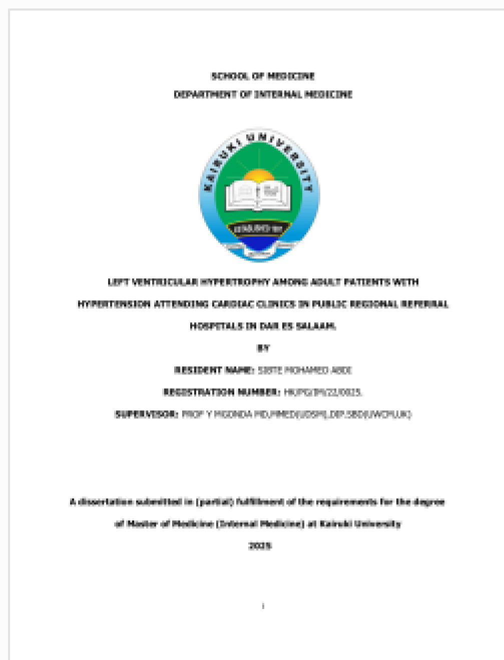

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BY

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A dissertation submitted in (partial) fulfillment of the requirements for the degree of Master of Medicine (Internal Medicine) at Kairuki University

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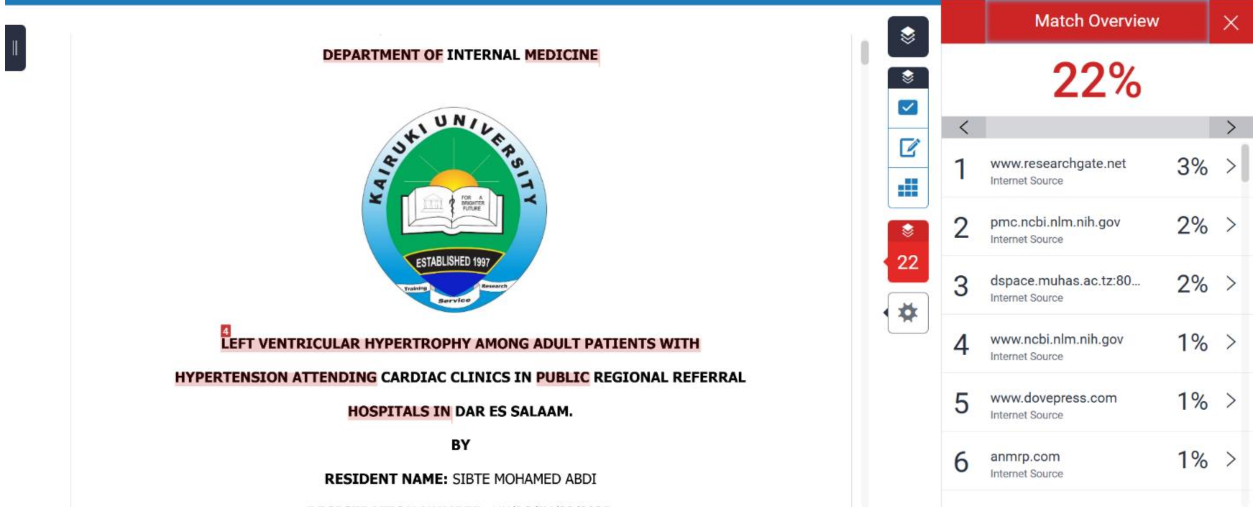
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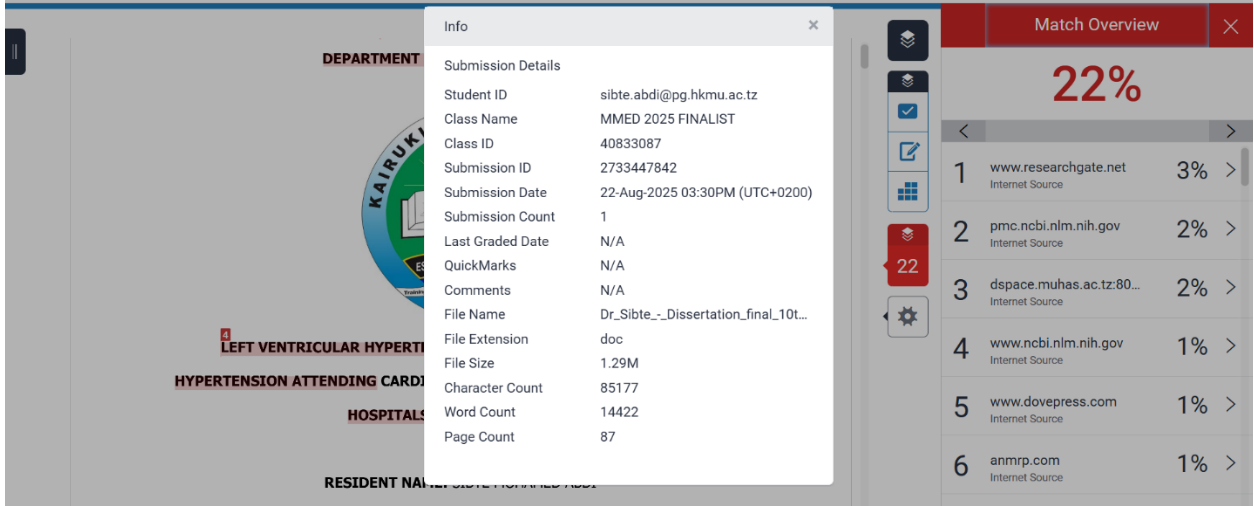
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