MAGNITUDE AND DETERMINANTS OF HYPERTENSION AMONG PEOPLE LIVING WITH HIV ATTENDING CARE AND TREATMENT CENTRES IN TABORA REGION, WESTERN TANZANIA

Thobias Bollen, MD

MSc (Applied Epidemiology) Dissertation
Muhimbili University of Health and Allied Sciences
October, 2024

Muhimbili University of Health and Allied Sciences

Department of Epidemiology and Biostatistics

MAGNITUDE AND DETERMINANTS OF HYPERTENSION AMONG PEOPLE LIVING WITH HIV ATTENDING CARE AND TREATMENT CENTRES IN TABORA REGION, WESTERN TANZANIA

By

Thobias Bollen

A Dissertation Submitted in Partial Fulfilment of the Requirements for the Degree of Master of Science (Applied Epidemiology) of

Muhimbili University of Health and Allied Sciences
October, 2024

CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled**; "Magnitude and Determinants of Hypertension Among People Living with Human Immunodeficiency Virus Attending Care and Treatment Centres in Tabora, Western Tanzania",** in *(*partial) fulfillment of the requirements for the degree of Master of Science (Applied Epidemiology) of Muhimbili University of Health and Allied Sciences**.**

_____

Dr. Erick Mboya

Supervisor

_____

Date

_____

Dr. Rogath Kishimba

Co-Supervisor

_____

Date

DECLARATION AND COPYRIGHT

I, **Thobias Bollen**, declare that this **dissertation** is my original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature…….…… **Date**……...….....

This dissertation is copyright material protected under the Berne Convention, the Copyright Act 1999, and other international and national enactments, in that behalf, on intellectual property. It may not be reproduced by any means, in full or in part, except for short extracts in fair dealing, for research or private study, critical scholarly review, or discourse with an acknowledgment, without the written permission of the Directorate of Postgraduate Studies, on behalf of both the author and the Muhimbili University of Health and Allied Sciences.

ACKNOWLEDGMENT

The completion of this dissertation was successful through joint efforts by members from Muhimbili University of Health and Allied Science, Ministry of Health, Tanzania Field Epidemiology and Laboratory Training Program (TFELTP), Centre for Disease Control and Prevention (CDC) through Mzumbe University and different individuals.

Additionally, I would like to express sincere gratitude to all college principals/Rectors for their support and provision of data for analysis

Furthermore, I am grateful to my supervisor Dr Erick Mboya, and co-supervisor Dr Rogath Kishimba for their technical assistance while conducting this study, without forgetting Professor Innocent Semali who was initially my supervisor in the proposal development.

I also convey my appreciation to CDC Mzumbe through TFELTP for the financial support that they provided to ensure this study was successful.

Last but not least, I would like to thank my family for their tolerance during my absence for studies, and all of my colleagues for their time, contributions, and encouragement during our learning experience.

DEDICATION

This work is dedicated to all my friends and family members; Mother, Wife, Daughter, and Sons, Brothers and Sisters for their continuous love, support, and encouragement.

ABSTRACT

Background: HIV is associated with an increased risk of hypertension among people living with HIV (PLWHIV). While long-term survival due to ART use has increased the burden of hypertension among PLWHIV, but the burden is not well known especially in remote and less urbanized regions of Tanzania.

Objective: This study determined the magnitude and determinants of hypertension among people living with HIV attending care and treatment clinic in the Tabora region.

Methodology: A cross-sectional study of 712 PLWHIV aged 18 years and older attending CTC was conducted in twelve randomly selected facilities in Tabora Region in 2024. Data were collected using an interview-administered standardized questionnaire. Hypertension was defined by blood pressure ≥140 or ≥ 90 mmHg. Data were analysed using STATA 15. modified poison regression was used to assess associations between hypertension and independent variables with p value of < 0.05 significant. Ethical approval was obtained from the MUHAS ethical research review board.

Results: A total of 712 participants were recruited in the study, of whom 398 (55.9%) female and the mean age (SD) was 45.3 (13.2) years. The overall prevalence of was estimated at 25.8%. Majority 114 (47.05) were aged between 40–59 years. The participants who were aged 60 years older had 17% Increased prevalence of having hypertension with (aPR (95%, CI): 1.17: (1.08 - 1.28) p<0.001)) compared with those with less than 40 years, while those 40 -59 years had 13% increased prevalence of hypertension with (aPR 95%, CI: 1.13(1.10 - 1.19) p<0.01. compared to those with less than 40 years. Those with the history of hypertension had 13% Increased prevalence of hypertension with aPR (95%, CI) 1.13(1.07 - 1.19) p<0.01), compared to those with no family history of hypertension. Those who were obese and overweight had 26% and 12% Increased prevalence of hypertension with aPR (95%, CI): 1.26: (1.11 - 1.42) p<0.001and aPR (95%, CI): 1.12 (1.02 - 1.23) p value of 0.016 compared to those with underweight.

Conclusion and Recommendation: Hypertension is higher and the proportional of untreated hypertension among PLWHIV not known. Key factors include, age above 40years, family history of hypertension, obese and overweight which were found to be significantly

associated with increased hypertension, while physical activity and viral load count less th20 copies were found to be protective.

Recommend lifestyle modification particularly physical activity and weight loss program among PLHIV patients on ART, also integration of HIV care with Hypertension within the routine in the CTCs.

TABLE OF CONTENT

CERTIFICATION i
DECLARATION AND COPYRIGHT ii
ACKNOWLEDGMENT iii
DEDICATION iv
ABSTRACT v
TABLE OF CONTENT vii
LIST OF TABLES x
LIST OF FIGURE x
LIST OF ABBREVIATION xi
STANDARD DEFINITION xiii
CHAPTER ONE 1
1.0 INTRODUCTION 1
1.1 Background 1
1.2 Problem statement 3
1.3 Conceptual frame work 4
1.4 Rationale 5
1.5 Research Questions 6
1.5.1 Broad research question 6
1.5.2 Specific research question 6
1.6 Objectives 6
1.6.1 Broad Objective 6
1.6.2 Specific Objectives 6
CHAPTER TWO 7
2.0 LITERATURE REVIEW 7
2.1 Pathophysiology of hypertension in People living with the human immune deficiency virus 7
2.2 Prevalence of hypertension among people living with human immunodeficiency virus 8
2.3 Determinants of hypertension 9
2.3.1 Social demographic factors 9

2.3.2 Behavioral risk factors 9
2.4 HIV-related determinants of hypertension among People living with human immunodeficiency virus 10
CHAPTER THREE 12
3.0 METHODOLOGY 12
3.1 Study Design 12
3.2 Study setting 12
3.3 Study population 12
3.4 Inclusion criteria 12
3.5 Exclusion criteria 13
3.6 Sample size estimation 13
3.7 Sampling procedure 13
3.8 Variables 15
3.8.1 Outcome Variable. 15
3.8.2 Predictor Variable 16
3.9 Measurements of variable 16
3.9.1 Blood Pressure 16
3.9.2 Body weight 16
3.9.3 Height 16
3.10 Data collection tools 17
3.11 Validity and reliability of data collection tools 17
3.12 Training of research assistance 18
3.13 Data collection 18
3.14 Data analysis 19
3.15 Research Ethics Considerations 20
CHAPTER FOUR 21
4.0 RESULTS 21
4.1 Demographic characteristics 21
4.2 Prevalence of Hypertension and distribution across the socio-demographic factors among PLWHIV attending care and treatments clinics in Tabora region 23
CHAPTER FIVE 29
5.0 DISCUSSION 29

5.1 Prevalence of hypertension among PLWHIV. 29
5.2 Proportional of untreated hypertension 30
5.3 Social demographic factors of hypertension among PLWHIV 30
5.4 HIV-related factors of hypertension among PLWHIV 32
CHAPTER SIX 34
6.0 CONCLUSION AND RECOMMENDATION 34
6.1 Conclusion 34
6.2 Recommendation 34
REFERENCES 35
Appendix I: English Version Questionire 43
Appendix II: Swahili Version Questionaire 47
Appendix III: Ethical Clearance 51
Appendix IV: Pligiarirism Certificate 53
Appendix V: Pliagiarism Report 54

LIST OF TABLES

Table 1. Multistage sampling procedure from the regional level to facility level..... 15

Table 2. Demographic characteristics of PLWHIV attending care and treatment clinic in Tabora region from March to Apr 2024 21

Table 3. Prevalence of hypertension by distribution of social demographic factors on hypertension among PLWHIV attending care and care treatment clinic in Tabora region April to May 2024. 24

Table 3. Prevalence of hypertension by distribution of social demographic factors on hypertension among PLWHIV attending care and care treatment clinic in Tabora region April to May 2024. 27

LIST OF FIGURE

Figure 1. Conceptual framework prevalence and determinants of hypertension among people living with human immunodeficiency virus. 5

LIST OF ABBREVIATION

Abbreviation	Long Form
AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral Therapy
ARV	Ant retroviral
BMI	Body Mass Index
CD4	Cluster of Differentiation 4
CD8	Cluster of Differentiation 8
cART	Combined antiretroviral therapy
CDC	Centre for disease control and Prevention
CTC	Care and treatment center
CVD	Cardiovascular Disease
DM	Diabetes Mellitus
DNA	Deoxy ribonucleic Acid
gp120	Glycoprotein 120
HAART	Highly Active Antiretroviral Therapy
HIV	Human Immune Deficiency virus
HLA-DR	Human Leukocyte Antigen-DR
IL	Interleukin
IL-IB	Interleukin IB
INSTI	Integrase Strand Transfer Inhibitor
JNC-7	Joint National Committee
mtDNA	mitochondrial DNA

MUHAS	Muhimbili University of Health Science
NASHCOP	National Aids and Sis Hepatitis Control Program
NCD	Non communicable Disease
Nef	Negative Factor
PLHIV	People Living with Human Immunodeficiency Virus
PREPFAR	President Emergency Plan for AIDS Relief
RAAS	Renin-Angiotensin-Aldosterone System
SSA	Sub Saharan Africa
Tat	Trans-activator of Transcription,
TDF	Tenofovir
TNF-IL	Tumor Necrotic Factor
UNAIDS	United Nations Program on HIV/AIDS.
WHO	World Health Organization

STANDARD DEFINITION

Hypertension is defined as a systolic blood pressure (SBP) of 140 mmHg or higher or diastolic blood pressure (DBP) of 90 mmHg or higher, based on the average of two or more properly measured blood pressure readings on separate occasions (1).

Operational Definitions

High volume care and treatment centre were those facilities where the number of clients who were enrolled in care and treatment for HIV were more than for than 500 clients.

Low volume care and treatment centre were those facilities where the number of clients who were enrolled in care and treatment for HIV were more than were less than 500 clients.

Tier one care and treatment centre were high volume sites where the number of clients who were enrolled in care and treatment for HIV were more than for HIV is more than 1000 clients.

Tier two care and treatment centre were high volume sites where the number clients who were enrolled in care and treatment for HIV were more than for HIV were more than 500 clients.

Tier three were low volume sites where the number of clients who were enrolled in care and treatment for HIV were more than 300 clients.

Tier four were low facilities where number of clients who were enrolled in care and treatment for HIV were less than 300 clients.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Hypertension among people living with HIV (PLWHIV) on antiretroviral therapy (ART) is a growing public health concern (2). Globally, thirty eight million people are living with HIV, with seventy eight million (78%) on antiretroviral therapy (3,4). The extensive utilization of ART has significantly reduced HIV-related mortality, decreased viral replication, and extended life expectancy (5). However, it has also increased the risk of non-communicable diseases, particularly hypertension. Over the past decade, access to antiretroviral therapy (ART) for people living with HIV has increased rapidly from 7.8 million in 2010 to 28.7 million in 2021(6,7). Global and national strategies have increased ART utilization, leading to a significant reduction in AIDS-related deaths, dropping from 2.0 million in 2004 to 650,000 in 2021 (4).

Globally, 1.28 billion people aged 30 to 79 years have hypertension, with 75% of them residing in low- and middle-income countries, which are home to more than 90% of the HIV burden (8) In addition, 46% of people with hypertension are ignorant of their illness, and people who are HIV positive and on ART make up a significant portion of the untreated hypertensives. Recent observations have indicated that the prevalence of hypertension among individuals living with the human immunodeficiency virus is estimated to be higher than that of the general population, which further supports this (9–12).

Sub-Saharan Africa has been reported to be the epicentre of the HIV pandemic, accounting for approximately 67% of the global HIV prevalence (13,14). While the prevalence of hypertension among people living with HIV in sub-Saharan Africa has been reported to range from 12.5% to 53%, according to studies conducted in Cameroon and South Africa (15,16),

Limited epidemiological data are available regarding the magnitude of hypertension among PLWHIV. However, previous studies conducted in South Africa have shown a higher prevalence of hypertension among people living with human immunodeficiency virus compared to the general population, with an even higher prevalence observed among older PLWHIV (14). Similarly, other studies conducted in South Africa, Uganda, Malawi,

Tanzania and Botswana have found a higher prevalence of hypertension among PLWHIV compared to the general population (17–19)

In Tanzania, it was estimated that there were 1,700,000 PLWHIV virus in 2021, of which 1,477,809 were on combination antiretroviral therapy (ART) (20). Studies that have been conducted in various parts of the country have reported the prevalence of hypertension among people living with HIV to range from 17.4% to 34.6%.(15). With this prevalence of hypertension among PLWHIV in the country, there is limited data on the prevalence of hypertension among PLWHIV in remote regions particularly Tabora Region

Various studies have proposed a relationship between HIV and hypertension through prolonged use of ART, proteins, viral gene products, viral envelope components, mitochondrial dysfunction, and cell apoptosis. All these processes contribute to chronic inflammation, which can result in the development of type 2 diabetes, metabolic syndrome, and other non-communicable diseases, particularly hypertension(21). Additionally, it has been found that certain classes of ART can increase the activity of the renin-angiotensin-aldosterone system, which can result in hypertension(22). In a study conducted in South Africa, hypertension was found to be more prevalent in the PLWHIV populations than in the general population(23). This was attributed to factors such as chronic inflammation caused by ART use, renal disease, a high body mass index, and behavioral risk factors like smoking, alcohol intake, and physical inactivity (24).

The burden of hypertension has been rapidly increasing, leading to 15 million deaths annually in the younger generation (aged 30-69 years) globally, with 85% of these deaths occurring in low- and middle-income countries (22). Sub-Saharan Africa (SSA), including Tanzania, hosts more than 70% of people living with the human immunodeficiency virus and currently facing an increasing threat of hypertension, whose risk is highest among the PLWHIV in these SSA countries, including Tanzania (15,16,25) Response to this joint double burden of hypertension and HIV infection among PLWHIV requires early and regular screening of PLWHIV to detect and intervene in hypertension early and the provision of appropriate management.

1.2 Problem statement

Hypertension among PLWHIV has become a significant public health concern. Globally, the prevalence of hypertension among PLWHIV is estimated to be 42%(26). In Sub-Saharan Africa, this prevalence ranges from 19.7% to 50.1%, (23,27).

World wide Hypertension among PLHIV is on the rise, and it is linked to ART use and age hence prone adults who living with HIIV and on ART on increased incidences of hypertension. Adults living with HIV on ART had a greater incidence of hypertension than HIV-uninfected persons (28). A recent meta-analysis of data from throughout the globe indicated that 35% of all HIV-infected individuals on ART had hypertension, in comparison to an estimated 30% of HIV-uninfected persons(29) .

The World Health Organization recommends integrating blood pressure monitoring, nutrition counselling, smoking cessation support, and physical exercise encouragement into HIV services(19,30). Tanzania has been reported a prevalence of 29.3% (31) were this was conducted in more urbanized area.

Currently the country under WHO are recommended to adopt the policy to integrate HIV and hypertension care to reduce morbidity and mortality among PLWHIV(32), with some facilities in the country partially implementing the policy of integrating hypertension and HIV treatments while PLWHIV are unaware of their hypertension status. facilities already implementing this integration

Despite the awareness of the need for integrated care, there is a lack of data on the burden of hypertension among PLWHIV in less urban and remote regions. More regional representative data is needed to understand the determinants of hypertension among PLWHIV, so that effective and targeted interventions can be implemented to reduce this burden. This study aims to investigate the prevalence and determinants of hypertension among PLWHIV in urban and rural areas of the Tabora region in Tanzania.

1.3 Conceptual frame work

Indirect risk factors associated with hypertension in people living with human immunodeficiency virus encompass clinical factors like renal failure, social behavioral factors, HIV-related factors including HIV viral infection, antiretroviral therapy (ART) usage, behavioral factors like cigarette smoking, alcohol consumption, physical inactivity, and an unhealthy diet.

These factors significantly contribute to the development of hypertension among people living with human immunodeficiency virus. Clinical factors, such as HIV viral infection, can lead to immune system dysfunction, chronic inflammation, and vascular damage, thereby elevating the risk of hypertension. Furthermore, the use of ART, although crucial for managing HIV, may have metabolic effects that further contribute to hypertension risk (33).

Behavioral factors such as cigarette smoking and alcohol intake are recognized risk factors for hypertension in both the general population and people living with human immunodeficiency virus. These behaviours can increase blood pressure levels and the likelihood of cardiovascular diseases. Physical inactivity and an unhealthy diet, characterized by excessive sodium intake and poor nutritional choices, also contribute to hypertension among people living with human immunodeficiency virus (34).

social demographic factors, which include age, sex, family history of hypertension, marital status, education level, employment status, and religion, specifically the increasing number of people living with human immunodeficiency virus, indicate the expanding population affected by HIV, as the number of individuals living with HIV grows, the prevalence of hypertension among people living with human immunodeficiency virus is expected to rise. This highlights the importance of implementing strategies that focus on preventing hypertension, early detection, and effective management within the people living with human immunodeficiency virus population.

Addressing these risk factors necessitates a comprehensive approach that integrates HIV care with hypertension prevention and management. This includes regular monitoring of clinical indicators, promoting healthy lifestyle behaviours, addressing socioeconomic disparities, and ensuring access to appropriate healthcare services. Acknowledging and tackling these

factors, it is possible to reduce the burden of hypertension in people living with human immunodeficiency virus and improve overall health outcomes.

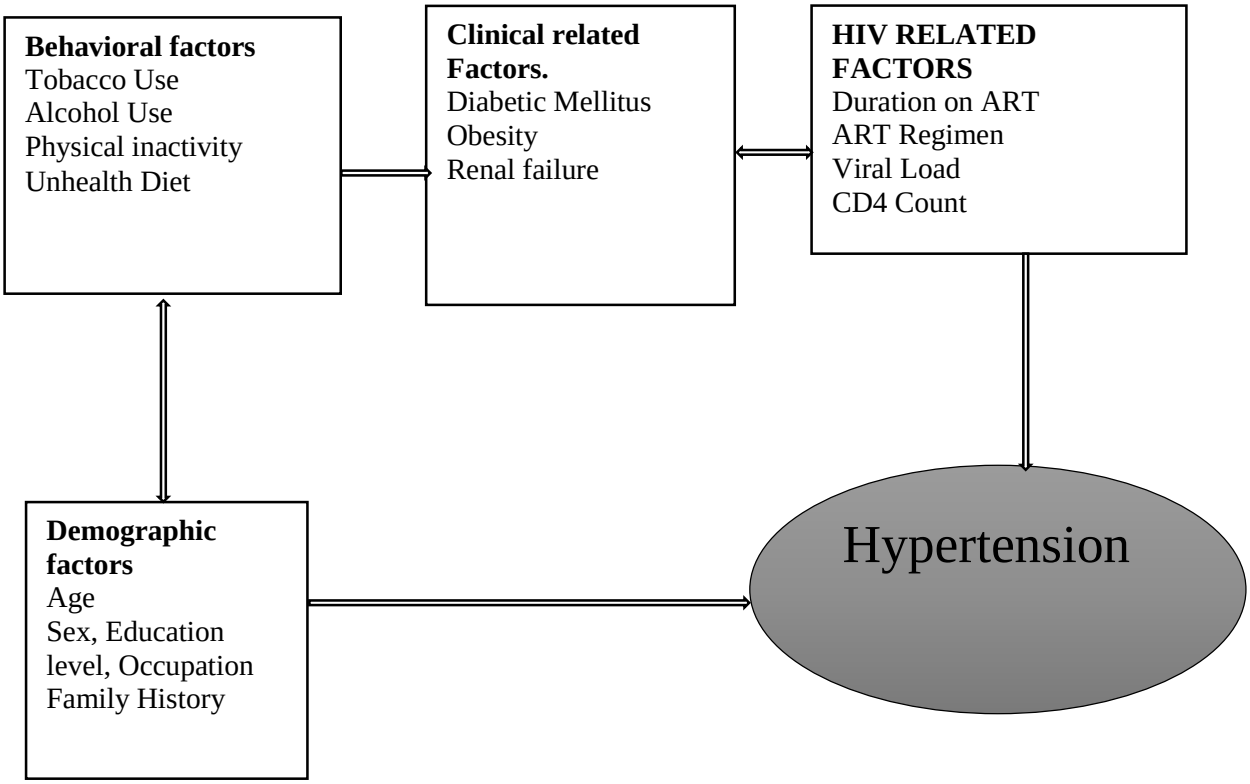


Figure 1: Conceptual framework prevalence and determinants of hypertension among people living with human immunodeficiency virus.

1.4 Rationale

The findings from this study will assist the country, programs and stakeholders; like ministry of health (MOH) national AIDS, STIs and Hepatitis control program (NASHCOP) and Implementing Partners (IP) in Planning and developing targeted interventions to effectively address the burden of hypertension among people living with HIV. Evaluate the occurrence and factors influencing hypertension in individuals living with HIV. Provide valuable insights for MOH and practitioners to enhance the care and management of PLWHIV in different areas of Tanzania.

Also, the findings from this study it will Stimulate other scholars to conduct and design further studies in this field particularly in study area.

1.5 Research Questions

1.5.1 Broad research question

What is the prevalence and determinants of hypertension among PLWHIV attending CTC on ART in the Tabora region?

1.5.2 Specific research question

1. What is the prevalence of hypertension among PLWHIV attending CTC on ART in Tabora Region?
2. What is the proportion of uncontrolled hypertension among those hypertensive PLWHIV attending CTC on ART in Tabora Region?
3. What are determinants of Hypertension among in PLWHIV attending CTC on ART in Tabora Region?

1.6 Objectives

1.6.1 Broad Objective

To determine the magnitude and determinants of hypertension treatment among PLWHIV attending CTC on ART in Tabora Region in 2024.

1.6.2 Specific Objectives

1. To determine the prevalence of hypertension among PLWHIV attending CTC on ART in Tabora region from Apr to May 2024.
2. To determine the proportion of untreated hypertension among hypertensive PLWHIV attending CTC on ART in Tabora Region April to May to2024.
3. To determine the determinants of hypertension among PLWHIV attending CTC on ART in Tabora region from April to May 2024.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Pathophysiology of hypertension in People living with the human immune deficiency virus

Hypertension among people living with HIV on ART its causal pathway could be mediated via HIV-induced inflammation, viral proteins (Nef, Tat, and gp-120), and genetic elements. These proteins play crucial role in causing hypertension by triggering oxidative stress, promoting the growth and movement of smooth muscle cells, and disrupting endothelial function, particularly in individuals with high HIV viral loads (35). The mechanism of connection between immunological activation or inflammation and hypertension in HIV is yet unknown, and more research is needed. In systematic review studies, it has been done suggested that the interaction between HIV viral proteins and antiretroviral therapy (ART) with immune system components can lead to kidney injury, vascular dysfunction, and activation of the sympathetic nervous system, ultimately causing hypertension (35). This process is expedited by traditional risk factors such as obesity, high salt intake, smoking, and genetic predisposition (33). Despite starting antiretroviral therapy (ART), individuals with HIV experience ongoing and mild immune activation. This continuous immune activation leads to elevated levels of CD38 in CD4+ and CD8+ T cells, which serves as a marker for disease progression in people living with HIV. Additionally, other T cell markers like HLA-DR, TNF-α, IL-6, and IL-1β have been observed in western countries (35). Viral translocation plays a role in the mechanism of hypertension in HIV-positive patients(35).

When HIV infects CD4 gut-associated lymphoid tissue, it weakens and destroys the natural immune defence in the mucosa (33). Suppression of gut-associated lymphoid tissue leads to pathogens entering the bloodstream, elevating lipopolysaccharides. These can cause hypertension through RAAS activation, prostaglandin E2 production, and stimulation of the sympathetic nervous system (36). The study conducted in Cameroon to explored the association between CD4 count and hypertension found no significant link between the two factors(37). However, in the same study, an association between HIV infection with or without HAART and hypertension was identified (37).

2.2 Prevalence of hypertension among people living with human immunodeficiency virus

Globally, 8.9 million people living with HIV are hypertensive, and Saharan Africa was estimated to have the highest prevalence compared to other regions; this was explained by South Africa also being home to highest proportion of the burden of HIV in Africa(38). The retrospective cohort study that was conducted in a rural part of Uganda shows the prevalence of hypertension among people living with human immunodeficiency virus to be 23.8%, compared to 33.5% among HIV-negative patients in another study that was conducted in Uganda (39,40). Both were retrospective cohort studies, but the difference can be explained by difference in sample size in these studies and the methodology used.

Nevertheless, hypertension remains prevalent among people living with HIV. This was evidenced by a study conducted in Cameroon, in three cities, which reported a high prevalence of 25% among PLWHIV on care (1). Similar studies reported a prevalence of 41.6% among people living with human immunodeficiency virus on ART (23,41). Additionally, a study conducted in South Africa reported a highest prevalence of 53% among people living with HIV (28). The prevalence of hypertension in people living with human immunodeficiency virus in sub-Saharan Africa varies a lot, ranging from 25% to 50%, depending on geographical area, population, within countries, and between countries (36, 38).

In Tanzania, the prevalence of hypertension in people living with human immunodeficiency virus epidemiological data is limited, though several studies that have been conducted in the country in different regions show that the prevalence of HIV in people living with human immunodeficiency virus ranged from 12.5% 29.3%, and 43% (31,42,43). So, there is a gross variability of levels of hypertension among people living with human immunodeficiency virus across countries and within countries, as supported by the findings in different countries in sub Saharan Africa countries(17).

2.3 Determinants of hypertension

2.3.1 Social demographic factors

In a study conducted in a rural area of South Africa, it was found that men experienced nearly twice the risk of developing hypertension compared to women (44). The disparity in hypertension risk based on gender was attributed to hormonal differences that seemed to offer women some protection against hypertension. This finding, however, caused controversy because it implied that men and women might have similar risks of hypertension after menopause. Men were observed to have a higher risk of hypertension than females because the group had a more sedentary lifestyle than females.

Age has traditionally been linked with hypertension because of vascular stiffening with age, which increases the resistance of blood flow (45). Moreover, the use of ART prolongs life and therefore predisposes them to traditional risk factors like obesity, metabolic syndrome, and hypertension(46). In one previous study in Ethiopia, it was observed that patients who had a family history of hypertension were at increased risk of hypertension (47).

High body mass index (BMI) have been observed that it is a risk factor for hypertension in patients who are using antiretroviral therapy (ART)(48). The risk of hypertension was explained by initial weight gain and immune reconstitution after starting to use ART. Likewise, the INSTI (Integrase Strand Transfer Inhibitors) dolutegravir was found to elevate oxidative stress, encourage fat accumulation(48,49), and hence lead to increased BMI and, consequently, increase the risk of hypertension among people living with human immunodeficiency virus

2.3.2 Behavioral risk factors

Being HIV positive does not exclude the people living with human immunodeficiency virus from other traditional risk factors; therefore, behavioral factors like cigarette smoking, alcohol intake, physical inactivity, and an unhealthy diet can also affect this population as well as the general population.

Several medical conditions including hypertension occur as a result of heavy alcohol intake (13,50,51). Heavy alcohol intake causes hypertension through endothelial dysfunction, intracellular calcium accumulation, stimulation of the renin-angiotensin-aldosterone system, enhanced sympathetic activity, vasoconstriction, and increased oxidative stress(50).

Moreover, alcohol has a high calorific value and is associated with obesity and type 2 diabetes, which are secondary risk factors for hypertension (52). Likewise, another study reported that heavy energy-based beverages, especially ethanol, are associated with renal atrophy, which ultimately leads to secondary hypertension (53). Moreover, a study that was conducted in Uganda showed that those who smoke cigarettes and have excessive alcohol intake had about twice the risk of hypertension prevalence as compared to people living with human immunodeficiency virus who do not smoke cigarettes or drink alcohol (18)

Apart from hypertension linked to HIV, individuals with HIV, like the general population, also face an elevated risk of developing hypertension. This happens, particularly when individuals do not follow through advices that include regular physical exercise, consumption of vegetables and fruits, and other relevant factors. This is significant because individuals who fail to manage risk factors for hypertension are at a higher likelihood of developing the condition. In a study that was conducted in rural parts of Uganda, it was shown that diets that aim to stop hypertension (DASH diet) rich in vegetables, fruits, low-dairy products, low-fat sugar, and sodium reduce blood sugar compared to standard western foods in adults (18). Though this finding was among the young age ranges of 13 to 25 it should also of relevance among older people.

2.4 HIV-related determinants of hypertension among People living with human immunodeficiency virus

The use of highly active antiretroviral therapy (HAART) has been attributed to the pathophysiology of hypertension, perhaps through lipodystrophy, inflammation, and the immune response. An example is tenofovir; TDF has been implicated to cause renal failure, hence causing secondary hypertension(54). However, a retrospective study in South Africa compared the effects of hypertension between the integrase strand transfer inhibitor (INSTI) dolutegravir and efavirenz, finding that the risk of hypertension was higher among those on dolutegravir than those on efavirenz. This was explained by the fact that dolutegravir was associated with increased BMI as compared to efavirenz (55). There is a need for further studies that will help to know more about the mechanism that makes it more associated with hypertension. Likewise, in the other study that aimed at studying the effects of switching from efavirenz/tenofovir disoproxil fumarate/emtricitabine-based regimens to the Integrase

Strand Transfer Inhibitor (INSTI) dolutegravir-based regimen, it was found that there was a significant increase in body mass index exceeding 25 kg/m2, which is termed overweight (56). This higher BMI resulted in an increased incidence of dyslipidaemia, hypertension, diabetes, and other comorbidities. Similarly, a retrospective study conducted in Nigeria observed an increase in hypertension prevalence from 14.7% to 20.3% after initiating the Integrase Strand Transfer Inhibitor (INSTI) dolutegravir (57). This suggests that the type of ART used could predispose people living with HIV to developing hypertension. Previous study consistently demonstrate that males have a higher risk of hypertension compared to females (58). In similar study, researchers compared the exposure to protease inhibitors between females and males and their association with the development of hypertension. In this study, males were found to have a higher likelihood of developing hypertension when compared to females after exposure to protease inhibitors. This was explained by the earlier development of body mass index in males than it was in females after exposure to protease inhibitors (PI). Though the reason was unclear, it was thought to be factors like ethnicity and type of diet (58).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Design

This was an analytical cross-sectional study design among adults' people living with human immunodeficiency virus (PLWHIV) attending care and treatment clinics (CTC) in Tabora region from April to May 2024.

3.2 Study setting

This study was conducted in four district councils (DC) in Tabora region namely Nzega DC, Igunga DC, Urambo DC and Kaliua DC. Tabora ranks the third most populated region in the country, with a population of 3,391,679 according to the 2022 national census report (56), and the highest populated in western Tanzania. The region has 365 health facilities, which comprising of 314 dispensaries, 34 health centres, and 15 hospitals. Ninety-six percent of the facilities are government-owned, while the remaining four percent are owned by faith-based organizations and private entities.

The region is among top five with the highest enrolment of PLWHIV attending CTC also been one of the regions which is less urbanized region of which most of the residents resides in the less urbanised region were the lifestyle does not pose the risk factors for hypertension. Among 78,467 of PLWHIV aged more than 18 years were enrolled in care, 99% are receiving highly active antiretroviral therapy (HAART). The region has approximately 199 care and treatment clinics, distributed based on the local HIV population.

3.3 Study population

The study population were all PLWHIV on ART aged more than 18 years who attends CTC in Tabora.

3.4 Inclusion criteria

1. PLWHIV on ART who were enrolled in CTC
2. Those who were older than 18 years study.

3.5 Exclusion criteria

1. People living with HIV who were pregnant.
2. People living with HIV who had cognitive impairments
3. People living with HIV who were very sick during data collection

3.6 Sample size estimation

Sample size was estimated using Cochran formular for estimation of sample size for cross sectional studies (59).

Substitutions to the formula included P which was prevalence of hypertension among PLWHIV found were found to be 43% from research projects carried out in northern Tanzania (60,61).

The desired level of absolute precision (d) was equal to 0.05.

This was a multistage sampling, accounting for this design, the design effect(DEFF) was estimated at 1.5 (12).

sample size $n = Z^2P(1-P)/d^2$ (59) and thus:

P= proportion with characteristic of interest 43%, 0.43

d=margin of error 0.05

n= $1.96^2 \times 0.43(1-0.4)/0.05^2$

n=$3768 =. \approx 377$

Adjusting for non-response of 20% 0.2 $n/(1-0.2)$ (28)

Sample size =465

Use design effect 1.5

$$sample\ size = DEFF \times n$$

$$= 1.5 \times 465$$

698≈ 700

Therefore, the sample size was estimated to be about 700 participants

3.7 Sampling procedure

In this study, multistage stratified cluster sampling procedure was employed. The first stage involved selecting four (50%) district councils from a list of eight councils in Tabora region using simple random sampling with the Excel random number generator application. The

selected councils were Kaliua DC, Nzega DC, Igunga DC, and Urambo DC. The sample size contributed by each council was determined by its total number of PLWHIV attending CTCs as a proportion of the total PLWHIV from the four selected councils, as illustrated in Table 1 below.

In the second stage, stratified the facilities tier one and tier two were three care and treatment centres (CTCs) were randomly sampled in each selected council from the list of tier one and tier two facilities. Each CTC was assigned a number, and random selection was performed using the Excel random number generator application. Three CTCs were obtained from each council. The number of participants required from each council for the study was determined based on probability proportion to size (PPS).

The third stage involved sampling clients at the CTC level. Simple random sampling was used on each clinic day. A proportionate sample number of study participants were selected from the appointment list, where participants were assigned numbers. Using a random number generator, the study participants were selected based on the numbers assigned. The number of participants sampled is illustrated in the table below. Participants who were selected from the list but did not attend the clinic oversampled were conducted on the next clinic.

Table 1: Multistage sampling procedure from the regional level to facility level

Sampling stage	**Level**		**Total Number of PLWHIV in Each council (N*)**	**Total Number of PLWHIV sampled by proportionate to size (n)**
Stage 1 4 councils were sampled from the list of 8 councils	Igunga Dc		13764	210
	Nzega Dc		14815	226
	Kaliua Dc		11871	186
	Urambo Dc		4696	75
Total			45146	700
Stage 2 Sampling of 3 facilities from each council.1934	Igunga Dc	Igunga D H	2894	124
		Nanga Hc	1027	43
		Ziba Hc	1107	46
	Nzega Dc	Ndala Hospital	1836	110
		Mwanihala HC	944	56
		Busondo HC	1071	64
	Kaliua DC	St John Paul Hospital	1227	76
		Usinge HC	919	57
		Igagala Hc	819	51
	Urambo DC	Urambo DH	1934	42
		Usoke HC	886	19
		Kamsekwa Dispensary	668	12
Stage 3: Sampling of study participants from each facility as it indicated in the last Column				

3.8 Variables

3.8.1 Outcome Variable

The outcome variable was hypertension

Hypertensive case A refers to a person whose systolic blood pressure (SBP) was 140 mmHg or higher or diastolic blood pressure (DBP) was 90 mmHg or higher, based on the average of two separate or properly measured blood pressure readings on two separate occasions 1 to 5 minutes apart.

3.8.2 Predictor Variable

The following variables were recorded as predictors of hypertension which are sociodemographic factors, behavioral factors, HIV-related factors, and physiological factors.

3.9 Measurements of variable

3.9.1 Blood Pressure

The blood pressure was measured by trained medical personnel using a calibrated FDA-approved automatic aneroid sphygmomanometer (Omron Health Care) with an adult-size cuff. The blood pressure machine was calibrated by comparing with the calibrated BP machine available in the Hospital. The patient was placed in a sitting position, and blood pressure was measured while the patient army rests over the pillow or book. The cuff was placed on the patient's arm such that the middle of the cuff was at the level of the heart. Two blood pressure measurements were taken at intervals of at least 5 minutes, and the average readings was recoded (53).

3.9.2 Body weight

The measurements of body weight were be done by using SECA scale that was calibrated daily. The weighing scale was place on flat and firm surface. Before stepping to the weighing scale, the participants were instructed to remove their footwear (shoes, slippers, sandals, etc.) and socks, also take off any heavy belts and empty out their pockets off mobiles, wallets and coins, and then the participant was asked to step onto weighing scale with one foot on each side of the scale. On measuring weight, the participants were instructed to stand still face forward, place arms on the side and wait until asked to step off. The weight of the participant was recorded to the nearest 0.1 (kg) (62). Then the participant was asked to step off the weighing scale.

3.9.3 Height

The height of the study participants was measured using a calibrated stadiometer (SECA) that was placed in flat and vertical surface. The patient was instructed to remove shoes, hair ornaments and head gear that interfere with measurement of height. The patient was instructed to stand straight facing forward not to tilt their head up ensuring that the eyes were at the same level with the ears. The participant’s feet were be placed be together, knee straight heel and buttocks against the back board. The measurement arm was gently move

down onto the head of the participant and the participant was asked to breathe in and stand tall. Reading of height were in centimetres at the exact point to the nearest mm (62).

Body Mass Index: this was calculated as the body weight in kg divided by the square of height (M2) and classified using the standard definition of WHO, where BMI >30 kg/m2 was classified as obesity, BMI 25–30 kg/m2 was classified as overweight, BMI 18.5-24.9 was classified as normal weight, and BMI less than 18.5 was classified as underweight BMI; therefore, the variable was taken as an ordinal variable.

3.10 Data collection tools

In this study, four investigation tools were used: two questionnaires and two consent forms. These included the Swahili version questionnaire (Appendix 1), the English version questionnaire (Appendix 2), the Swahili version consent form (Appendix 3), and the English version consent form (Appendix 4).

3.11 Validity and reliability of data collection tools

The questionnaire underwent a translation process to ensure accuracy and reliability. This process consisted of the following steps:

Forward Translation: The questionnaire was translated from English to Swahili by a skilled translator fluent in both languages. The goal of this translation was to accurately convey the original questions' meaning and intent while considering linguistic and cultural nuances.

Back Translation: Using only the Swahili text as a guide, a second translator fluent in both Swahili and English, and unaware of the original English version, independently back-translated the Swahili questionnaire.

Discrepancy Resolution: Consensus was used to resolve any differences between the back-translated questionnaire and the original English version.

The interview was conducted in Swahili by the principal investigator or research assistant in a closed room to make the participants comfortable and free to provide the information requested during the interview.

The questionnaire was pretested to check for clarity and understandability of the questionnaire and research assistants received one day of training of which they were able to familiarized with the study's objectives, data collection procedures, and the ethical principles guiding the research.

To ensure the validity of the data collection tool, a pilot survey was conducted on 10% of the study population before initiating full-scale data collection. Utilizing Kobo Collect, the questionnaire was sequentially filled out to ensure each question was completed before moving on to the next. To reduce information bias, medical data that participants found hard to recall, including viral load, ART start date, HIV diagnosis date, and ART regimen, were obtained from their CTC2 cards. The most recent values for viral load and ART regimen were utilized.

3.12 Training of research assistance

In the study, eight research assistants, including qualified clinical officers (COs) and nursing assistants (NAs), were employed. Most were volunteers already working at the facility to minimize disruptions during data collection. The research assistants underwent a one-day training, and the tool was piloted with the principal investigator. To reduce inter-observer variability, the principal researcher conducted follow-up visits, with data collection taking place weekly. In most facilities, the principal researcher was able to work closely with the research assistants during this process.

3.13 Data collection

Data was collected using the adopted Swahili version of the WHO steps questionnaire (Appendix 1). The questionnaire included questions that collected information on socio-demographic factors (e.g., occupation, level of education) and behavioral factors (e.g., cigarette smoking, alcohol intake, and eating habits); this information was obtained through interviews. The second part focused on clinical factors (e.g., ART use, regimen of ART, viral load), with this information obtained from the participants' files. The final section covered anthropometric measurements (e.g., body weight, height, BMI) and blood pressure.

To measure body weight and height, a SECA weighing scale capable of measuring up to 200 kg and up to 200 cm (2 meters) was used. Each morning, before beginning data collection,

the researcher calibrated the weighing scale to ensure its accuracy and reliability. BMI was calculated by dividing weight in kilograms (kg) by height in meters squared (m^2). Blood pressure was measured using an aneroid automatic sphygmomanometer following WHO guidelines, and the readings were recorded in the questionnaire.

The measurements and interview responses were electronically recorded using Kobo Collect and entered directly into the computer system. Missing data and data out of range were reviewed daily after data collection, and the data were stored on a password-protected computer to ensure data security before being analysed.

3.14 Data analysis

Data was cleaned by using Microsoft Excel were the errors, duplicates, inconsistence variables were removed and corrected while and then imported to STATA software for analysis (62). Continuous variables were summarized by Mean and standard deviation and categorical variable was summarized by frequency and percentage and presented in tables. blood pressure >140/90 or more was label hypertensive and was coded 1 and otherwise coded as 0. Body Mass Index (BMI) categories were defined and coded as follows: BMI less than 18.5 was categorized as underweight and coded as 1; BMI between 18.5 to 24.9 was categorized as normal and coded as 2; BMI ranging from 25.0 to 29.9 was categorized as overweight and coded as 3; and BMI of 30 and above was categorized as obese and coded as 4. Prevalence of hypertension was stratified by demographic characteristics.

modified poison regression with robust error was used to determine the association between independent variable with outcome variable hypertension.

The independent variables with $p<0.2$ in univariable analysis, which were age, sex, history of hypertension, history of cigarette smoking, history of alcohol consumption, harmful alcohol drinking, fruits intake, vegetable intake and body mass index. While HIV related factors were Viral load count, duration since HIV diagnosis, duration since ART initiation and ART regimen were included in multivariable analysis.

Variable with p-value less than 0.05 in multivariable analysis were considered statistically significant.

3.15 Research Ethics Considerations

The ethical approval was obtained from ethical review board of Muhimbili University of Health and Allied Science (MUHAS) with reference number MUHAS- No DA.282/298/01C/2096. Permission to collect the data from the facilities was obtained from President office and local administration authority (PROLAG), Regional administrative secretary Tabora, Districts Executive directors (DED) from Kaliua, Urambo, Nzega and Igunga DC and from the facility in charges of 12 facilities where the Data was collected. A signed informed concert was used to obtain permission from the patients and unique number was used in instead of names to maintain confidentiality.

CHAPTER FOUR

4.0 RESULTS

4.1 Demographic characteristics

A total of 712 people living with human immunodeficiency virus were recruited in the study, with the mean age (SD) 45.3(13.2) the response rate for this study was 90%. Majority were female 398(55.90%) and peasants 468 (65.73%). Nzega DC contributed more participants 230 (32.30%), about half of the participants had no formal education 325(45.65%) and less than one third 201(28.23%) had positive family history of hypertension.

Table 2: Demographic characteristics of PLWHIV attending care and treatment clinic in Tabora region from March to Apr 2024 (n=712)

Variable	Frequency	Percent %
Age group		
18-39	93	13.0
40-59	335	47.0
60 and above	284	39.8
Sex		
Male	314	44.1
Female	398	55.9
Employment		
Peasants	468	65.7
self employed	197	27.6
Employed	27	3.7
Unemployed	20	2.8
Name of council		
Igunga DC	216	30.3
Kaliua DC	195	27.3
Nzega DC	230	32.3
Urambo DC	71	9.9

Name of data collecting facilities		
Igunga DH	125	17.5
Ndala Hospital	110	15.4
St John Pauli	74	10.4
Busondo HC	64	8.9
Igagala Dispensary	64	8.9
Usinge Dispensary	58	8.1
Mwanihala Dispensary	56	7.8
Ziba HC	47	6.6
Nanga HC	45	6.3
Urambo DH	40	5.6
Usoke HC	17	2.3
Kamsekwa	12	1.6
Type of facility		
Tier 1	513	72.0
Tier 2	199	27.9
Marital status		
Married	394	55.3
Separated/divorced	164	23.0
Singel	84	11.8
Widowed	70	9.8
Education level		
No formal education	325	45.6
Primary Education	293	41.1
secondary Education	68	9.5
Higher Education	26	3.6
Type		
No history of HTN	511	71.7
Family history of HTN	201	28.2

SD standard deviation, DC district council, HC health centre, HTN hypertension, DH district hospital

4.2 Prevalence of Hypertension and distribution across the socio-demographic factors among PLWHIV attending care and treatments clinics in Tabora region April to May 2024.

In this study, the overall prevalence of hypertension among PLWHIV attending CTC was estimated at 25.8% with a 95% CI of 22% - 29%.

The prevalence of hypertension and distribution among PLWHIV was distributed by social demographic and HIV related factors as follows. Those aged, over 60 years: had prevalence of 43 (43%) at 95%, CI of 33.6% to 52.9%, Those with family history of hypertension had prevalence of 81 (44.3%) at 95%, CI 36.9% - 51.3%, those who were Obese had prevalence of 28 (52.8%) at 95% CI 39.3% - 65.8%.

Duration since HIV diagnosis had prevalence of 127 (31.9%) with 95% CI of 27.5 – 36.7, duration since ART diagnosis: 126 (32.1%) at 95% CI 27.6% – 36.9%. Those who were on protease inhibitor-based regimen had prevalence of 8 (57.1%) 95% CI 30.7% - 80.0% while those who had history of drank daily had a prevalence of 12 (57.1%) at 95% CI 35.4%-76.4%, those with viral load less than 10,000 copies had prevalence of 33. (37.3%) at 95% CI 28.3% - 48.5%. Those who Smoke more than 20 cigarettes per day had prevalence of 5 (55.5%) at 95% CI 23.6% - 83.4%. Those with history of alcohol consumption: 60 (31.0%) at 95% CI 26.8% – 47.5%

Table 3: Prevalence of hypertension by distribution of social demographic factors on hypertension among PLWHIV attending care and care treatment clinic in Tabora region April to May 2024. (N=712)

Variable	Total (N)	Hypertensive (n)	Percentage %	95% CI
Overall prevalence	**712**	**184**	**25.8**	**22.7 – 29.1**
Age				
18-39	257	27	10.5	7.2 - 14.9
40-59	355	114	32.1	27.4 - 37.1
60 and above	100	43	43.0	33.6 - 52.9
Sex				
Male	314	86	27.3	22.7 – 32.6
Female	398	98	24.6	20.6 - 29.1
Family history of Hypertension				
No	511	120	20.1	16.8 - 23.8
Yes	201	81	44.0	36.9 - 51.3
Education level				
Higher education	26	7	26.9	13.1 – 47.1
Secondary education	68	17	25.0	16.0 - 36.7
Primary Education	293	68	23.2	18.7 – 28.4
No formal education	325	92	28.3	23.6 – 33.4
Harmful cigarette smoking				
Less than 20 cigarette per day	73	25	34.2	24.2 - 45.8
More than 20 cigarette per day	9	5	55.5	23.6 - 83.4
Not smoking	630	154	24.4	21.2 - 27.9
History of alcohol consumption				
No	519	124	24.4	21.2 – 27.9
Yes	193	60	36.5	26.8 – 47.5
Harmful alcohol drinking				
More than 5 drinks	31	10	32.2	18.1 - 50.6

Drunk Daily	21	12	57.1	35.4 - 76.4
Less than 5 drinks per day	141	38	26.9	20.2 – 34.9
Not drinking	519	124	23.8	20.4 - 27.7
Health diet Fruits intake				
0-4 servings	660	178	26.2	23.0 - 29.6
5-7 servings	52	6	15.3	5.7 - 35.0
Health diet Vegetables				
0-4 servings	323	90	28.4	24.4 - 32.7
5-7 servings	389	94	21.17	16.5 – 26.6
BMI category				
Under weight	63	12	19.0	11.0 - 30.7
Normal weight	434	84	19.9	15.8 – 23.3
Overweight	162	60	37.0	29.9 - 44.7
Obese	53	28	52.8	39.3 - 65.8
Duration since HIV diagnosis				
0-5 years	315	57	18.1	14.2 – 22.7
More than 5 years	397	127	31.9	27.5 – 36.7
Duration since ART initiation				
Duration 0-5 years	320	58	18.1	14.2 – 22.7
Duration more than 5 years	392	126	32.1	27.6 – 36.9
Viral load count				
>100,000 copies/ml of blood	5	1	20.0	19.1 - 74.4
<10,000 copies/ ml of blood	87	33	37.9	28.3 - 48.5
< 20 copies/ml of blood	620	150	24.19	20.9 - 27.7
ART Regimen				
DTG based Regimen	698	176	25.2	22.1 - 28.5
PI based Regimen	14	8	57.1	30.7 - 80.0

CI Confidence interval, DTG-Dolutegravir, PI-Protease Inhibitor, ART Antiretroviral Therapy, BMI-Body Mass Index, HIV Human Immunodeficiency Virus, PLWHIV people living with human immunodeficiency virus,

Proportion of untreated hypertension among hypertensive people living with human immunodeficiency virus attending CTC in Tabora Region from May to June 2024

In this study the proportional of untreated hypertension among hypertensive people living with HIV was 129(78.18%) (95% CI: 63%-79%).

Factors associated with hypertension among people living with human immunodeficiency virus attending HIV clinic in Tabora region from April to May 2024.

Participants aged over 60 years had a 17% increased prevalence of having hypertension (aPR (95% CI): 1.17, (1.08 - 1.28), $p < 0.001$), which compared to those who are less 40 years. Those aged 50 to 59 years had a 13% increased prevalence hypertension aPR (95% CI): 1.13(1.06 - 1.19) $p < 0.01$ compared to those with less than 40 years. Participants with a history of hypertension had a 13% increased prevalence hypertension (aPR (95% CI): 1.13, (1.07 - 1.19) $p < 0.01$), compared to those with no family history of hypertension. Obese and overweight participants had 26% and 12% increased prevalence hypertension, respectively obese: aPR (95%, CI): 1.26, (1.11 - 1.42), $p < 0.001$; overweight: aPR, 95% CI: 1.12, (1.02 - 1.23), $p = 0.016$, compared to those who are underweight.

The participants with viral load less than 20 copies had 8% reduced prevalence of hypertension aPR (95%, CI: 0.93(0.88-0.98) $p=0.038$ compare to viral load count more 100,000 copies, while other HIV related factors, which were, the duration since HIV diagnosis and durations since ART initiation, and ART regimen were not statistically associated with hypertension.

Table 4: Prevalence of hypertension by distribution of social demographic factors on hypertension among PLWHIV attending care and care treatment clinic in Tabora region April to May 2024. (N=712)

Factors of interest	Total (N)	Hypertensive (n) (%)	Crude PR (CI) 95%	P value	Adjusted PR (CI) 95%	P-value
Age						
18-39	257	27 (10.51)	**Ref**		**Ref**	
40-59	355	114 (32.11)	1.35 (1.24-1.47)	<0.001	1.13 (1.06-1.19)	**<0.01**
60 and above	100	43 (43.00)	1.156 (1.38 -1.76)	<0.001	1.17 (1.08- 1.28)	**<0.01**
Sex						
Female	398	98 (24.62)	**Ref**			
Male	314	86 (27.39)	1.05 (0.96 -1.14)	0.24		
Family History of Hypertension.						
No	511	120 (59.70)	**Ref**		**Ref**	
Yes	201	81 (40.30)	1.32(1.20-1.44)	<0.001	1.13 (1.07 - 1.19)	**<0.01**
Cigarette smoking						
Not smoking cons	630	154 (24.44)	**Ref**		**Ref**	
Less than 20 cigarette per day	73	25 (34.25)	1.07(0.99-1.17	0.082	1.02(0.94 -1.09)	0.67
More than 20 cigarette per day	9	5 (55.56)	1.25(1.01-1.54)	0.038	1.09(89-1.27)	0.43
History of alcohol consumption						
No	519	124 (23.89)	**Ref**		**Ref**	
Yes	193	60 (31.09)	1.11(1.01-1.22)	0.024	1.00(1.02-1.15)	0.92
Harmful drinking						
Do not drink	519	124 (23.89)	**Ref**		**Ref**	
More than 5 drinks per day	31	10 (32.26)	1.12(0.91-1.37)	0.28	1.00(0.88 -1.14)	0.92
Drunk daily	21	12 (57.14)	1.56(1.31-1.87)	<0.001	1.15 (0.95 -1.25)	0.2
Less than 5 drinks per day	141	38 (26.95)	1.03(0.93-1.15)	0.69	1.01(0.93 -1.05)	0.85
Fruits intake						
0-4 servings	660	178 (26.97)	**Ref**		**Ref**	
5-7 servings	52	6 (11.54)	0.82(0.70-0.95)	0.012	1.09(0.90-1.18)	0.029
Vegetables intake						
0-4 servings	323	90 (27.86)	**Ref**		**Ref**	
5-7 servings	389	94 (24.16)	0.88(0.80-0.96)	<0.005	0.9(0.92 -1.02)	0.26
BMI category						
Under weight	63	12 (19.05)	**Ref**		**Ref**	
Normal weight	434	84 (19.95)	1.02(0.88 -1.19)	0.74	1.03(0.94 -1.12)	0.95

Overweight	162	60 (37.04)	1.26 (1.07-1.49)	0.006	1.12 (1.02 -1.23)	**0.016**
Obese	53	28 (52.83)	1.48(1.22 - 1.79)	<0.001	1.26 (1.11-1.42)	**<0.001**
Physical activity						
No	231	78(33.77)	**Ref**			
Yes	481	106(29.20)	0.91 (0.86 - 0.96)	0.002	**0.93 (0.88 -0.98)**	**0.019**
Duration since HIV diagnosis						
0-5 yrs.	315	57(18.10)	Ref			
More than 5 yrs.	397	127(31.99)	1.22(1.12-1.33)	<0.001	**0.84 (0.62 -1.12)**	**0.25**
Duration since ART Initiation						
0-5 yrs.	320	58(18.13)	Ref			
More than 5 years	392	126 (32.14)	1.25(1.15-1.35)	<0.001		
ART Regimen						
PI based regimen	14	8(57.14)	Ref			
DTG based regimen	698	176(25.21)	1.25(1.22 - 1.28)	<0.001	**0.92(0.77-1.09)**	**0.34**
Viral load count						
>100,000 copies/ml of blood	5	1(20.00)	Ref			
<10,000 copies/ ml of blood	87	33(24.84)	**1.14(0.46 -1.31)**	0.358	**0.86 (0.60 - 1.23)**	**0.43**
< 20 copies/ml of blood	620	150(24.84)	1.03(0.52 - 0.81)	<0.001	**0.92 (0.86 - 0.99)**	**0.038**

HIV human immunodeficiency virus, ART antiretroviral therapy CI confidence interval.

Age, sex and education level was used to adjust for confounding *variables with p>0.02 in bivariable analysis BMI body mass index body mass index, CI confidence interval,

Age, sex and education level was used to adjust for confounding.

CHAPTER FIVE

5.0 DISCUSSION

The study reveals a hypertension prevalence of 25.8% among PLWHIV. Social demographic characteristics associated with hypertension in this group include being over 40 years, having a family history of hypertension, and being overweight and obese. Among HIV-related factors, a viral load of less than 20 copies was protective against hypertension. However, the duration between diagnosis and ART initiation, the duration since HIV diagnosis, and the type of ART regimen were not associated with hypertension.

5.1 Prevalence of hypertension among PLWHIV.

The study found that the prevalence of hypertension among PLWHIV on ART was 25.8%, which is consistent with findings from studies in Nigeria, and other parts of Tanzania, where the prevalence was 24.7%,26%, 29% respectively (31,46,63).lower the prevalence rate found in a study conducted in the Ghana, which was 17.4% (61). The highest prevalence was found in the study that was conducted in Ghana which was 36.7% (64). The increased prevalence of hypertension among people living with HIV may be due to the interaction between HIV viral proteins and antiretroviral therapy (ART) with the immune system components. This interaction can cause kidney damage, vascular dysfunction, and activation of the sympathetic nervous system, all of which contribute to the development of hypertension (30). The prevalence of hypertension is expected to be higher with the prolonged use of ART especially the currently introduced Integrase Strand Transfer Inhibitor (INSTI) dolutegravir-based regimen, which has been linked to hypertension. (56). Moreover, prolonged HIV infection and being overweight, particularly with an excess of visceral adipose tissue, can contribute to chronic inflammation, which is implicated in the development of hypertension (33). Although in the current study it was found that there were no association between hypertension and HIV related factors such as ART regimen, Duration since HIV diagnosis, viral load and duration since HIV diagnosis this could be explained by nature of study. The variation in prevalence rates can be attributed to the geographical differences in study locations. For instance, previous research has demonstrated that

Northern Tanzania has a higher prevalence of hypertension compared to the findings of the current study, which aligns with reports indicating higher hypertension rates in that region.

5.2 Proportional of untreated hypertension

In the current study, it was found that 70.18% of participants with hypertension were not receiving treatment for Hypertension. This suggests that a substantial majority of people with hypertension diagnoses had not begun or were not receiving any kind of medical intervention to control their condition. This high percentage of untreated hypertension draws attention to gaps in the healthcare system, such as access to care, awareness, or adherence to treatment protocols, and raises concerns about the population's potential risk for complications, such as cardiovascular disease. This proportional of untreated hypertension slower than similar study in northern Tanzania, where the prevalence of untreated hypertension was 89.6% (65). This higher finding may be attributed to the partial integration of hypertension and HIV services at the facilities where data collection took place. Those diagnosed with hypertension were referred to treatment at their respective facilities or to higher-level facilities when hypertensive medication was not available at the primary facility. Additionally, we shared the data of hypertensive patients with the District Non-Communicable Disease Coordinator (DNCDCo)

5.3 Social demographic factors of hypertension among PLWHIV

In the present study, the finding that age above 40 years was significantly associated with hypertension suggests that individuals older than 40 are more likely to have hypertension compared to younger participants. This finding is consistent with findings from studies conducted in Tanzania, Uganda, Ethiopia, and Ghana (11, 17, 47, 61). The possible reason for this finding is that older people tend to have stiffer artery vasculature, fewer elastic vessels, and lower blood flow resistance, which can lead to an increased likelihood of hypertension. This finding emphasizes the importance of targeted intervention such as hypertension screening and management strategies for people over 40 to prevent complications.

Individuals with a history of hypertension had a stronger association with hypertension compared to those without history, this suggests that people who have been previously diagnosed with hypertension are more likely to continue experiencing elevated blood pressure. This finding aligns with results from a study conducted in Tanzania and South Africa Ethiopia (28,66). This underscores the chronic nature of hypertension, where those with a history may require ongoing and more intensive management to prevent further complications, compared to individuals without a prior diagnosis. This finding could be explained by the shared genetic components, environmental factors, and the tendency for families to adopt similar lifestyles and behaviours among individuals with a family history of hypertension.

The current study indicates that being overweight or obese is significantly associated with hypertension among PLWHIV. This finding suggests that excess body weight plays a crucial role in increasing the risk of high blood pressure among PLWHIV. This observation aligns with previous studies conducted in Kenya, Zimbabwe, and Tanzania (31, 32, 38). However, this finding contrasts with the results of a study conducted in Nigeria (56). This may be explained by those people living with HIV after initiating ART fail to adopt lifestyle modifications like physical exercise, eating vegetables and fruits. The possible explanation for overweight and obesity being associated with hypertension may be changes in dietary habits and excessive alcohol intake. Also, use of some classes of ART, like integrase strand transfer inhibitor (INSTI) dolutegravir, was associated with increased BMI, which led to dyslipidaemia, hypertension, and diabetes, according to previous study findings (7).

Furthermore, the current study found that engaging in physical activity is associated with a lower prevalence of hypertension among people living with HIV. This research emphasises how beneficial exercise is for controlling blood pressure in this particularly among PLWHIV, by increasing blood flow, lowering arterial stiffness, and strengthening the body's ability to control blood pressure, regular physical activity helps to improve cardiovascular health. Additionally, it helps control weight and lowers the risk of obesity, which is recognised as a risk factor for high blood pressure.

This finding contrasts with results from other studies conducted in Zimbabwe (11). This finding can be explained by the fact that physical activity has been linked to rapid reductions in systolic blood pressure. This occurs because physical activity reduces peripheral vascular resistance through a combination of structural changes and neurohormonal responses that lower sympathetic nerve activity and increase arterial lumen diameters (67).

5.4 HIV-related factors of hypertension among PLWHIV

Additionally, in a multivariate analysis, having a viral load count of less than 20 copies was found to be protective against hypertension. The finding that having a viral load count of less than 20 copies found to be protective against hypertension among people living with HIV (PLWHIV) suggests that effective management of HIV, resulting in viral suppression, may help reduce the risk of developing high blood pressure. A low viral load indicates that the HIV infection is well-controlled, often through antiretroviral therapy (ART), which in turn may reduce inflammation and immune activation in the body. This similar with findings from a study conducted in Chicago, USA (63), In the current study's findings where a low viral load was associated with a reduced risk of hypertension, a study conducted in Chicago, USA, reported that a high viral load was linked to hypertension. The possible explanation for the current study's findings is that a low viral load is associated with fewer viruses present in the body, leading to reduced inflammatory reactions that may lower the likelihood of developing hypertension. (30).

However, other HIV-related factors such as the time since diagnosis, the duration between diagnosis and the start of antiretroviral therapy (ART), and the ART regimen did not show a significant association with hypertension in the multivariable analysis. This suggests that these factors may not play a major role in influencing the risk of hypertension among people living with HIV (PLWHIV), at least within the context of this study. This findings were similar to the findings to the study that was conducted in Nigeria and Kenya (68,69) which indicates that ART and duration of were not associated with hypertension among PLWHIV though the in the current study 698 study participants were on DTG based regimen. These findings were contrary to the study that was conducted in

Strengths of this study include a sufficient sample size and the use of random sampling to select study participants.

Limitations of this study include its cross-sectional design, which makes it difficult to establish a temporal relationship between hypertension and associated factors among PLWHIV.

The majority of participants in this study were over the age of 60, which could have introduced age-related confounding effects on the findings which can overestimate the prevalence of hypertension.

The study only included patients who attended their appointments, potentially excluding those who missed appointments different from those who adhere to appointment and thus not fully representing all PLWHIV in the population.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The prevalence of hypertension among people living with HIV in the Tabora region is high. Traditional risk factors associated with hypertension include age over 40 years, family history of hypertension, and being overweight or obese but physical exercise and viral load is associated with reduced prevalence of hypertension. However, HIV related which were duration since diagnosis, duration since ART initiation and ART regimen did not show significant association in multivariable analysis though in bivariate analysis the shows association.

6.2 Recommendation

Patients who are on ART should adhere to lifestyle modification practises particularly physical activity and dietary program aiming at reducing weight.

At facility level health care workers working at CTC should screen all PLHIV who are on ART who attends on care for hypertension and other communicable disease for early diagnosis and comprehensive management of the patients.

Strengthen health promotion in all CTCs, focusing on lifestyle modifications, particularly in physical activity, weight loss and dietary programs among PLWHIV attending CTC.

Due to high prevalence of untreated hypertension was high Ministry of Health, in collaboration with NASHCOP and implementing partners, should strengthen the integration of HIV care with comprehensive hypertension management within routine CTC healthcare services for people living with HIV (PLWHIV).

REFERENCES

1. Medical WHO, Technical D. WHO Technical Specifications For Automated Non-Invasive Blood Pressure Measuring Devices With Cuff. 2020 Who, editor. WHO;
2. Joint United Nations Programme on HIV/AIDS. IN DANGER: UNAIDS Global AIDS Update 2022. Geneva: Joint United Nations Programme on HIV/AIDS; 2022. Licence: CC BY-NC-SA 3.0 IGO.
3. Achwoka D, Mutave R, Oyugi JO, Achia T, Achwoka D, Mutave R, et al. Essay Tackling an emerging epidemic : the burden of non-communicable diseases among people living with HIV / AIDS in sub-Saharan Africa. 2020;36(271):1–9.
4. Adults HIVT. Epidemiological fact sheet HIV statistics , globally and by WHO region , 2023. 2025;
5. Ames MK, Atkins CE, Pitt B. The renin-angiotensin-aldosterone system and its suppression. 2019;(January):363–82.
6. Bakris G, Cushman WC, Green LA, Izzo JL. Committee on Prevention , Detection , Evaluation , and Treatment of National Institutes of Health. 2003;(November 2017).
7. Birungi J, Kivuyo S, Garrib A, Mugenyi L, Mutungi G, Namakoola I, et al. Integrating health services for HIV infection , diabetes and hypertension in Saharan Africa : a cohort study sub- -. 2021;1–10.
8. Zhou B, Carrillo-Larco RM, Danaei G, Riley LM, Paciorek CJ, Stevens GA, et al. Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. Lancet. 2021;398(10304):957–80.
9. Care P. Predictors of Metabolic Syndrome Among People Living with HIV in Gedeo-Zone , Southern- Ethiopia : A Case – Control Study. 2020;535–49.
10. Charan J, Biswas T. Review Article How to Calculate Sample Size for Different Study Designs in Medical Research ? 2013;35(2).

11. Chhoun P, Ngin C, Tuot S, Pal K, Steel M, Dionisio J, et al. Non-communicable diseases and related risk behaviors among men and women living with HIV in Cambodia: Findings from a cross-sectional study. Int J Equity Health. 2017;16(1):1–12.

12. Chireshe R, Naidoo K, Nyamakura R, Africa S, Africa S. Hypertension among human immunodeficiency virus infected patients on treatment at Parirenyatwa Hospital : A descriptive study. 2017;1–8.

13. Choi JW, Han E, Kim TH. Risk of Hypertension and Type 2 Diabetes in Relation to Changes in Alcohol Consumption: A Nationwide Cohort Study. Int J Environ Res Public Health. 2022;19(9).

14. Costa AN, e Val FF de A, Macedo ÁE, Cubas-Vega N, Tejo PL Del, Marques MM, et al. Increased prevalence of hypertension among people living with HIV: Where to begin? Rev Soc Bras Med Trop. 2020;53(May):1–6.

15. Tegegne KD, Adela GA, Kassie GA, Mengstie MA, Seid MA, Zemene MA, et al. Prevalence and factors associated with hypertension among peoples living with HIV in East Africa, a systematic review and meta-analysis. BMC Infect Dis [Internet]. 2023;23(1):1–12. Available from: https://doi.org/10.1186/s12879-023-08679-x

16. Dzudie A, Hoover D, Kim H, Ajeh R, Adedimeji A, Shi Q, et al. PLOS ONE Hypertension among people living with HIV / AIDS in Cameroon : A cross-sectional analysis from Central Africa International Epidemiology Databases to Evaluate AIDS. 2021;1–17.

17. Mphekgwana PM, Malema N, Monyeki KD, Mothiba TM, Makgahlela M, Kgatla N, et al. Hypertension prevalence and determinants among black South African adults in semi-urban and rural areas. Int J Environ Res Public Health. 2020;17(20):1–12.

18. Migisha R, Ario AR, Kadobera D, Bulage L, Katana E, Ndyabakira A, et al. High blood pressure and associated factors among HIV-infected young persons aged 13 to 25 years at selected health facilities in Rwenzori region, western Uganda, September–October 2021. Clin Hypertens [Internet]. 2023;29(1):1–9. Available from: https://doi.org/10.1186/s40885-022-00230-5

19. Mfinanga SG, Nyirenda MJ, Mutungi G, Mghamba J, Maongezi S, Musinguzi J, et al. Integrating HIV, diabetes and hypertension services in Africa: Study protocol for a cluster randomised trial in Tanzania and Uganda. BMJ Open. 2021;11(10).

20. Iverson BL, Dervan PB. Joint United Nations Programme on HIV/AIDS. The path that ends AIDS: UNAIDS Global AIDS Update 2023. Geneva: Joint United Nations Programme on HIV/AIDS; 2023. Licence: CC BY-NC-SA 3.0 IGO. 2023.

21. Godongwana M, Wet-billings N De. Heliyon Time to hypertension development among people living with HIV in South Africa : A longitudinal analysis of the National Income Dynamics Survey (NIDS). Heliyon [Internet]. 2021;7(July):e07750. Available from: https://doi.org/10.1016/j.heliyon.2021.e07750

22. Sarfo FS, Nichols M, Singh A, Hardy Y, Norman B, Mensah G, et al. Characteristics of hypertension among people living with HIV in Ghana: Impact of new hypertension guideline. J Clin Hypertens. 2019;21(6):838–50.

23. Okyere J, Ayebeng C, Owusu BA, Dickson KS. Prevalence and factors associated with hypertension among older people living with HIV in South Africa. BMC Public Health [Internet]. 2022;22(1):1–9. Available from: https://doi.org/10.1186/s12889-022-14091-y

24. Rassy N, Van Straaten A, Carette C, Hamer M, Rives-Lange C, Czernichow S. Association of Healthy Lifestyle Factors and Obesity-Related Diseases in Adults in the UK. JAMA Netw Open. 2023;6(5):E2314741.

25. Parker E, Judge MA, Dorward J, Schacht C De, Vaz P, Vitoria M. HIV infection in Eastern and Southern Africa : Highest burden , largest challenges , greatest potential. :1–8.

26. Dakum P, Kayode GA, Alash'le A, Avong YK, Okuma J, Onyemata E, et al. Prevalence of hypertension among patients aged 50 and older living with human immunodeficiency virus. Med (United States). 2019;98(15).

27. Isaac Derick K, Khan Z. Prevalence, Awareness, Treatment, Control of Hypertension, and Availability of Hypertension Services for Patients Living With Human Immunodeficiency Virus (HIV) in Sub-Saharan Africa (SSA): A Systematic Review

and Meta-analysis. Cureus. 2023;15(4):1–16.

28. Tsuro U, Oladimeji KE, Pulido-Estrada GA, Apalata TR. Risk Factors Attributable to Hypertension among HIV-Infected Patients on Antiretroviral Therapy in Selected Rural Districts of the Eastern Cape Province, South Africa. Int J Environ Res Public Health. 2022;19(18).

29. Davis K. HIV Glasgow - Virtual, 5-8 October 2020. J Int AIDS Soc. 2020;23(October):e25616.

30. Ussher MH, Faulkner GEJ, Angus K, Hartmann-Boyce J, Taylor AH. Exercise interventions for smoking cessation. Cochrane Database Syst Rev. 2019;2019(10).

31. Nyangi G, Festo C, Olotu A. The Prevalence of Hypertension and its association with HIV related factors in HIV patients on ART, Bagamoyo district, Eastern Tanzania. East African J Sci Technol Innov. 2020;1(4):1–13.

32. Delivery DS. Integrating Hypertension And Hiv Management.

33. Mohan J, Ghazi T, Chuturgoon AA. A critical review of the biochemical mechanisms and epigenetic modifications in hiv-and antiretroviral-induced metabolic syndrome. Int J Mol Sci. 2021;22(21).

34. Odukoya O, Badejo O, Sodeinde K, Olubodun T. Behavioral risk factors for hypertension among adults living with HIV accessing care in secondary health facilities in Lagos State , Nigeria. 2020;

35. Memiah P, Nkinda L, Majigo M, Opanga Y, Humwa F, Inzaule S, et al. Hypertension and Associated Inflammatory Markers Among HIV-Infected Patients in Tanzania. 2021;41(8):291–301.

36. Ames MK, Atkins CE, Pitt B. The renin-angiotensin-aldosterone system and its suppression. J Vet Intern Med. 2019;33(2):363–82.

37. Dimala CA, Kadia BM, Kemah B, Tindong M, Choukem S. Association between CD4 Cell Count and Blood Pressure and Its Variation with Body Mass Index Categories in HIV-Infected Patients. 2018;2018.

38. Yussuf FM, Barbarawi A, Nor MA, Ali AI, Sheikh IM, Ogedegbe OJ, et al. A Systematic Review Exploring the Range of Renal Complications of Human Immunodeficiency Virus. Cureus. 2023;15(3).

39. Byonanebye DM, Polizzotto MN, Parkes-Ratanshi R, Musaazi J, Petoumenos K, Castelnuovo B. Prevalence and incidence of hypertension in a heavily treatment-experienced cohort of people living with HIV in Uganda. PLoS One [Internet]. 2023;18(2 February):1–16. Available from: http://dx.doi.org/10.1371/journal.pone.0282001

40. Niwaha AJ, Wosu AC, Kayongo A, Batte C, Kalyesubula R, Kirenga B, et al. Association between Blood Pressure and HIV Status in Rural Uganda : Results of Cross-Sectional Analysis. 2021;16(1):1–14.

41. Davis K, Perez-Guzman P, Hoyer A, Brinks R, Gregg E, Althoff KN, et al. Correction to: Association between HIV infection and hypertension: a global systematic review and meta-analysis of cross-sectional studies (BMC Medicine, (2021), 19, 1, (105), 10.1186/s12916-021-01978-7). BMC Med. 2021;19(1).

42. Kivuyo S, Birungi J, Okebe J, Wang D, Ramaiya K, Ainan S, et al. Integrated management of HIV, diabetes, and hypertension in sub-Saharan Africa (INTE-AFRICA): a pragmatic cluster-randomised, controlled trial. Lancet. 2023;402(10409):1241–50.

43. Birungi J, Kivuyo S, Garrib A, Mugenyi L, Mutungi G, Namakoola I, et al. Integrating health services for HIV infection, diabetes and hypertension in sub-Saharan Africa: A cohort study. BMJ Open. 2021;11(11):1–10.

44. Sharma JR, Mabhida SE, Myers B, Apalata T, Nicol E, Benjeddou M, et al. Prevalence of hypertension and its associated risk factors in a rural black population of mthatha town, south africa. Int J Environ Res Public Health. 2021;18(3):1–17.

45. Laurent S, Boutouyrie P. Arterial Stiffness and Hypertension in the Elderly. Front Cardiovasc Med [Internet]. 2020th ed. 2020;7(October):1–13. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7673379/

46. Trifirò S, Cavallin F, Mangi S, Mhaluka L, Maffoni S, Taddei S, et al. Hypertension in people living with HIV on combined antiretroviral therapy in rural Tanzania. Afr Health Sci. 2023;23(1):129–36.

47. Tarekegn TT, Gebreeyesus FA. Prevalence and Associated Factors of Hypertension Among Adults in Gurage Zone , Southwest Ethiopia , 2022. 2023;9:1–8.

48. Mwakyandile TM, Shayo GA, Sasi PG, Mugusi FM, Barabona G, Ueno T, et al. Hypertension and traditional risk factors for cardiovascular diseases among treatment naïve HIV- infected adults initiating antiretroviral therapy in Urban Tanzania. BMC Cardiovasc Disord. 2023;23(1):1–9.

49. Brennan AT, Nattey C, Kileel EM, Rosen S, Maskew M, Stokes AC, et al. Articles Change in body weight and risk of hypertension after switching from efavirenz to dolutegravir in adults living with HIV : evidence from routine care in Johannesburg , South Africa. eClinicalMedicine. 2023;57:101836.

50. Tasnim S, Tang C, Musini VM, Wright JM. Effect of alcohol on blood pressure. Cochrane Database Syst Rev. 2020;2020(7).

51. Okojie OM, Javed F, Chiwome L, Hamid P. Hypertension and Alcohol: A Mechanistic Approach. Cureus. 2020;12(8):1–7.

52. Ramos-Vera C, Serpa Barrientos A, Calizaya-Milla YE, Carvajal Guillen C, Saintila J. Consumption of Alcoholic Beverages Associated With Physical Health Status in Adults: Secondary Analysis of the Health Information National Trends Survey Data. J Prim Care Community Heal. 2022;13.

53. Lai YJ, Chen YY, Lin YK, Chen CC, Yen YF, Deng CY. Alcohol consumption and risk of chronic kidney disease: A nationwide observational cohort study. Nutrients. 2019;11(9):1–9.

54. Doshi S, Ucanda M, Hart R, Hou Q, Terzian AS, Subramanian T, et al. Incidence and Risk Factors for Renal Disease in an Outpatient Cohort of HIV-Infected Patients on Antiretroviral Therapy. Kidney Int Reports. 2019;4(8):1075–84.

55. Musekwa R, Hamooya BM, Koethe JR. Prevalence and correlates of hypertension in HIV-positive adults from the Livingstone Central. 2021;

56. Brennan AT, Nattey C, Kileel EM, Rosen S, Maskew M, Stokes AC, et al. Change in body weight and risk of hypertension after switching from efavirenz to dolutegravir in adults living with HIV: evidence from routine care in Johannesburg, South Africa. eClinicalMedicine [Internet]. 2023;57:101836. Available from: https://doi.org/10.1016/j.eclinm.2023.101836

57. Ilesanmi OS, Akpa OM. Prevalence and risk factors of hypertension in HIV-positive adults on antiretroviral therapy in Ondo State , Nigeria. 2020;19(3).

58. Masenga SK, Povia JP, Mutengo KH, Hamooya BM, Nzala S, Heimburger DC, et al. Sex differences in hypertension among people living with HIV after initiation of antiretroviral therapy. 2022;2022(November):1–14.

59. Charan J, Biswas T. How to calculate sample size for different study designs in medical research? Indian J Psychol Med. 2013;35(2):121–6.

60. Musyani A, Mosi G, Kinyenje E, Damasceno A, Mizinduko M, Kishimba R, et al. Integrated Ncds Treatment And Care Among People Living With HIV/AIDS Attending Care And Treatment At A Health Facility. medRxiv [Internet]. 2023;1–29. Available from: https:// www. embase.com/ search/results?subaction= viewrecord&id=L2023147242&from=export%0Ahttp://dx.doi.org/10.1101/2023.02.21.23286233

61. Memiah P, Nkinda L, Majigo M, Opanga Y, Humwa F, Inzaule S, et al. Hypertension and Associated Inflammatory Markers among HIV-Infected Patients in Tanzania. J Interf Cytokine Res. 2021;41(8):291–301.

62. Publication ASP. STATA BASE REFERENCE MANUAL [Internet]. 18th ed. Published by Stata Press, 4905 Lakeway Drive, College Station T 77845, 978-1-59718-395-6 I-10: 1-59718-395-4 I-13:, This, editors. Texas USA: Published by Stata Press, 4905 Lakeway Drive, College Station, Texas 77845 ISBN-10: 1-59718-395-4 ISBN-13: 978-1-59718-395-6 This; 2023. 13 p. Available from: www.ststs.com

63. Jackson IL, Jackson IL, Lawrence SM, Igwe CN, Ukwe CV. Prevalence and control of hypertension among people living with HIV receiving care at a Nigerian hospital hospital. 2022;

64. Nartey ET, Tetteh RA, Anto F, Sarfo B, Kudzi W, Adanu RM. Hypertension and Associated Factors among Patients on HIV Antiretroviral Therapy at Korle-Bu Teaching Hospital. 2021;12.

65. Hertz JT, Prattipati S, Kweka GL, Mlangi JJ, Tarimo G, Mmbaga BT, et al. Prevalence and predictors of uncontrolled hypertension, diabetes, and obesity among adults with HIV in northern Tanzania. 2023;17(12):3747–59.

66. Getera I, Charles F, Olotu A. The Prevalence of Hypertension and its association with HIV related factors in HIV patients on ART, Bagamoyo District, Eastern Tanzania. East African J Sci Technol Innov. 2020;1(4).

67. Sheila M. Hegde and Scott D. Solomon. Influence of Physical Activity on Hypertension and Cardiac Structure and Function. HHS Public Access [Internet]. 2016;17(10):1–13. Available from: cdc_113246_DS1.pdf

68. Okonkwo P, Ajayi O, Babatunde D, Ezekiel DM. Prevalence and Factors Associated with Hypertension among People Living with HIV Receiving Care in Three Large HIV Clinics in Nasarawa State , Nigeria. 2024;1–17.

69. Mbuthia GW, Magutah K, Mcgarvey ST. HIV Patients. Int J Hypertens [Internet]. (ereza Mar. 2021;Volume 202(Article ID 5544916):8 pages. Available from: https://doi.org/10.1155/2021/5544916%0AResearch

Appendix I: English Version Questionire

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

TITLE

MAGNITUDE AND DETERMINANTS OF HYPERTENSION AMONG PEOPLE LIVING WITH HUMAN IMMUNODEFICIENCY VIRUS (PLWH) ATTENDING CARE AND TREATMENT CENTRES IN TABORA 2024.

SCHOOL OF PUBLIC HEALTH AND SOCIAL SCIENCE (SPSS)

EPIDEMIOLOGY AND BIOSTATISTICS DEPARTMENT

RESIDENT NAME: Thobias Bollen.

SUPERVISORS

1. Dr Erick Mboya (MUHAS)
2. Dr. Rogath Kishimba (FELTP)

REG number HD/MUH/T.840/2022

DATE MARCH 2024

ENGLISH VERSION QUESTINNAIRE

Fill in the blanks

Circle the correct response

1. Date of interview .....
2. Participants ID.....
3. Is the Concert has been given?

☐ Yes (read the concert to the patient). If yes, continue to the next question, but if no, do not continue

☐ No

Instruction completes all sections of the questionnaire by indicating V in the appropriate checkbox or writing in the space provided.

Social demographic characteristics

1. Age of participants: ..... years.
2. Sex Male ☐ Female ☐

3. Marital status

   Married ☐ Separated ☐ Widow ☐ Cohabiting ☐

4. Religious Affiliation.

   Christian. ☐ Islam. ☐ Hindu. ☐ Pagani. ☐

5. The education level of the participants.

   No formal education. ☐ Primary education. ☐

   Secondary education. ☐ Higher education. ☐

6. Employment: What is the status of your employment currently or in the last 12 months?

   ☐ Employed.

   ☐ Unemployed.

   ☐ Self-employed.

   ☐ Others.

7. In your family, is there anyone who has been diagnosed with hypertension?

   ☐ Yes ☐ No

Behavioral factors

8. Do you currently smoke any tobacco products (cigarettes, cigar pipes)?

   ☐ Yes. ☐ No.

9. If yes, how long have you been smoking? If no skip questions 9 and 10

   ☐ Less than a year.

   ☐ More than one year.

10. On average, how many cigarettes do you smoke per day?

    ☐ More than 20 cigarettes per day.

    ☐ Less than 20 cigarettes per day.

11. Have you ever consumed alcoholics drinks such as Beer, wine, fermented cedar, or any local brew currently on in the past 30 days

    ☐ Yes ☐ No

12. If yes, in the Question above, how many standard drinks do you consume on one occasion or one day?

    ☐ More than 5 drinks per day.

    ☐ Less than 5 drinks per day.

    ☐ Drunk daily

13. How many days in a week are involved in the 30 minutes of vigorous/ moderate sports, recreational activities or fitness such as cycling, jogging, swimming, or volleyball that causes a small or large increase in breathing or heartbeat.

    ..... per week?

14. Based on your assessment, how many servings of fruits and vegetables do you consume per day? ..... servings.

    (1 serving = 400ml or one cup of vegetable or one medium-sized fruit such as banana, apple, one large orange, or a wedge of water melon)

Biomedical factors.

15. How many years has it been since you were diagnosed as HIV positive?

    .....Years (check the patient treatment cards to confirm)

16. Are on ART ☐ Yes ☐ No

17. If yes, for how long? .....years/months

18. If on ART what current regimen are using.....(check in the patient treatment cards)

19. If on ART and have used other regimen indicates other regimen used .....(check in the patient treatment card)

20. What is your current viral load?..... (check the patient treatment card)

Physiological factors.

21. Blood pressure reading

First blood pressure reading Systolic BP, ... Diastolic BP, ... Heartrate, ...

Second blood pressure reading Systolic BP, ... Diastolic BP, ...Heart rate, ...

22. Based on the blood pressure measurement above, is the patient hypertensive?

☐ Yes ☐ No

23. In the past 30 days, have you ever been treated for raised blood pressure with medication?

☐ Yes ☐ No

24. If yes, where did you receive the treatment for hypertension?

☐ In CTC, where I attend, ☐ In the medical clinic, ☐ Others.

Weight and Height

25. Body weight in kgs .....

26. Height in cms .....

Convert in meter .....

27. BMI..... Kg/m^2

Appendix II: Swahili Version Questionaire

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

TITLE

MAGNITUDE AND DETERMINANTS OF HYPERTENSION AMONG PEOPLE LIVING WITH HUMAN IMMUNODEFICIENCY VIRUS ATTENDING CARE AND TREATMENT CENTRES IN TABORA 2024.

SCHOOL OF PUBLIC HEALTH AND SOCIAL SCIENCE (SPSS)

EPIDEMIOLOGY AND BIOSTATISTICS DEPARTMENT

RESIDENT NAME: Thobias Bollen

SUPERVISORS

1. Erick Mboya (MUHAS)
2. Dr. Rogath Kishimba (FELTP)

REG number HD/MUH/T.840/2022

DATE MARCH 2024

DODOSO LA KIWASWHILI KUHUISU UKUBWA WA SHINIKIZO LA DAMU KWA WAVIU

SEHEMU YA KWANZA UTANGULIZI

Jaza panapostahili na zungushia jibu sahhihi

1. Namba ya Utambulisho wa mteja ……...
2. Tarehe ya kujaza dokezo ……. /……/2024
3. Je unaridhia kushiriki kwenye utafiti huu.

☐ Ndio Hapana (soma maelezo ya idhini akikubali endelea na akikataa usiendelee) kuuliza)

☐ Hapana (soma maelezo ya idhini akikubali endelea na akikataa usiendelee kuuliza)

4. Je una umri wa miaka mingapi ……

5. Jinsia yako ☐ Me ☐ Ke
6. Je, Umefikia kiwango gani cha ya elimu?
7. Hali ya ndoa ☐ Nimeolewa ☐ Tumetengana ☐ Sijaolewa ☐ Mjane
8. Dini yako ☐ Mkristu ☐ Muislam ☐ Mhindu ☐ Mpagani
9. Ngazi ya juu ya elimu uliyofikia
   - ☐ Sijasoma
   - ☐ Elimu ya Msingi
   - ☐ Ngazi ya sekondari
   - ☐ Ngazi ya chuo
10. Hali ya Ajira

☐ Nimeajiriwa

☐ Nimejiajiri mwenyewe

☐ Sijaajiriwa

☐ Nyingine

11. Katika familia yako kuna mtu yoyote aliyewahi kugundulika kuwa na shinikizo la damu

    ☐ Ndio ☐ Hapana

Sababu za Tabia

12. Je? Umewahi kutumia aina yoyote ya Tumbaku (sigara, sigara ya kiko, shisha, sigara iliyoviringishwa)

    ☐ Ndio ☐ Hapana
13. Kama ndio Umekuwa ukivuta kwa muda gani sasa?
    - ☐ Chini ya mwaka mmoja
    - ☐ Zaidi ya mwaka mmoja
14. Kwa wastani unavuta sigara ngapi kwa siku
    - ☐ Zaidi ya sigara 20 kwa siku
    - ☐ Chini ya sigara 20 kwa siku

15. Je? Umewahi kunywa pombe kama Bia Mvinyo, pombe ya kienyeji katika kipindi cha siku 30 zilizopita

    ☐ Ndio ☐ Hapana

16. Kama ndio katika swali la 15 hapo juu unatumia vinywaji vingapi kwa siku?

    ☐ Zaidi ya chupa tano kwa siku

    ☐ chini ya chupa tano kwa siku

    ☐ nalewa kila siku

17. Je? Ni siku ngapi kwa wiki unajihusisha kwa angalau nusu saa katika michezo ya nguvu, burudani, kuweka mwili sawa kama vile (kuogelea, kukimbia, kucheza mpira kikapu, n.k)

    .....kwa wiki

18. Kulingana na tathimini yako ni sehemu ngapi za matunda na mboga mboga unatumia kila siku

.....kwa siku (mlo mmoja wa matunda na mboga mboga= kikombe kimoja cha mboga za majani au tunda moja kama Ndizi, Embe, chungwa)

Mambo ya Biomedical

19. Je? Una miaka mingapi tang kugundulika kuwa na maambukizi ya VIVIU

    .....

20. Je? Unatumia dawa za kuvubaza makali ya virusi vya UKIMWI

☐ Ndio ☐ Hapana

21. Kama ndio unatumia kwa muda wa miaka mingapi? Miaka.....

22. Kama unatumia dawa ni aina gani ya dawa unatumia kwa sasa

    ..... (Chunguza kadi ya matibabu ya mgonjwa)

23. Je? Kiwango cha kuanzia cha Kipimo cha CD4 kilikuwa ngapi?

    .....

24. Je? Wingi wa virusi vya ukimwi kwa sasa ni ngapi?

    .....

    Mambo ya Biologia

25. Kipimo cha shinikizo la Damu

    Kipimo cha kwanza cha shinikizo la Damu systolic .....mmHg diastolic .....mmHg Mapigo ya moyo.....kwa dakika.

Kipimo cha pili cha shinikizo la Damu systolic .....mmHg diastolic .....mmHg Mapigo ya moyo.....kwa dakika.

26. Kutokana na majibu ya Kipimo cha shinikizo la Damu hapo Juu je Mgonjwa ana Shinikizo la damu?

    ☐ Ndio ☐ Hapana

27. Kwa muda wa siku 30 ulishawahi kupokea matibabu ya shinikizo la damu kwa kutumia dawa za hospitali?

    ☐ Ndio ☐ Hapana

28. Kama ndio katika swali hapo juu ni sehemu gani uliyopokea matibabu ya shinikizo la damu

    ☐ Katika clinic ya huduma ☐ Katika clinic ya magonjwa ya ndani ya hospital

    ☐ Nyingine

29. Uzito wa mshiriki ni (Kilo) .....
30. Urefu wa mshiriki katika sentimita ni.....
31. Mwili wa misa Index (BMI) .....Kg/M^2

Appendix III: Ethical Clearance

UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

OFFICE OF THE DIRECTOR – RESEARCH, PUBLICATIONS AND INNOVATION

Ref. No.DA.282/298/01.C/2096 Date: 18/03/2024

MUHAS-REC-03-2024-2096
THOBIAS BOLLEN
MUHAS

RE: APPROVAL FOR ETHICAL CLEARANCE FOR A STUDY TITLED: MAGNITUDE AND DETERMINANTS OF HYPERTENSION, AMONG PEOPLE LIVING WITH HUMAN IMMUNODEFICIENCY VIRUS (PLHIV) ATTENDING CARE AND TREATMENT CENTRES IN TABORA.

Reference is made to the above heading,

I am pleased to inform you that the Chairman has on behalf of the University Senate, approved ethical clearance of the above-mentioned study, on recommendations of the Senate Research and Publications Committee meeting accordance with MUHAS research policy and Tanzania regulations governing human and animal subjects research.

APPROVAL DATE: 18/03/2024
EXPIRATION DATE OF APPROVAL: 18/03/2025

STUDY DESCRIPTION:
Purpose:

To determine the magnitude of the determinants of hypertension and access to treatment among people living with HIV in the Tabora Region in 2024.

The approved protocol and procedures for this study is attached and stamped with this letter, and can be found in the link provided: https://irb.muhas.ac.tz/storage/Certificates/Certificate%20-%2015194.pdf and in the MUHAS archives.

The PI is required to:

1. Submit bi-annual progress reports and final report upon completion of the study.
2. Report to the IRB any unanticipated problem involving risks to subjects or others including adverse events where applicable.
3. Apply for renewal of approval of ethical clearance one (1) month prior its expiration if the study is not completed at the end of this ethical approval. You may not continue with any research activity beyond the expiration date without the approval of the IRB. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.
4. Obtain IRB amendment (s) approval for any changes to any aspect of this study before they can be implemented.
5. Data security is ultimately the responsibility of the investigator.
6. Apply for and obtain Data Transfer Agreement (DTA) from NIMR if data will be transferred to a foreign country.
7. Apply for and obtain Material Transfer Agreement (MTA) from NIMR, if research materials (samples) will be shipped to a foreign country.
8. Apply for and obtain permission to publish the results from National Institute for Medical Research. The application should be before submitting to a publisher and not concurrently through the email publications@nimr.or.tz.
9. Any researcher, who contravenes or fail to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine as per NIMR Act No. 23 of 1979, PART III section 10 (2)
10. The PI is required to ensure that the findings of the study are disseminated to relevant stake holders.
11. PI is required to be versed with necessary laws and regulatory policies that govern research in Tanzania. Some guidance is available on our website https://drp.muhas.ac.tz/.





Dr. Kasusu Nyamuryekung'e.

Chairperson, MUHAS Research and Ethics Committee

Appendix IV: Pligiarirism Certificate

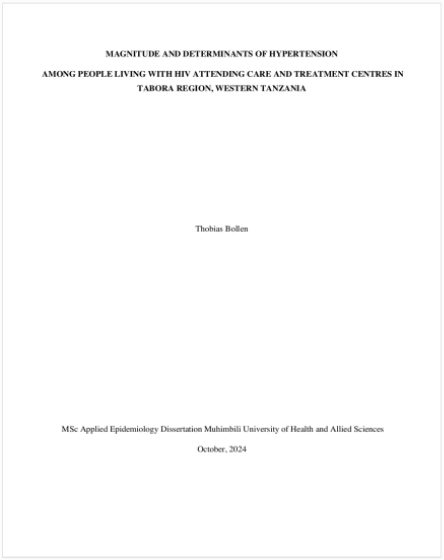
turnitin

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	Thobias Bollen
Assignment title:	Dissertation Reports
Submission title:	Magnitude and Determinants of Hypertension Among Peopl...
File name:	UDE_AND_DETERMINANTS_OF_HYPERTENSION_thobias_leo_...
File size:	489.56K
Page count:	68
Word count:	14,593
Character count:	82,991
Submission date:	27-Jun-2024 04:08PM (UTC+0300)
Submission ID:	2409402774



MAGNITUDE AND DETERMINANTS OF HYPERTENSION

AMONG PEOPLE LIVING WITH HIV ATTENDING CARE AND TREATMENT CENTRES IN TABORA REGION, WESTERN TANZANIA

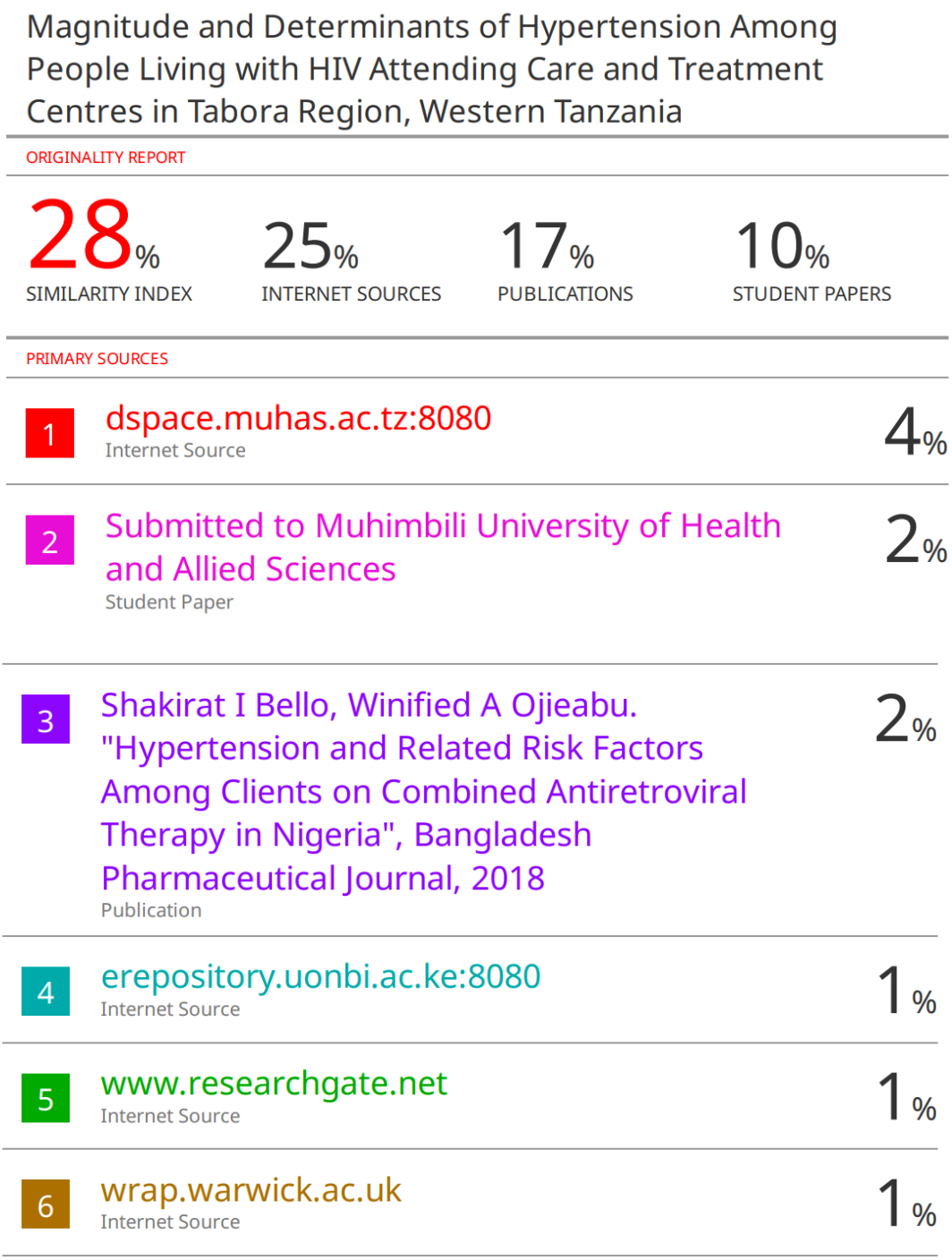
Thobias Bollen

MSc Applied Epidemiology Dissertation Muhimbili University of Health and Allied Sciences

October, 2024

Copyright 2024 Turnitin. All rights reserved.

Appendix V: Pliagiarism Report



Magnitude and Determinants of Hypertension Among People Living with HIV Attending Care and Treatment Centres in Tabora Region, Western Tanzania

ORIGINALITY REPORT

28%	25%	17%	10%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	dspace.muhas.ac.tz:8080 Internet Source	4%
2	Submitted to Muhimbili University of Health and Allied Sciences Student Paper	2%
3	Shakirat I Bello, Winified A Ojieabu. "Hypertension and Related Risk Factors Among Clients on Combined Antiretroviral Therapy in Nigeria", Bangladesh Pharmaceutical Journal, 2018 Publication	2%
4	erepository.uonbi.ac.ke:8080 Internet Source	1%
5	www.researchgate.net Internet Source	1%
6	wrap.warwick.ac.uk Internet Source	1%

6	wrap.warwick.ac.uk Internet Source	1 %
7	erepository.uonbi.ac.ke	
	Internet Source	1 %
8	bmcinfectdis.biomedcentral.com Internet Source	1 %
9	pubmed.ncbi.nlm.nih.gov Internet Source	1 %
10	aidsrestherapy.biomedcentral.com Internet Source	1 %
11	clinicalhypertension.biomedcentral.com Internet Source	1 %
12	journals.plos.org Internet Source	<1 %
13	www.frontiersin.org Internet Source	<1 %
14	Submitted to Roehampton University Student Paper	<1 %
15	escholarship.org Internet Source	<1 %
16	etd.aau.edu.et Internet Source	<1 %

17	www.researchsquare.com Internet Source	<1 %
18	www.scirp.org Internet Source	<1 %
19	Submitted to University of KwaZulu-Natal Student Paper	<1 %
20	www.coursehero.com Internet Source	<1 %
21	ir.mu.ac.ke:8080 Internet Source	<1 %
22	www.dovepress.com Internet Source	<1 %
23	www.nature.com Internet Source	<1 %
24	ihi.eprints.org Internet Source	<1 %
25	hdl.handle.net Internet Source	<1 %
26	Sasha A. Fahme, Gerald S. Bloomfield, Robert Peck. "Hypertension in HIV-Infected Adults", Hypertension, 2018 Publication	<1 %

27	Submitted to UNIVERSITY OF LUSAKA Student Paper	<1 %
28	Submitted to University of Rwanda Student Paper	<1 %
29	Assane Diouf, Amandine Cournil, Khadidiatou Ba-Fall, Ndèye Fatou Ngom-Guèye et al.	<1 %

"Diabetes and Hypertension among Patients Receiving Antiretroviral Treatment Since 1998 in Senegal: Prevalence and Associated Factors", ISRN AIDS, 2012
Publication

Factors", ISRN AIDS, 2012
Publication

30	archpublichealth.biomedcentral.com Internet Source	<1 %
31	www.medrxiv.org Internet Source	<1 %
32	docslib.org Internet Source	<1 %
33	www.ajol.info Internet Source	<1 %
34	www.qeios.com Internet Source	<1 %
35	www.termedia.pl Internet Source	<1 %

36	Sepiso K. Masenga, Benson M. Hamooya, Selestine Nzala, Geoffrey Kwenda et al. "Patho-immune Mechanisms of Hypertension in HIV: a Systematic and Thematic Review", Current Hypertension Reports, 2019 Publication	<1 %
37	assets.cureus.com Internet Source	<1 %
	dspace.alquds.edu	
38	Internet Source	<1 %
39	research.edgehill.ac.uk Internet Source	<1 %
40	www.grandviewresearch.com Internet Source	<1 %
41	Submitted to University of Colombo Student Paper	<1 %
42	academic.oup.com Internet Source	<1 %
43	doi.org Internet Source	<1 %
44	www.mdpi.com Internet Source	<1 %

45	Submitted to Copperbelt University Student Paper	<1 %
46	Meskelu Haile, Tamiru Degelo, Takele Adilo, Fatimetu Adem, Bedasa Gidisa. "Prevalence of Hypertension and Its Associated Factors Among Adults Living with HIV on Antiretroviral Treatment in Selected Public Hospitals in Addis Ababa, Ethiopia", HIV/AIDS - Research and Palliative Care, 2024 Publication	<1 %
47	object.cato.org Internet Source	
		<1 %
48	www.medindia.net Internet Source	<1 %
49	www.wjgnet.com Internet Source	<1 %
50	translational-medicine.biomedcentral.com Internet Source	<1 %
51	www.tephinet.org Internet Source	<1 %
52	Déo Harimenshi, Théodore Niyongabo, Pierre-Marie Preux, Victor Aboyans, Ileana Desormais. "Hypertension and associated factors in HIV-infected patients receiving	<1 %

53	article.sciencepublishinggroup.com Internet Source	<1 %
54	assets.researchsquare.com Internet Source	<1 %
55	dissertation.npmcn.edu.ng Internet Source	<1 %
56	Caihua Wang, Jiaru Sun, Zhaozhao Hui, Xiaohan Ren, Shuangyan Lei, Wenjin Han, Xiaoqin Wang, Ming-Xu Wang. "Consumption frequencies of beverages and the hypertension risk in adults: a cohort study in China", BMJ Open, 2023 Publication	<1 %
57	Dathan M Byonanebye, Mark N Polizzotto, Fernando Maltez, Andri Rauch et al. "Associations between change in BMI and the risk of hypertension and dyslipidaemia in people receiving integrase strand-transfer inhibitors, tenofovir alafenamide, or both compared with other contemporary antiretroviral regimens: a multicentre, prospective observational study from the RESPOND consortium cohorts", The Lancet HIV, 2024 Publication	<1 %

58	Submitted to Intercollege Student Paper	<1 %
59	files.osf.io Internet Source	<1 %
60	southhillcalvary.org Internet Source	<1 %
61	bmcprimcare.biomedcentral.com Internet Source	<1 %
62	www.pa.org.za Internet Source	<1 %

63	Joshua Okyere, Castro Ayebeng, Bernard Afriyie Owusu, Wonder Agbemavi, Joseph Kwarteng Amoako, Kwamena Sekyi Dickson. "Utilisation of traditional healers among older people living with HIV in South Africa: a WHO SAGE well-being of older people study", AIDS Research and Therapy, 2023 Publication	<1 %
64	Submitted to Liverpool School of Tropical Medicine Student Paper	<1 %
65	assets-eu.researchsquare.com Internet Source	<1 %
66	elibrary.tucl.edu.np Internet Source	<1 %

67	munin.uit.no Internet Source	<1 %
68	phgkb.cdc.gov Internet Source	<1 %
69	publications.iarc.who.int Internet Source	<1 %
70	www.paidafrica.org Internet Source	<1 %
71	www.walshmedicalmedia.com Internet Source	<1 %
72	www.who.int Internet Source	<1 %
73	Harriet Chiyangi, John B. Muma, Sydney Malama, Joel Manyahi, Ahmed Abade, Geoffrey Kwenda, Mecky I. Matee. "Identification and antimicrobial resistance patterns of bacterial enteropathogens from children aged 0–59 months at the University Teaching Hospital, Lusaka, Zambia: a prospective cross sectional study", BMC Infectious Diseases, 2017 Publication	<1 %
74	Jiawei He, Abraham Flaxman, Jeffrey W. Imai-Eaton, Aleksandr Aravkin, Peng Zheng, Reed Sorensen, Shachi Mittal, Hmwe H. Kyu. "Association Between Early Sexual Debut and	<1 %

75	Katuramu Richard, Kihumuro Bernard Raymond, Nakawuki Ashely Winfred, Akech Gabriel Madut et al. "Prevalence of Type 2 Diabetes Mellitus and Associated Factors among People Living with HIV in Eastern Uganda: a descriptive cross-sectional study", Research Square Platform LLC, 2024 Publication	<1 %
76	Submitted to Mount Kenya University Student Paper	<1 %
77	cdr.lib.unc.edu Internet Source	<1 %
78	implementationsciencecomms.biomedcentral.com Internet Source	<1 %
79	ir.knust.edu.gh Internet Source	<1 %
80	link.springer.com Internet Source	<1 %
81	ulspace.ul.ac.za Internet Source	<1 %
82	www.aids2018.org Internet Source	<1 %
83	www.biochem.utah.edu Internet Source	<1 %
84	www.texilajournal.com	<1 %

84	www.texilajournal.com Internet Source	<1 %
85	www3.pids.gov.ph Internet Source	<1 %
86	"Hypertension and Cardiovascular Disease in Asia", Springer Science and Business Media LLC, 2022 Publication	<1 %
87	Bitew Tefera Zewudie, Shegaw Geze Tenaw, Mamo Solomon, Yibeltal Mesfin et al. "The magnitude of undiagnosed hypertension and associated factors among HIV-positive	<1 %
88	Mahdi Sheikh, Shahen Movassaghi, Mohammad Khaledi, Maryam Moghaddassi. "Hyperuricemia in systemic lupus erythematosus: is it associated with the neuropsychiatric manifestations of the disease?", Revista Brasileira de Reumatologia (English Edition), 2016 Publication	<1 %
89	Nivriti Hurbans, Panjasaram Naidoo. "Comorbidity and concomitant medication use in an integrase strand transfer inhibitor (INSTI) naïve cohort on first-line dolutegravir-based antiretroviral therapy (ART)", Pan African Medical Journal, 2024 Publication	<1 %
90	Submitted to Reykjavík University	<1 %

90	Submitted to Reykjavík University Student Paper	<1 %
91	Shemsedin Amme Ibro, Ahmed Zeynudin Kasim, Sheka Shemsi Seid, Kedir Abdella	<1 %

Abdusemed et al. "Mapping the evidence on integrated service delivery for non-communicable and infectious disease comorbidity in sub-Saharan Africa: protocol for a scoping review", BMJ Open, 2024
Publication

92	chs-nhlbi.org Internet Source	<1 %
93	doaj.org Internet Source	<1 %
94	reliefweb.int Internet Source	<1 %
95	repository.ueab.ac.ke:8080 Internet Source	<1 %
96	www.hsd-fmsb.org Internet Source	<1 %
97	www.panafrican-med-journal.com Internet Source	<1 %
98	www.science.gov Internet Source	<1 %

99	www.scientificarchives.com Internet Source	<1 %
100	www.thelancet.com Internet Source	<1 %
101	Aldrey Nascimento Costa, Fernando Val, Álvaro Elias Macedo, Nadia Cubas-Vega et al. "Increased prevalence of hypertension among people living with HIV: where to begin?", Revista da Sociedade Brasileira de Medicina Tropical, 2020	<1 %
103	Mawulorm KI Denu, Ritika Revoori, Maame Araba E. Buadu, Oluwakemi Oladele, Kofi Poku Berko. "Hypertension Among Persons Living With HIV/Aids and Its Association With Hiv-Related Health Factors", Research Square Platform LLC, 2023 Publication	<1 %
104	Prosper Okonkwo, Oluseye Ajayi, Deborah Babatunde, Dimas Mercy Ezekiel. "Prevalence and Factors Associated with Hypertension among People Living with HIV Receiving Care	<1 %

105	Amadou Jallow, Gunnar Ljunggren, Per Wändell, Axel C. Carlsson. "Prevalence, incidence, mortality and co-morbidities amongst human immunodeficiency virus (HIV) patients in Stockholm County, Sweden – The Greater Stockholm HIV Cohort Study", AIDS Care, 2014 Publication	<1 %
106	Anxious J. Niwaha, Adaeze C. Wosu, Alex Kayongo, Charles Batte et al. "Association between Blood Pressure and HIV Status in Rural Uganda: Results of Cross-Sectional Analysis", Global Heart, 2021 Publication	<1 %
107	Cihangir Erem, Rıdvan Yildiz, Halil Kavgaci, Caner Karahan, Orhan Deger, Gamze Can,	<1 %
108	Donatha Uwanyirigira, Emmanuel Biracyaza, Innocent Uzabakiriho, Jared Omolo, François Hakizayezu, Manasse Nzayirambaho. "Prevalence and Factors Associated with Hypertension Among HIV Positive Patients on Antiretroviral Therapy: A Hospital-Based Cross-Sectional Study in Rwanda", Vascular Health and Risk Management, 2023 Publication	<1 %
109	Urgent Tsuro, Kelechi E. Oladimeji, Guillermo-Alfredo Pulido-Estrada, Teke R. Apalata. "Risk Factors Attributable to Hypertension among	<1 %