PREVALENCE OF UNCONTROLLED HYPERTENSION AND ASSOCIATED FACTORS AMONG ADULT HIV-INFECTED PATIENTS ON INTEGRATED HIV AND HYPERTENSION CARE AT MULAGO NATIONAL REFERRAL HOSPITAL, UGANDA

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Declaration

Declaration

I, Walugembe Fred, hereby certify that the work submitted in this dissertation is my original work and has never been submitted for any award of academic award in any university or institution of higher learning. All sections of this dissertation that used quotes or described an argument or concept developed by other authors were referenced.

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List of Acronyms and Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral therapy
CKD	Chronic Kidney Disease
CVD	Cardiovascular Diseases
HIV	Human Immunodeficiency Virus
HTN	Hypertension
MJAP	Makerere Joint Aids Program
MNRH	Mulago National Referral Hospital
MoH	Ministry of Health
NCD	Non-Communicable Diseases
PLHIV	People Living with HIV
SDOH	Social Determinants of Health
SSA	Sub-Saharan Africa
T2DM	Type 2 Diabetes Mellitus
TB	Tuberculosis
UNAIDS	United Nations Program on HIV/AIDS
WHO	World Health Organization

Operational definitions

Hypertension: Systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg on two occasions at least two weeks apart.

Uncontrolled hypertension: Systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg following initiation of anti-hypertensives from January 2019 to December 2021.

Stable HIV patient: HIV Patient with viral load < 1000 copies/mm^3 or CD4 count > 200 cells/uL.

Defaulting treatment: Missing one scheduled clinic review visit was considered non-adherence to Anti-HTNs and ART

Integrated care: This was defined as screening for, diagnosing HTN, and treatment of hypertensive PLHIV within HIV care platforms other than separate vertical HTN care clinics.

Social determinants of health (SDOH): SDOH were defined as social and economic conditions categorized into health and health care, social and community context, neighborhood and built environment, education, and economic stability.

Address: A place that was habitually used for longer periods, not being changed regularly. A place where the participant had lived for the past 6 months

Good adherence to hypertension (HTN) drugs: Patient's confession to daily consumption of drugs, honoring of clinic appointments, and the ability of the patient to buy HTN drugs when out of stock at the MNRH-MJAP HIV clinic.

Good health literacy: Defined as patients' knowledge of HTN care and prevention and their rating of their interactive, proactive, and receptive communication with healthcare providers.

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Abstract

Background

The integration of hypertension (HTN) management into HIV care is the most sustainable approach to addressing the burden of uncontrolled HTN among people living with HIV (PLHIV). However, HTN control is still suboptimal among PLHIV. Literature on factors associated with uncontrolled HTN among hypertensive PLHIV on integrated HIV/HTN care is scanty. This study sought to establish the prevalence of uncontrolled HTN and associated factors among hypertensive PLHIV in HIV/HTN integrated care.

Methods

A cross-sectional design was used to study hypertensive PLHIV in integrated care at Mulago national referral hospital HIV Clinic from January 2019 to December 2021. Adult PLHIV with suppressed viral load and diagnosed with HTN were included in the study. Secondary data for hypertensive PLHIV who were in integrated care were abstracted from medical records, and primary data was collected from patients whose secondary data were abstracted. Modified Poisson regression analysis was used to determine the factors associated with uncontrolled HTN. Prevalence ratios at 95% confidence intervals were used as the measure of association.

Results

Among 332 randomly selected eligible patients, 38.9% (129/332) had uncontrolled HTN. On adjusted analysis, the prevalence of uncontrolled HTN was higher among PLHIV who consumed vegetables for < 4 days per week (adj. PR: 1.62; 95% CI: 1.01-2.33) and actively smoked (adj. PR: 1.64; 95% CI: 1.20-2.25) compared to PLHIV who consumed vegetables for ≥ 4 days per week, and non-active smokers respectively. Uncontrolled HTN was 49% higher among males (adj. PR: 1.49; 95% CI: 1.11-1.98) compared to females. Good adherence to HTN drugs (adj. PR: 0.70; 95% CI: 0.50-0.90), and good health literacy (adj. PR: 0.44; 95% CI: 0.30-0.64 were protective factors against uncontrolled HTN among hypertensive PLHIV in integrated HIV/HTN care.

Conclusion

The results of the study suggest the need for prioritization of measures to facilitate behavior and lifestyle modification by MoH and healthcare providers to combat modifiable factors associated with uncontrolled HTN among hypertensive PLHIV.

CHAPTER ONE

1.0. Introduction and Background

1.1. Introduction

In the year 2021, globally, over 38.7 million people were living with HIV (PLHIV), and 28.7 million are currently receiving lifelong antiretroviral therapy (ART) (UNAIDS, 2020). The increased use of ART has increased the life expectancy of PLHIV, leading to the emergence of other chronic conditions in these individuals, such as hypertension (HTN), chronic kidney diseases (CKD), and cardiovascular diseases (CVDs) (Zanetti et al. 2008, UNAIDS, 2013). The combined global burden of CVDs and human immunodeficiency virus (HIV) is of public health concern. The burden is more pronounced in Sub-Saharan Africa (SSA), where nearly 70% of HIV-infected patients commute (UNAIDS, 2019; El-Sadr et al., 2018).

According to the World Health Organization (WHO) (2021), HTN-related CVDs commonly lead to premature death. HIV-infected individuals have an increased risk of CVD risk factors and cardiovascular morbidity and mortality outcomes compared to noninfected individuals (Todowede et al., 2019). HTN is highly prevalent and affects 14% of PLHIV in Africa (Bigna et al., 2016). The increased risk in PLHIV has been linked to the traditional CVD risk factors, HIV infection itself, ART, and the immunological dynamics that originate from the infection (Cerrato et al., 2015). For example, in 2012, Mutede and colleagues' study revealed that weight gain is a risk factor for HTN, and it’s a common side effect of ART medicines. Tenofovir (TDF) causes renal tubular toxicity leading to renal insufficiency and eventually HTN due to resulting renal disease (Hall et al., 2011; Bloomfield et al., 2011). Other ART medicines like protease inhibitors (PIs) and efavirenz are associated with HTN through lipodystrophy-induced insulin resistance and resultant metabolic syndrome (Gazzaruso et al., 2003).

Worldwide several clinic-based studies have reported associations between HIV infection and HTN. For example, in Italy, Gazzaruso et al. (2003) reported higher HTN prevalence in HIV-positive compared to HIV-negative adults; other SSA clinic-based studies reported HIV infection to be positively associated with CVDs as a whole (Schwartz et al. 2011;2012; Chillo et al. 2012). In Uganda, in a study by Kansiime and colleagues (2019) at a tertiary HIV care center, the overall

prevalence of having at least one non-communicable disease (NCD) was 20.7%, and the prevalence of HTN was 12.4%. In another study in rural Uganda, the overall HTN prevalence was 14% overall while 11% among HIV-positive individuals (Kwarisiima et al., 2016).

Relatedly, the burden of uncontrolled HTN is high among HIV-infected patients, which translates into a high prevalence of CVDs within HIV-positive sub-groups. For example, in a SSA systematic review on the prevalence of uncontrolled HTN, 83.7% of HIV/HTN patients on HTN treatment had uncontrolled HTN (Mohamed et al., 2021); in rural Uganda, 50% of hypertensive HIV patients on anti-HTNs had poorly controlled HTN (Kwarisiima et al. 2016).

Given the successful rollout of HIV care programs in Africa and rising concern about NCDs within HIV patient populations, there is growing consensus that integration of NCD management into HIV chronic care platforms may be cost-effective for mitigating the rising burden of NCDs among PLHIV (El-Sadr & Goosby, 2018; Njuguna et al., 2018). Therefore, it was crucial to understand the factors associated with uncontrolled HTN among hypertensive PLHIV on HIV/HTN integrated care for further advancement of integrated care policy and guidelines in Uganda.

1.2. Background

Hypertension and HIV infection are chronic conditions that, when managed in the early stages, lead to improved quality of life and prolonged life span (Mutede et al., 2012). Successful rollout of HIV care programs coupled with increasing NCDs among HIV patients, integration of NCD management into HIV chronic care platforms may be cost-effective and clinically effective for mitigating the rising burden of NCDs among PLHIV (El-Sadr et al., 2018; Njuguna et al., 2018; Birungi et al., 2021; McCombe et al., 2022). Due to the increasing burden of HTN-related CVDs among PLHIV, HIV populations at risk of developing NCDs and/or presenting with multimorbidities could potentially benefit from the achieved scale-up of HIV care services (Patel et al., 2018). In 2002, WHO recommended the integration of proven strategies for HTN control, like the WHO CVD Risk Package into the HIV chronic care platform suggesting the importance of the prevention and treatment of HIV-associated comorbidities.

However much integration of NCD management in HIV care platforms is recommended, and several governments in SSA, like Uganda, have commenced on implementation of the strategy (Chang et al., 2019; MoH, 2016). For example, Uganda's consolidated guidelines for the prevention and treatment of HIV/AIDS (2020) recommended that at each clinic visit, the patient should be screened and managed for the common NCDs, particularly diabetes mellitus (DM), and HTN, Ameh and colleagues reported likelihood of HIV/HTN integrated care controlling hypertension (Ameh et al., 2017). Pre-implementation studies like Vittorio et al. (2014), Jackson et al. (2022), and Mohamed et al. (2021) reported that 83.7%, 24.4%, and 16.3% of the HIV/HTN had controlled HTN, respectively (Vittorio et al., 2014; Jackson et al., 2022; Mohamed et al., 2021). In Post-implementation studies by Kwarisiima et al. (2019) and Muddu et al. (2019), hypertension control was at 50% and 24.3% among HIV/HTN patients in integrated care.

Clinical factors associated with uncontrolled HTN within HIV sub-populations have been studied with less attention on social and demographic determinants of poor HTN control. Clinical factors like body mass index, duration of ART, comorbidity with diabetes, HIV status, and medication prescribed are associated with uncontrolled HTN among hypertensive PLHIV (Kwarisiima et al., 2019; Jackson et al., 2022).

Although post-integrated care studies show improvement in HTN control prevalence among HIV/HTN patients in integrated care compared to pre-integration care results, for example, a SSA systematic review study revealed a pooled prevalence of HTN control among HIV/HTN patients of 16.3% (Mohamed et al., 2021), the improvement is still low compared to the general population. For example, in a comparative cross-sectional study in Uganda by Musinguzi et al. (2015), the general population HTN control was at 79.8% (Musinguzi et al., 2015). Therefore, the further establishment of the burden of uncontrolled HTN and associated factors among HIV/HTN patients on integrated care was important to guide goal-oriented holistic management of hypertensive HIV patients.

1.3. Problem Statement, Justification, and Conceptual Framework

1.3.1. Problem statement

Increasing HTN-related CVDs among PLWHIV, especially in Africa, is a public health concern (Bigna et al., 2016). This is a result of successful HIV care platforms leading to increased survival of HIV patients (Zanetti et al. 2008). NCDs are responsible for the great majority of mortality, contributing to 71% of all deaths worldwide, and the burden is more pronounced in Africa (WHO, 2022) with CVDs alone contributing to more than half of these mortalities (Forouzanfar et al., 2016). Uncontrolled HTN is associated with subclinical cerebrovascular injuries, such as myocardial infarction, heart failure, stroke, kidney disease, and cardiovascular disease mortality (W. Liu et al., 2021; Weber et al., 2014 Lanti et al., 2015; Zhou et al., 2018)**.** Since HIV and ART are also associated with cerebrovascular diseases, kidney and heart diseases (Hall et al., 2011; Bloomfield et al., 2011), therefore, HIV and HTN synergistically contributed to the occurrence of these complications (Nüesch et al., 2013; Triant et al., 2007).

Integration of NCD care into the HIV care programs has been suggested as a sustainable and cost-effective approach to address the increased mortality and morbidity due to NCDs secondary to uncontrolled HTN within HIV-positive populations (El-Sadr et al., 2018; Njuguna et al., 2018). However, despite the implementation of HIV/HTN care in Uganda and SSA at large (Chang et al., 2019; MoH, 2016), the scanty small clinics and rural-based post-implementation studies showed not only a high burden of uncontrolled HTN but also discordant results on the prevalence of uncontrolled HTN. These studies revealed a burden of uncontrolled HTN ranging from 24% to 50% among hypertensive HIV -infected patients on integrated HIV/HTN care (Kwarisiima et al., 2019; Jackson et al., 2022). Although clinical factors responsible for uncontrolled HTN among HIV-infected patients in integrated care had been pointed out by Kwarisiima et al. (2019) and Jackson et al. (2022), there was an unmet need to explore the factors associated with uncontrolled HTN among PLWHIV in integrated HIV/HTN care.

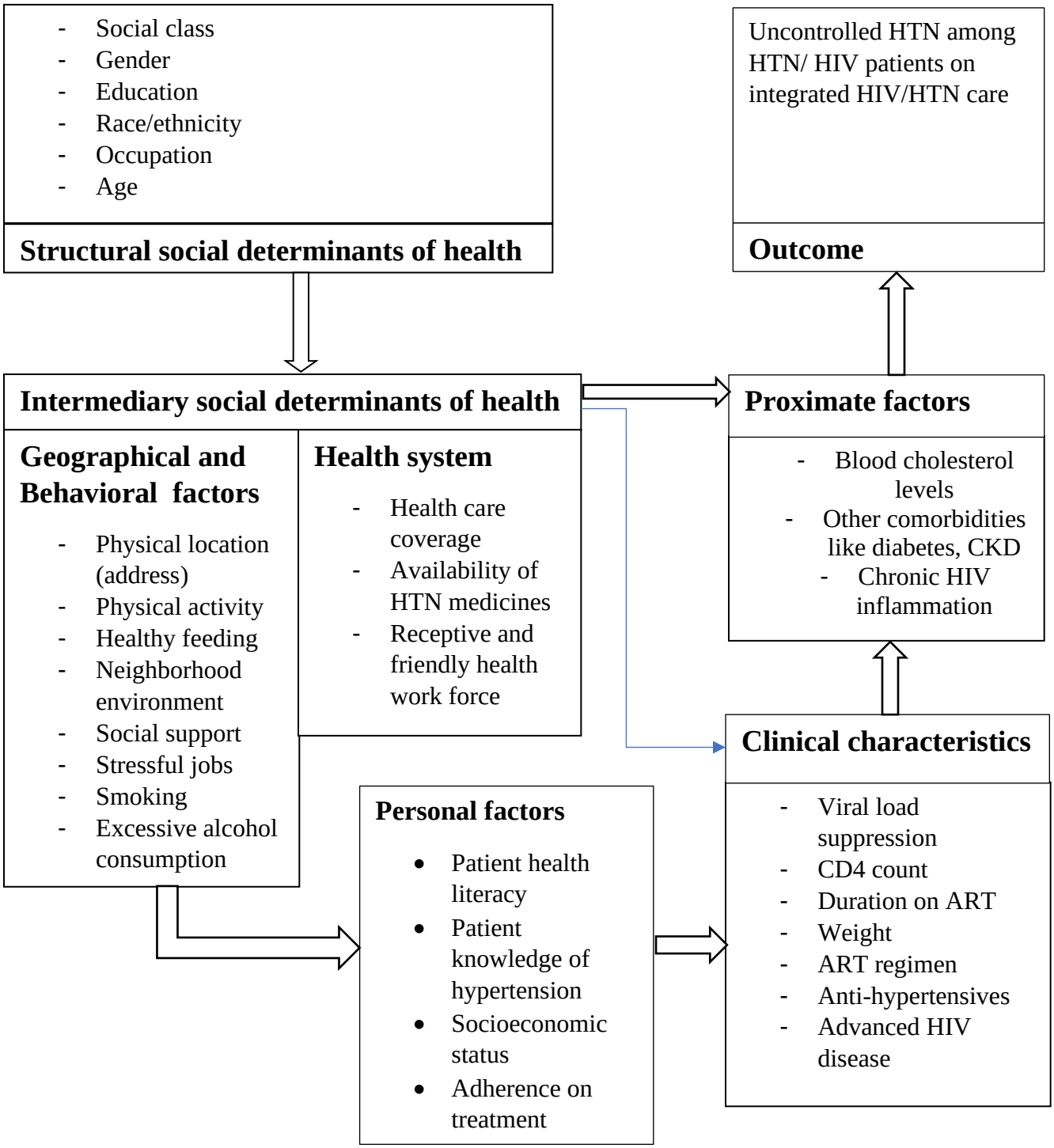
Therefore, in the efforts to mitigate the problem, this study, in addition to the identification of factors associated with uncontrolled HTN, sought to add more knowledge concerning the existing burden of uncontrolled HTN among hypertensive HIV-infected patients in HIV/HTN integrated care.

1.3.2. Justification of the Study

WHO and the Ugandan Ministry of Health (MoH) in 2014 and 2016, respectively, recommended the integration of HTN management in HIV care. Several cost-effective HTN control measures like lifestyle counseling and medical treatment have been recommended (WHO, 2010). It's usually incumbent upon the countries to fit into the recommendations depending on their respective capabilities. Integrated care is a feasible strategy for the control of HIV, diabetes, and HTN in Africa (Birungi et al., 2021; Kwarisiima et al., 2016). In Uganda, the integration of HTN management in HIV care has been implemented in some HIV care platforms, and a few operational studies have revealed little improvement in HTN control (Kwarisiima et al., 2019; Vittorio et al., 2014). This directly implies that hypertensive PLHIV continue to succumb to complications of uncontrolled HTN like stroke, heart and kidney diseases (W. Liu et al., 2021; Weber et al., 2014 Lanti et al., 2015; Zhou et al., 2018**),** rendering programs of HIV/HTN integrated care ineffective.

Therefore, this was a timely study for more exploration of the prevalence and factors associated with uncontrolled HTN among hypertensive HIV patients in integrated care. The results of the study intended to guide policy on the advancement of HTN/HIV care integration and holistic management of hypertensive HIV patients.

1.3.3. Figure 1: Conceptual framework describing the relationship between uncontrolled HTN and factors among hypertensive PLHIV in integrated HIV/HTN care (WHO, 2010).



1.3.3.1. Conceptual Framework Narrative

This framework was a modification of the WHO conceptual framework of SDOH (WHO, 2010). The modification was guided by the literature review done during protocol design but also by putting into consideration the scope of the study. The literature review process revealed an interplay between structural and intermediary SDOH and other factors leading to disease development and control, as elaborated in the subsequent deliberation of this narrative. WHO (2010) conceptual framework categories SDOH into structural and intermediary SDOH; structural SDOH includes the socio-economic and political context of the society that cannot be easily measured on an individual basis but potentially impacts health equity and social stratification due to their influence on intermediary SDOH while intermediary SDOH complements the structural factors at an individual level leading to precursors of disease development or poor disease control.

Additional literature review revealed that social demographic factors have had a direct association with high blood cholesterol levels, other comorbidities like DM, and CKD, and other clinical factors responsible for poor HTN control (Cleven et al., 2020; Martino et al., 2019). For example, being a woman, older, more educated, wealthier, and not being a current smoker were all positively associated with attaining good outcomes of chronic care (Geldsetzer et al., 2019). Socio-demographic factors act through patient characteristics and other proximate factors to lead to uncontrolled HTN among hypertensive HIV patients. Patients' clinical factors like body mass index, previous cardiovascular events, diabetes, central obesity, metabolic syndrome, duration of HIV infection, duration of antiretroviral therapy, and CD4+ T-cell count have been linked to uncontrolled HTN among HIV-positive subpopulations (de Socio et al., 2014).

Demographic factors were found to be associated with patients' clinical characteristics that are responsible for uncontrolled HTN. For instance, overweight and obesity were high in men and females, respectively. Both overweight and obesity prevalence were high in young adults aged 18-29 years (Oguoma et al., 2021). Social factors were found to be heavily interlinked with demographic factors in a causal pathway of uncontrolled hypertension (Weng et al., 2020).

Therefore, uncontrolled hypertension among HIV patients was conceptualized as an outcome of the interaction of sociodemographic factors, clinical and personal characteristics, and other proximate factors.

1.4. Research Questions and Objectives

1.4.1. Research questions

1) What is the prevalence of uncontrolled hypertension among stable adult hypertensive HIV patients on integrated HIV/HTN care?
2) What are the factors associated with uncontrolled hypertension among stable adult HIV patients in HIV/HTN integrated care?

1.4.2. General Objective

The study determined the prevalence and factors associated with uncontrolled HTN among ART-stable adult PLHIV on integrated HTN/HIV care. The identified factors will guide the formulation of a holistic HIV/HTN integrated care package that accelerates HTN control among PLHIV.

1.4.3. Specific objectives

1. To estimate the prevalence of uncontrolled HTN among stable HIV adult PLHIV in integrated HIV/ hypertension care.
2. To identify the factors associated with uncontrolled HTN among stable adult PLHIV receiving integrated HIV/HTN care.

CHAPTER TWO

2.0. Literature review

2.1. Introduction

Globally, NCDs are responsible for the great majority of mortality, contributing to 71% of all deaths worldwide, and the burden is more pronounced in Africa (WHO, 2022). The four top killers are CVDs, malignancies, respiratory diseases, and DM; all aggregately contribute 80% of all yearly premature NCD deaths, with CVDs alone contributing more than half of these mortalities (Forouzanfar et al., 2016). There has been a progressive increase in the burden of NCDs in SSA with a substantial increase in disability-adjusted life years (Gouda et al., 2019). This surge in the burden of NCDs has been attributed to increased incidence of cardiovascular risk factors such as unhealthy diets, reduced physical activity, HTN, obesity, DM, dyslipidemia, air pollution, HIV infection, and ART (Kraef et al., 2020; Muted et al., 2012; Hall et al., 2011; Bloomfield et al., 2011).

Therefore, the high HIV prevalence in Africa translates into a high burden of HIV-associated HTN in Africa (Lalkhen and Mash, 2015). To make matters worse, 83.7% of HTN cases among PLHIV are uncontrolled (Mohamed et al., 2021). This leads to high premature NCD deaths in Africa (WHO, 2022). To combat the burden of NCDs, low and middle-income countries (LMICs) need to fasten the provision of holistic care and integrated strategies to improve health service delivery, efficiency, and equity (Nigatu, 2012). Healthcare platforms must transit from vertical programs to an integrated approach to address shared NCD risks and associated determinants (Barr et al., 2016; Haldane et al., 2018).

Health services integration refers to “managerial or operational changes to health systems to bring together inputs, delivery, management, and organization of particular service functions as means of improving coverage, access, quality, acceptability, and cost-effectiveness” (Atun et al., 2010b). This includes combining different packages of services, such as integration of service delivery points, integration at different levels of service delivery, process modifications, the introduction of technologies aimed at aiding integration, and integration of management decisions (Valentijn et al., 2013). Integrated models of healthcare services provide people with comprehensive options centered on the health needs of people with resultant enhanced community self-reliance (Haldane

et al., 2018). This is because, in addition to being comprehensive care that is health-centered rather than disease-tailored (Nigatu, 2012), integrated programs increase system effectiveness and cost-effectiveness, particularly in low-resource settings (Atun et al., 2010a; Shigayeva et al., 2010). In this study, integration of HIV/HTN was defined as screening for, diagnosing of HTN and management of hypertensive PLHIV within HIV care platforms other than separate vertical HTN clinics (Muddu et al., 2019; Van Hout et al., 2020). Integrating care for HIV and NCDs like hypertension is feasible, acceptable, less costly, and a possible solution to improving access to care among patients with multiple conditions (Uganda HIV management guidelines, 2020).

However, concerning HIV/HTN integrated care, the outcomes of post-HIV/HTN integrated care implementation research have revealed minimal improvement in hypertension control (Ameh et al., 2017; Gausi et al., 2021). Therefore, in this section, the literature on the burden and determinants of uncontrolled HTN among hypertensive HIV-infected patients in integrated HIV/HTN was reviewed.

2.2. Socio-demographic factors associated with HIV/HTN integrated care outcomes

Social determinants of health are vital gradients of health (Graham, 2007). Social determinants of health (SDOH) are majorly categorized into structural and intermediary social determinants; structural social determinants include public and sociocultural policies, ethnicity, race, gender, social class, and socioeconomic position, while intermediary factors include material circumstances, behaviors, biological and psychosocial factors (WHO, 2010). Studies have found associations between the increased burden of disease and increasing levels of poverty, hunger, lower levels of income, education level, socioeconomic status, discrimination, physical environment, housing, transportation, violence, self-management efficacy, health literacy, age, and gender (Kumari et al., 2005; M. G. Marmot et al., 1978; Wang et al.,2017).

Relatedly, education level, which is heavily linked to health literacy, is an important determinant of adherence to chronic hypertension care (Miller, 2016; Uchmanowicz et al., 2018). Those with language and literacy barriers were noted to have worse health status, chronic health conditions, lack of health insurance, and difficulty following medication directions (Santana et al., 2021; Goryakin et al., 2017; Silva-Tinoco et al., 2020). The level of education one obtains determines the type of job one has, the income one earns, and benefits such as health insurance hence promoting adherence to treatment (Abellán et al., 2015; Chmielewski & Reardon, 2016). On the

other hand, unemployed individuals are more likely to have stress-related conditions such as CVD, HTN, and DM (Liu et al., 2017; X. Q. Wang et al., 2020). However, other researchers have found no association between psychosocial stress and HTN (Agyei et al., 2014). But also, low education level coupled with age and culture is associated with other unhealthy habits like cigarette smoking (G. Wang & Wu, 2020).

Social stress, which is usually the result of low or lack of formal education and resultant unemployment, leads to the development of chronic diseases and poor disease outcomes. For example, Low socioeconomic status, adverse childhood experiences, less social support, and limited healthcare access are associated with higher CVD risk and poorer health outcomes (Mannoh et al., 2021). Gradual factors introduced in childhood and early adult life due to stressful social environments like weight gain leading to overweight/obesity, unhealthy diet, excessive dietary sodium, and inadequate potassium intake, insufficient physical activity, and consumption of alcohol lead to early onset of HTN and other related NCDs (Whelton et al., 2018). Further research has shown that factors like increasing age, BMI, DM in both sexes, extremes of education level (none and secondary or above) among men, being unmarried, and waist circumference ≥80 cm among women were independently associated with HTN (Maher et al., 2011). In other studies, low income has also been associated with HTN and CKD (Yusuf et al., 2020; Banerjee et al., 2017). This is because low-income families can not usually afford healthy diets, which leads to obesity and limited access to healthcare (Banerjee et al., 2017; Cooksey-Stowers et al., 2017: Firebaugh & Acciai, 2016; HAAN et al., 1987).

Furthermore, social discrimination at both the individual and structural levels in health care has been associated with early smoking (Sartor et al., 2021) and uncontrolled HTN (Holanger et al., 2020). Individual discrimination leads to negative interactions between a patient and a healthcare provider due to race and gender; negative interactions may limit healthcare resources and the well-being of the patient (Arayasirikul et al., 2022). Studies have shown that higher amounts of social support are associated with lower levels of CVDs and improved health outcomes because it leads to adherence to healthcare appointments and substance abuse avoidance (Lindsay Smith et al., 2017; Wenn et al., 2022; Santana et al., 2021).

Therefore, socio-demographic factors have been revealed to affect a wide range of healthcare programs. For instance, in Tanzania, long distance to the nearest health facility affects rural child

mortality (Kadobera et al., 2012); in Mozambique, transportation and other indirect costs limit the consumption of free prenatal care (Munguambe et al., 2016). In Uganda, transportation barriers limit care-seeking behavior and reduce access to HIV services, malaria treatment, and emergency obstetrical interventions (Bergmann et al., 2017; Tuller et al., 2010). Another rural area study revealed that utilization of integrated HIV and SRH services in Uganda is influenced greatly by demographic and socioeconomic characteristics like level of education and geographical location (Rutaremwa and Kabagenyi, 2016). Further research has shown that regular addition of salt in dishes, mode of transport, duration of being HIV positive, and duration since HTN diagnosis are associated with HTN management outcomes (Magande et al., 2017). These findings have been enhanced by the Kwarisiima et al. (2019) work which revealed that age, sex, comorbid diabetes, stage of hypertension at diagnosis, medication prescribed at the previous visit, and HIV status as strong independent predictors of HTN control in the integrated care model. These factors not only affect HTN control but also exposes individuals to other risky behavior like heavy alcohol consumption and its related health problems (Hwang & Choi, 2022; Wittbrodt et al., 2014)

The importance of the socio-demographic factor in treatment outcomes has been emphasized by Khatib and colleagues' study (2014), which reported that patients' perspectives related to their needs are important to consider because they can affect their clinical outcomes. For example, interventions directed specifically toward improving outcomes among persons with hypertension have tried to extend beyond the traditional biomedical model and address social determinants of health, such as social support (Criswell, Weber, Xu, & Carter, 2010). Therefore, rethinking health care from predominantly focusing on diseases and disorders to comprehensively integrating social factors and person-driven goals for wellness is associated with a stronger likelihood of improving population health outcomes, such as better plan adherence, engaged patients, and fewer readmissions (Gaudet & Kligler, 2019; Chamberlan, 2018).

Despite the highlighted importance of socio-demographic determinants of health, in SSA, literature on socio-demographic determinants of integrated HIV/HTN care was lacking. Therefore, this study set out to establish whether these SDOHs have a significant impact on integrated HIV/HTN care. This was because by understanding how the SDOH affected an individual's health and their ability to manage their care, care managers and policymakers could more effectively support holistic chronic care plans with lasting outcomes (Chamberland, 2018).

2.3. Uncontrolled HTN among hypertensive PLHIV in HIV/HTN integrated care

This study adopted the Eight Joint National Committee Criteria (2014) definition of uncontrolled HTN. The committee defined uncontrolled HTN following treatment targets systolic blood pressure (SBP) ≥ 140 mmHg and diastolic blood pressure (DBP) ≥ 90 mmHg (James et al., 2014). A systematic review by Mohamed et al. (2021) revealed a high burden of uncontrolled HTN in people with comorbidities in SSA, with 83.7% of uncontrolled HTN among HIV-positive patients.

Integrated management of chronic diseases has been suggested as a feasible strategy for the control of HIV and HTN in Africa, with a recommendation for further evaluation in a comparative study (Birungi et al., 2021). The SEARCH study by Kwarisiima and colleagues reported improved HTN control in an integrated HIV and chronic care model (Kwarisiima et al., 2019). HTN control increased from 35% to 59% within 12 months of integrated care (Vittorio et al., 2014). Much as these two studies showed an improvement in HTN control, the prevalence of uncontrolled HTN remains high relative to the general population burden, as evidenced by the findings of the Musinguzi et al. (2015) study, which estimated uncontrolled HTN prevalence at 20.2%. On the contrary, a Nigerian hospital-based study by Jackson et al. (2022) reported suboptimal HTN control among hypertensive HIV patients on integrated care. The finding of the Jackson et al. study was reinforced by Melaku et al. (2020), which revealed that 60.2% of HIV-positive on HTN care had uncontrolled blood pressure after a year of care (Melaku et al., 2020). In addition, in a multiple-center study in rural South Africa, integrated care for HIV and HTN showed less likelihood of controlling HTN (Ameh et al., 2017), and Muddu et al. study (2019) in eastern Uganda revealed that 75.7% of HIV/Hypertensive patients in integrated care had uncontrolled HTN.

The effectiveness of integrated HIV/HTN care was less studied in Uganda, and although all reviewed literature revealed a higher prevalence of uncontrolled HTN in hypertensive HIV-infected patients on integrated care, there were discrepancies in both the role of integrated care in HTN control and the absolute burden of uncontrolled HTN among the same sub-category of patients. This created the need to establish factors associated with uncontrolled HTN among HIV-infected patients in HIV/HTN integrated care. Therefore, this study thought to bridge the knowledge gap concerning HTN control among HIV patients in HIV/HTN integrated care in Ugandan to foster further policy and treatment guidelines development.

2.4. Other factors associated with uncontrolled HTN among hypertensive PLHIV

Although little had been done to identify social and demographic factors associated with poor HTN control, there was enormous work done to explore the clinical factors associated with uncontrolled HTN among hypertensive HIV-infected patients following the initiation of anti-hypertensives. Regular addition of salt in dishes or excessive salt consumption, obesity (BMI ≥25kg/m^2), being a diabetic patient, smoking, patients age (especially ≥50 years), being a male, and other comorbidities like CKD and previous cardiovascular events were found by several researchers to be associated with uncontrolled HTN among HIV infected patients (Kwarisiima et al., 2019; Godongwana et al., 2021; Jackson et al., 2022; Magande et al., 2017; Sarfo et al., 2019). Godongwana et al. (2021) and Magande et al. (2017) further highlighted that the duration of ART, ART regimen, and level of viral load suppression were strongly associated with poor HTN control. Relatedly, factors like duration of HIV diagnosis >2 years, duration < 5 years since HTN diagnosis, and walking or cycling were protective against uncontrolled HTN among HIV-infected patients.

A clinic-based study by Kwarisiima and colleagues (2019) also pointed out some social factors like distance from the health facility, education level, and geographical location being linked to poor HTN control. The glaring limited knowledge of the influence of socio-demographic factors on HTN control among hypertensive HIV-infected patients led to the study that intended to identify the socio-demographic factors that were associated with uncontrolled HTN among HIV patients that, if targeted, could lead to improved HTN control among hypertensive HIV patients on hypertension care.

In summary, available literature reveals HIV and NCD care integration is cost-effective. The minimal obtainable research on the implementation of HIV/HTN integrated care shows elevated uncontrolled HTN among hypertensive PLHIV. The burden has been majorly attributed to individual clinical characteristics, the health system, and personal and sociodemographic factors. Despite the noted contribution of these factors, across Africa and Uganda in particular there is limited knowledge on the factors associated with uncontrolled HTN among hypertensive PLHIV in HIV/HTN integrated care.

CHAPTER THREE

3.0. Methodology

3.1. Study site

The study was conducted at Mulago National Referral Hospital (MNRH)-Makerere University Joint AIDS Program HIV clinic (MJAP HIV care clinic). MNRH is located in central Uganda, within Kampala, the Capital city of the country. In addition to outpatients from Kampala metropolitan area, the hospital receives referrals from numerous parts of the country. At the time of the study, the government of Uganda defined the Kampala Metropolitan Area as consisting of the city proper and neighboring districts of Mukono, Wakiso, Mpigi, Buikwe, and Luwero, with an approximated population of 6.5 million and a surface area of 8451sqKm (UBoS, 2019).

Central Uganda's burden of HIV was at 8.0 %, and Kampala alone contributed 6.9%; both of them were higher than that of the whole country (UPHIA, 2017); therefore, the hospital ran MJAP HIV care clinic as part of its outpatient department to cater for the high prevalence of HIV within the metropolitan area and Uganda at large. MNRH- MJAP HIV clinic offers free differentiated ART refills, testing, counseling services, and integrated HTN management to several thousands of patients from mainly the Kampala metropolitan area, with retention into care of approximately 90%. It is one of the largest HIV clinics in Uganda, with approximately 15000 PLHIV on care, of whom 1200 patients were hypertensive patients initiated on integrated HIV/HTN care from January 2019 to December 2021 (MNRH-MJAP HIV clinic medical records). The patients seen at the clinic include children, adult males, females, and pregnant women, whose HIV care is integrated with antenatal/postnatal care across all social, demographic, and cultural domains. Therefore, a large number of HIV/HTN patients in integrated HTH/HIV care coupled with high retention in care provided an opportunity for attaining the desired sample size for the study.

3.2. Population

3.2.1. Target population

Adult PLHIV with HTN in HIV/HTN integrated care in Uganda.

3.2.2. Accessible population

All stable adult PLHIV with HTN in integrated HIV/HTN care at MNRH from January 2019 to December 2021.

3.2.3. Study population

All stable adult PLHIV with HTN in integrated HIV/HTN care at the MNRH-MJAP HIV clinic from January 2019 to December 2021. Determination of HTN status at the clinic is based on the Eighth Report of the Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-8) criteria (James et al. 2014). Operationally, HTN was defined as systolic blood pressure (SBP) of $\geq$ 140 mmHg and/or diastolic blood pressure (DBP) of $\geq$ 90 mmHg on 2 consecutive visits separated by at least 2 weeks.

3.3. Study design

A cross-sectional study design was used to answer all the objectives of the study. The study involved the collection of both secondary and primary data from a cohort of HIV/HTN patients in integrated HIV/HTN care from January 2019 to December 2021 at the MNRH-MJAP HIV clinic. The patient's medical records were reviewed to confirm whether the patient diagnosed with HTN met the HTN diagnosis and study criteria. Subsequently, patients who met both sets of criteria constituted the sampling frame.

3.4. Sample size

A study by Kwarisiima and colleagues (2016) at a tertiary HIV care center in Uganda showed that only 50% of patients on HTN medication had controlled blood pressure. Therefore, 50% was the anticipated prevalence (P) of uncontrolled HTN among hypertensive PLHIV on anti-HTNs; this implied that the probability of controlled HTN (Q) in the same population was also 50%. The desired precision (δ) for the study was set at 5%. The minimum sample size was estimated using Leslie Kish's formula of 1964. Estimated sample size (n) = (Z^2PQ/δ^2); Z = 1.96 at 95% confidence interval; n = (1.96^2 x 0.5 x 0.5)/0.05^2; estimated sample size was 385 hypertensive PLHIV.

The study put into consideration possible potentially poorly filled medical records and a nonresponse rate of approximately 10% of the estimated sample size (Wang et al., 2022); 10% of 385 participants was equivalent to 39 possible participants with poorly filled medical records and or incomplete questionnaires. Therefore, to control for incomplete medical records and incomplete questionnaires, 39 participants were added to 385 participants. Hence the estimated sample size following adjustment for losses was 424 participants.

The MNRH-MJAP HIV clinic had an estimated finite population of 1138 HIV/HTN patients on integrated HIV/HTN care who started care between January 2019 to December 2021, and the estimated sample size (424 participants) was 37% of the finite population. Daniel's formula (1999) of sample size adjustment was employed; $n' = [n/(1+n/N)] = [424/ (1+424/1138)] = 309$. Therefore, the final adjusted sample size for this study was 309 participants. However, during research participant recruitment, 340 participants were recruited. This was intended to allocate equal participatory opportunity to all eligible patients enrolled in care during the period of interest.

3.5. Sampling and Selection Criteria

3.5.1. Sampling Method

Systematic random sampling was used to select study participants. The systematic selection interval was calculated by dividing the sampling frame (N) by the sample size (n'). The sampling frame consisted of medical record files of hypertensive PLHIV already in HIV/HTN integrated care at the MNRH-MJAP HIV clinic from January 2019 to December 2021. At the time of the study, N was estimated at 1138 hypertensive PLHIV. Therefore, (N/n') =1138/309= 3.7; hence every 3rd patient's file was selected until the sample size had been achieved. Systematic sampling was the best for this study since patient medical records were used to choose the study participants. A technique with an apparent form of randomness was applied to determine the first research participant.

3.5.2. Selection Criteria

Inclusion criteria

All study participants met the following criteria: Stable PLHIV; PLHIV with viral load < 1000 copies/ cubic mm or CD4 count > 200 cells/uL, hypertensive PLHIV with controlled and uncontrolled HTN in integrated care, PLHIV who were correctly diagnosed with HTN before initiation on HTN treatment (correct diagnosis meant systolic blood pressure (SBP) was ≥ 140mmHg and/or diastolic blood pressure (DBP) ≥ 90mmHg on 2 consecutive clinic visits at least 2 weeks apart), lastly all study participants were aged ≥18 years.

Exclusion criteria

PLHIV with AIDS-defining illnesses like tuberculosis, cryptococcal meningitis, and opportunistic diarrhea with severe weight loss were excluded from the study. An unexplained 10% weight loss was considered to be associated with severe HIV disease. Pregnant women and HIV/HTN Patients with mental illnesses were also excluded from the study. The co-existence of mental illness was established using the patient's medical records and/or subjective assessment of the patient's cognitive functionality by the research assistant.

3.6. Variables

3.6.1. Dependent variable

This was a binary dependent variable. It included both uncontrolled HTN and controlled HTN. A case of uncontrolled HTN was defined as hypertensive PLHIV initiated on HTN care at any time from January 2019 to December 2021 with SBP ≥ 140mmHg and/or DBP ≥ 90mmHg on two consecutive readings of at least two weeks apart, while a case of controlled HTN was defined as hypertensive PLHIV initiated on HTN care at any time from January 2019 to December 2021 with SBP <140mmHg and/or DBP <90mmHg on two consecutive readings of at least two weeks apart at the time of data collection. HTN control status was determined from the average of two patients' blood pressure measurements: the blood pressure measured on the most recent clinic visit (abstracted from medical records), and the blood pressure that was measured at the point of primary data collection.

3.6.2. Independent variables

The independent variables were the geographical and behavioral factors, clinical characteristics, health system, and personal factors as highlighted in the conceptual framework.

Table 1: Summary of independent variables

Variables	Variable definition	Variable Measurement
Background characteristics		
Age	Numerical	It was measured as a discrete variable in completed years. The patients' most recent birthdays were used to determine their ages. It was arbitrarily categorized during analysis.
Gender	Categorical	It was measured on a nominal scale based on biological sex as male and female.
Socio-economic status	Categorical	It was analyzed on a nominal scale as low-, middle-, and upper-socioeconomic statuses (Majumder, 2021). Occupation, number of dependents, reception of financial support, means of transport, and type of house were used to assess socio-economic status. Points were awarded across different levels of each of the sub-variables as follows: 1) Occupation: professional job/business person (3 points), peasant farmer/causal laborer (2 points), and non-employed (1 point) 2) Number of dependents: zero dependents (3 points), ≤ 4 dependents (2 points), and ≥5 dependents (1 point) 3) Reception of financial support: yes (3 points) and no (1 point) 4) Means of transport: private means (3 points), public means (2 points) and walking (1) 5) Type of house: permanent house (3 points), semi-permanent house (2 points) and temporary/no house (1) Regarding the revised Udai Pareek socioeconomic status class, the score for each participant was summed up and categorized into arbitrary percentile groups as follows. Low socioeconomic status ≤ 50%, Middle-socioeconomic status 51% to 74%, Upper-socioeconomic status ≥ 75% (Majumder, 2021).
Family size	Numerical	It was measured as a discrete variable. As the number of occupants of the patient's household. It included children and other relatives. It was analyzed as a categorical binary variable after the creation of arbitrary categories. ≤ 4 occupants "desirable family size" and ≥ 5 occupants "big family size." (UDHS, 2016)
Education level	Categorical	It was measured on an ordinal scale, categorized as no formal education, primary level, secondary level, tertiary level, and university level (ISCED, 2011).
Clinical characteristics		
Weight	Numerical	It was measured as a discrete numerical variable in kilograms (Kgs)
Height	Numerical	It was measured as a discrete numerical variable in centimeters. It was converted to meters (m) to the nearest decimal point to enable the calculation of the body mass index (BMI)

BMI	Numerical	It was calculated as a continuous numerical variable to the nearest decimal point, calculated by dividing weight (kg) by height (m). It was categorized on a nominal scale at 4 levels. The levels were; underweight (BMI≤ 18kg/m^2), normal weight (18.1 to 24.9 kg/m^2), overweight (25 to 30kg/m^2), and obesity (≥30kg/m^2) (WHO,2010).
Duration with HTN	Numerical	It was measured as a discrete variable in the nearest completed years. And categorized into: Recently on HTN treatment ≤ 4 years and Experienced on HTN treatment > 4 years.
Duration on ART	Numerical	It was measured as a discrete variable in the nearest completed years. And categorized into: Recently on ART ≤ 8 years and less experienced on ART 9-14 years and experienced ≥ 15 years
Socio-demographic, Personal and Health system factors		
Nationality	Categorical	It was measured as a nominal binary variable—either a Ugandan or a refugee/asylum seeker. A national was defined as a born of Uganda or possession of a national identity card/ passport.
Address	Categorical	It was defined as the participant's residential place for at least the past 6 months (UBOS, 2020) and measured as a nominal categorical variable at 2 levels. The levels were urban and rural as gazetted by the government of Uganda (UBOS, 2020).
Marital status	Categorical	This was measured as a nominal categorical variable at 4 levels. The levels were being single, married/cohabiting, divorced/separated, and widow/er
Religion	Categorical	It was assessed as a nominal categorical variable at 7 levels. The categories were Catholic, Muslim, Protestant, Born Again Christian, Orthodox, Seventh-day Adventist, and None of the above.
Type of house	Categorical	It was assessed as a nominal categorical variable at 4 levels. The levels were permanent, semi-permanent, temporary, and none of the above. A permanent house was defined as a type of house with a stone foundation, a cemented floor, and plastered walls. The roof was covered with iron sheets, tiles, or stones in the case of flats; a semi-permanent house was defined as a house with a cemented floor but never had a stone foundation. The walls were made of iron sheets, timber, mud or mud bricks, and iron sheet roofing while the temporary house was defined as a house with an earthen floor, walls made of cardboard, polythene paper, grass, or mud, and a roof thatched with the same material as the walls (UNHS, 2016; UBOS, 2016).
Transport means	Categorical	Categorical variable at 3 levels. The levels were public, private, and walking.
Physical exercises	Categorical	It was measured as a binary categorical variable. Exercising at least 4 days/week was considered good practice; < 4 days is poor practice. (Wexler & Aukerman, 2006; Chobanian et al., 2003). A participant who was walking daily for ≥ 30 minutes was considered adequate exercise (good practice).
Dietary raw salt consumption	Categorical	It was measured as a binary categorical variable (Yes or No). The frequency of consumption was also categorized as daily or occasional.
Cigarette smoking	Categorical	Binary categorical variable. Categorized as smoking (Yes) and no smoking (No) (Wexler & Aukerman, 2006)
Alcohol consumption	Categorical	It was measured as a binary categorical variable (Yes or No). (O'Keefe et al., 2014).

HTN drugs availability	Categorical	Measured as a binary categorical variable (Yes or No).
Adherence to HTN drugs	Categorical	It was assessed and measured as a binary categorical variable. Adherence was subjectively assessed using the patient's confession, missing clinic appointment (a missed appointment refers to non-adherence), and the inability of the patient to buy HTN drugs when out of stock at the MNRH-MJAP HIV clinic. The presence of at least one of the 3 indicators signified poor adherence
Consumption of vegetables and fruits	Numerical	It was measured as the number of days a patient consumes vegetables per week. It was categorized into 2 groups at the analysis level. Vegetables and fruit consumption ≥ 4 days per week will be regarded as frequent, and < 4 days per week will be regarded as less effective (Wexler & Aukerman, 2006).
Healthy literacy	Categorical	It was a composite variable that was assessed through patients' knowledge of HTN and prevention and patients' rating of their interactive, proactive, and receptive communication with healthcare providers (Sorensen et al., 2012). 1) Patient knowledge of HTN care: good knowledge (2 points) and poor knowledge (1 point) 2) Interactive communication: good (2 points) and poor (1 point) 3) Proactive communication: good (2 points) and poor (1 point) 4) Receptive communication: good (2 points) and poor (1 point) The total points per individual were calculated and expressed as percentages; ≤ 50% was poor health literacy while > 50% was good health literacy.
Knowledge of hypertension	Categorical	It was measured as a nominal categorical variable at 2 levels. It was categorized into good knowledge and poor knowledge. There were four sub-variables assessing hypertension knowledge, and each question carried 25 points, so the maximum points were 100 points. Therefore, good knowledge > 50 points, and poor knowledge ≤ 50 points (Nakibuuka et al., 2014). The four sub-variables were as follows: 1) Definition of hypertension: correct definition (25 points) and wrong definition (0 points) 2) Dietary limitation for hypertensive patients: correct diet (25 points) and incorrect diet (0 points) 3) Complications of hypertension: at least one complication known (25 points) and no complication known (0 points) 4) Adherence to hypertension drugs: good adherence (25 points) and poor adherence (0 points)

3.7. Data collection

A structured questionnaire was used to collect data. The questionnaire was administered and filled out by the research assistants (MNRH-MJAP HIV clinic nurses and a medical officer). We collected both primary and secondary data. Secondary data was used to establish HTN diagnosis, patients initiated on anti-hypertensives at any time from January 2019 to December 2021, collect data on clinical characteristics and confirm some of the factors obtained in primary data while primary data was collected on factors associated with HTN control status among hypertensive PLHIV in integrated care. A patient whose medical file had been randomly selected was followed during their clinic review, consented, and a face-to-face collection of primary data was executed. Primary data was collected using hard copies of questionnaires during face-to-face interviews between the research assistants and the research participants and checked for completeness before being stored and analyzed. This process of data collection was ideal because it limited the incomplete filling of the questionnaires, and it catered to the medical expertise required to objectively measure some variables like weight. This was in addition to the source of data triangulation that helped to enhance the quality of data collected hence controlling for some systematic biases.

3.8. Research Procedure

Hypertension diagnosis

Past medical records of HIV/HTN patients on integrated care from January 2019 to December 2021 were reviewed to confirm the correctness of established HTN diagnosis, SBP ≥ 140mmHg and/or diastolic blood pressure (DBP) ≥ 90mmHg at least two weeks apart before initiation of HTN treatment.

Sampling

A sample of 340 HIV/HTN patients was systematically and randomly sampled from January 2019 to December 2021 HIV/HTN patients' cohort whose HTN diagnosis was correctly established and initiated on anti-hypertensives at any time within the targeted 3 years.

Checking for uncontrolled HTN

In addition to primary data, secondary data was used to assess HTN control. Any research participant initiated on anti-hypertensives at any point from January 2019 to December 2021 with SBP ≥ 140 mmHg and or DBP ≥ 90 mmHg for 2 consecutive clinic visits at least 2 weeks apart was considered uncontrolled HTN. Secondary data was also used to ascertain whether the patient was initiated on anti-hypertensives and adhering to treatment within the targeted period of 3 years.

Assessing for other variables using secondary data

The blood sugar control status of the patient, the most recent patient's viral load (viral load results of ≤ 1 year), and the patient's height were established from the patient's medical records.

Primary data collection

The research participants who met the selection criteria and consented to participate in the study were further subjected to a structured questionnaire by the research assistant to collect data on determinants of HTN control in HIV/HTN integrated care. The most recent body weight and blood pressure (BP) of the patient were established through active measurements using a well-calibrated weighing scale and sphygmomanometer respectively.

3.9. Quality assurance and control

Quality assurance and control included pre-sampling, data collection, and data entry measures to be put in place to ensure the validity and reliability of the study results.

Pre-sampling and pre-data collection measures

All PLHIV initiated on anti-hypertensives at any time from January 2019 to December 2021 had their HTN diagnosis correctly made. All study participants were initiated into HTN care after being diagnosed with HTN within three years. PLHIV enrolled on ART with an already established HTN diagnosis and on anti-hypertensives were considered hypertensive regardless of their SBP or DBP recording and duration on anti-hypertensives at the time of ART initiation.

Questionnaires were pre-tested on 50 hypertensive patients on chronic HTN care at MNRH chronic care clinic, item analysis was done and the distribution of the responses on each item of the questionnaire was inspected to eliminate items with a low item discriminative power (IDI). In

addition, five classmates read through the questionnaire items to gauge their suitability for measuring the variables of interest. Those with low IDI and face validity were revised. Research assistants were trained on inclusion criteria, body weight, and BP measurement.

Measures during data collection

The questionnaire was a research assistant administered through face-to-face interviews. This helped the participants to fully comprehend the questions since the questions were interpreted by the research assistants. Continuous quality control meetings with research assistants were conducted to ensure timely solutions to emerging challenges during data collection. Body weight and height were recorded in kilograms and centimeters, respectively. Both of them were recorded to the nearest decimal point. Weight was measured using a well-calibrated weighing scale and measured without extra loads on participants apart from clothes and small cosmetic jewelry and standard operating procedures for BP measurement were provided to the research assistants. All questionnaires were checked for complete filling before being stored in a secure place; accessibility was only guaranteed to authorized persons.

During data entry

Completed questionnaires were revised and checked for completeness before entry. Double data entry was done by the principal investigator and an assistant.

3.10. Data management and analysis

3.10.1. Data entry

Data was entered into excel before being imported into STATA version 14.0 for analysis. Data was double-entered for comparison to check for data entry mistakes. Data cleaning and validation were done before analysis.

3.10.2. Data analysis

Data was imported into STATA version 14.0 for analysis. For analysis, the decision level (α) was set at 0.05. A descriptive analysis of age, gender, address, marital status, religion, weight, duration of ART, duration with HTN, and ART regimen was done. Key findings from descriptive analysis were summarized **(Table 2)**. The number of research participants who were initiated on anti-hypertensives within the targeted period of 3 years (from January 2019 to December 2021) with SBP ≥ 140mmHg at the time of data collection (uncontrolled HTN) was determined. The participants with uncontrolled HTN were expressed as a percentage of the total number of study participants to determine the prevalence of uncontrolled HTN **(Table 3)**.

HTN control was categorized into both controlled (SBP ≤ 139mmHg) and uncontrolled (SBP≥140mmHg) blood pressure. Bivariable and multivariable analysis were done using modified Poisson regression with robust variances and Prevalence ratios (PR) at 95% confidence intervals were used as the measure of association. Both unadjusted and adjusted PR were summarized (table 4) and were reported to reflect the factors associated with uncontrolled HTN. Modified Poisson regression was preferred to logistic regression because the prevalence of uncontrolled HTN was >10% (Guangyong Zou, 2004). Previous studies highlighted the importance of clinical characteristics like patient's HIV viral load, adherence to HTN drugs, duration on ART, duration with HTN, and other associated comorbidities like Diabetes and chronic kidney disease in uncontrolled HTN among hypertensive PLHIV (Kwarisiima et al.; 2019). Therefore, the clinical characteristics of the patient were considered potential confounders or effect modifiers in this current study. In addition, the strength of association between each potential confounder and the independent factor of interest and uncontrolled HTN was estimated in crude modified Poisson regression models. Any clinical characteristic with a statistically significant association with the factor of interest and uncontrolled HTN was considered a confounding factor. Furthermore, a greater or equal to 10% change between crude and adjusted PR was used to confirm the

confounding effect of a clinical characteristic. Heterogeneity between models without interaction terms and those with interaction terms was tested to identify effect modifiers.

Consequently, multivariable modified Poisson regression analysis helped to deal with systematic biases secondary to patients' clinical characteristics. The selection of factors carried into the multivariable modified Poisson regression analysis followed the following criteria: A factor that had a P-value ≤ 0.2 at the bivariable modified Poisson analysis level, a biologically plausible factor, and noncollinear to other factors was carried to multivariable modified Poisson regression analysis. Noncollinearity was defined as a correlation coefficient $\leq \pm 0.4$ between two factors. During model development, independent variables were dropped one by one in descending order of their p-values, and in a back-and-forth process until a final parsimonious model with a Pearson χ^2 P value > 0.05 was considered the model of best fit.

3.11. Ethical considerations

Ethical approval for the study was obtained from the Makerere University College of Health Sciences, the School of Public Health Research and Ethics Committee, and the MNRH Research and Ethics Committee before commencing the study.

All hypertensive HIV patients at the clinic were given an equal chance to participate in the study through a random selection of research participants. Before eligible HIV/HTN patients' medical data was included in this research, patients were informed about the importance of the study, and informed consent was sought from the eligible participants. Consent forms were produced both in English and Luganda. Patients reserve the right to withdraw from the study at any time. Confidentiality and privacy for patient information were highly respected by allowing only authorized research participants to access patient medical information.

3.12. Dissemination of results

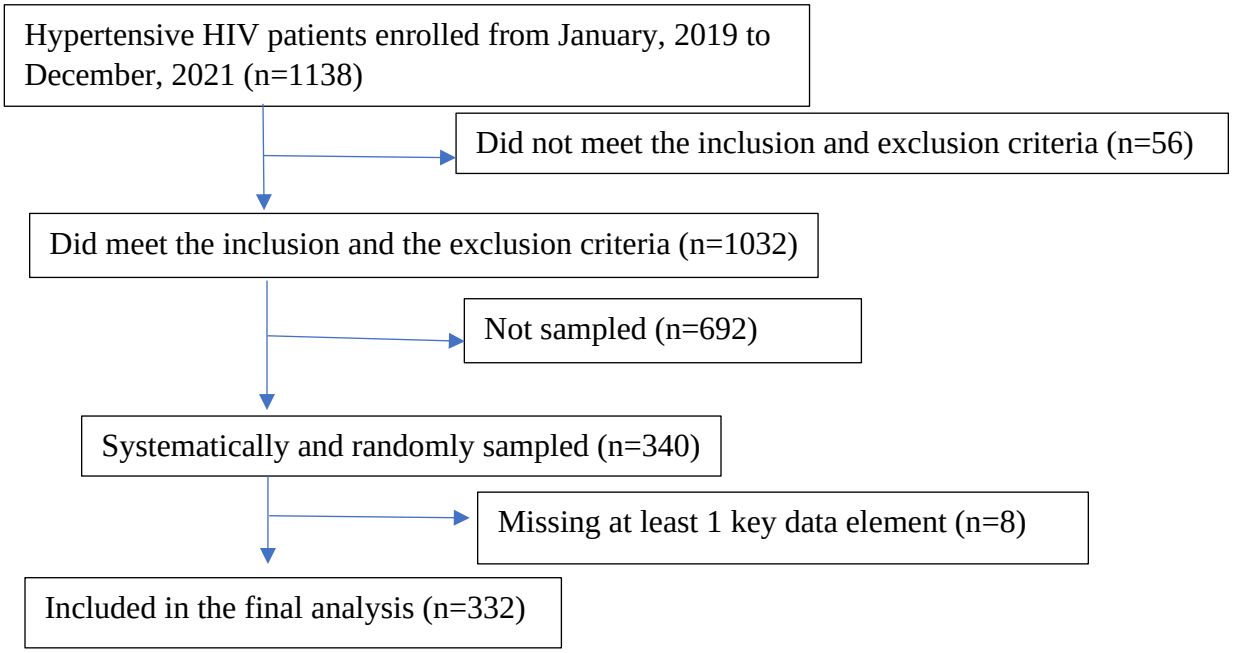
The findings from this study will be presented to the College of Health Sciences, School of Public Health Makerere University, local and international conferences, and the Ministry of Health, Uganda. A copy of the dissertation will be submitted to the Sir Albert Cook Library, Directorate of Research and Graduate Training. Finally, this work will be published in a peer-reviewed journal.

CHAPTER FOUR

4.0. RESULTS

4.1. Background characteristics of the respondents

Figure 2: Study participants' recruitment and data analysis from January 2019 to December 2021.



A total of 340 stable hypertensive HIV-infected persons on HTN treatment from January 2019 to December 2021 were recruited (Figure 2). We analyzed data for 332 (97.6%, 332/340) participants who had complete medical records. The mean age of respondents was 50 (SD± 9) years. Almost sixty percent (199/332) were females. Ninety-two percent (304/332) of participants were living in urban settings. The majority of them (57%, 189/332) were employed and involved in the business sector, and forty-two percent (42%, 140/332) of participants were in upper socioeconomic status. The majority (n=213) of the patients were on TDF-based ART regimens. The prevalence of obesity (BMI≥30kg/m^2) and overweight (BMI≥25kg/m^2) among the participants was 23.8% (79/332) and 34.9% (116/332), respectively. A high percentage of participants had undergone formal (85%, 283/332). More than half of the participants (57.5%, 191/332) had good health literacy, and 87% (289/332) of the participants had good knowledge concerning HTN.

Table 2: Background characteristics of hypertensive PLHIV in integrated HIV/HTN care at MNRH-MJAP HIV clinic (n=332).

Variable	*Mean (SD)*	*Number*	*Percentage (%)*
Age (Years)	50.3 (±9.4)	332	100
Age categories (years)			
≤ 39		34	10.2
40-49		123	37.1
50-59		124	37.4
60-69		37	11.1
70-79		12	3.6
80-89		2	0.6
BMI (Kg/m^2)	27 (±5.5)	332	100
BMI categories			
Underweight		6	1.8
Normal weight		131	39.5
Overweight		116	34.9
Obesity		79	23.8
Duration of ART (years)	9.3 (±2.8)	332	100
Duration of ART categories			
≤ 8		163	49.1
9-14		150	45.2
≥ 15		19	5.7
Duration of HTN drugs (years)	4.3 (±1.8)	332	100
Categorized duration of HTN drugs (years)			
≤ 4		198	59.6
> 4		134	40.4
Education level			
Degree		33	9.9
Tertiary		80	24.1
Secondary		64	19.3
Primary		106	31.9
None		49	14.8
Residency			
Urban		304	91.6
Rural		28	8.4
Socioeconomic status (Percentile)			
≥ 75% (Upper socioeconomic status)		140	42.2
51%-74% (Middle socioeconomic status)		146	44.0
≤ 50% (low socioeconomic status)		46	13.8
Gender			
Female		199	59.9
Male		133	40.1
Health literacy			
Poor		141	42.5
Good		191	57.5
Knowledge of HTN			
Good		289	87.0
Moderate		42	12.7
Poor		1	0.3

Objective 1

4.2. Prevalence of uncontrolled HTN among hypertensive PLHIV in integrated HIV/HTN care

The overall prevalence of uncontrolled HTN in the study population was 38.9% (129/332) **(Table 3)**. There was a higher prevalence of uncontrolled HTN in patients who had been on anti-hypertensives for more than 4 years (46.3%, 62/134) (P=0.023).

Table 3: Prevalence of uncontrolled HTN among stable adult HIV-infected patients in integrated HIV/HTN care (n= 332)

Variable	***Uncontrolled HTN, N (%)***	***Controlled HTN, N (%)***
Overall Prevalence	129 (38.9)	203 (61.1)
Duration of HTN drugs (years)		
≤4	67 (33.8)	131(66.2)
>4	62 (46.3)	72 (53.7)
Duration of ART (years)		
≤ 8	102 (62.6)	61(37.4)
9-14	93 (62.0)	57 (38.0)
≥ 15	8 (42.1)	11 (57.9)
HTN treatment regimen		
Amlodipine + Valsartan + Hydrochlorothiazide	112 (40.4)	165 (59.6)
Amlodipine only	16 (30.8)	36 (69.2)
Valsartan + Hydrochlorothiazide	1(33.3)	2 (66.7)
Possession of comorbidities		
Yes (kidney disease + diabetes)	20 (46.5)	23 (53.5)
No	109 (37.7)	180 (62.3)

Objective 2

4.3. Factors associated with uncontrolled HTN among stable hypertensive PLHIV in integrated care

At bivariate analysis, the prevalence of uncontrolled HTN was higher among patients who were active smokers (unadj. PR: 1.73; 95% CI: 1.29-2.32), alcohol consumers (unadj. PR: 1.76; 95% CI: 1.26-2.45), male gender (unadj. PR: 1.58; 95% CI: 1.20-2.05), and vegetable consumption for < 4 days per week (unadj. PR: 2.5; 95% CI: 1.68-3.74) when compared to nonsmokers, non-alcoholics, females and vegetable consumption for ≥ 4 days per week respectively. Factors like a good knowledge of HTN (unadj. PR: 0.68; 95% CI: 0.48-0.88), good health literacy (unadj. PR: 0.32; 95% CI: 0.24-0.43), good adherence to HTN treatment (unadj. PR: 0.44; 95% CI: 0.32-0.61) and less consumption of raw salt (unadj. PR: 0.63; 95% CI: 0.44-0.90) were associated with lower prevalence of uncontrolled HTN relative to patients who had poor knowledge of HTN, poor health literacy, poor adherence on HTN treatment and regularly consumed raw salt respectively **(Table 4)**. However, after controlling for other factors at multivariable analysis, active smoking, vegetable consumption for < 4 days per week, and male gender were independently associated with a high prevalence of uncontrolled HTN. For example, the PR of uncontrolled HTN was: 1.64 times higher among active smokers (adj. PR: 1.64; 95% CI: 1.20-2.25), 1.53 times higher among PLHIV who consumed vegetables for < 4 days per week (adj. PR: 1.62; 95% CI: 1.01-2.33), and 1.49 times higher among male patients (adj. PR: 1.49; 95% CI: 1.11-1.98) when compared to their counterparts respectively. Relatedly, the prevalence of uncontrolled HTN was 56% (adj. PR: 0.44; 95% CI: 0.30-0.64) and 25% (adj. PR: 0.75; 95% CI: 0.59-0.91) less among patients with good health literacy and middle-socioeconomic status hypertensive PLHIV relative to patients with poor health literacy and upper socioeconomic status hypertensive PLHIV respectively. Patients with good adherence to HTN treatment were also protected against uncontrolled HTN (adj. PR: 0.70; 95% CI: 0.50-0.90).

Table 4: Factors associated with uncontrolled HTN among hypertensive PLHIV in integrated HIV/HTN care

Key: *P<0.05, **P<0.01, ***P<0.001, PR= Prevalence Ratio

Covariates	Uncontrolled HTN (SBP≥ 140mmHg)		Unadjusted PR (95% CI)	Adjusted PR (95% CI)
	No n (%)	**Yes** n (%)		
Sociodemographic factors				
Gender				
Female	136 (68.3)	63 (31.7)	**1**	**1**
Male	67 (50.4)	66 (49.6)	**1.58 (1.20-2.05)	**1.49 (1.11-1.98)
Age (Years)				
≤ 39	26 (76.5)	8 (23.5)	1	1
40-49	80 (65.0)	43 (35.0)	1.49 (0.77-2.89)	1.20 (0.72-2.00)
50-59	77 (62.1)	47 (37.9)	1.61 (0.84-3.08)	1.18 (0.70-1.99)
60-69	16 (43.2)	21(56.8)	*2.41 (1.24-4.71)	1.35 (0.78-2.33)
70-79	4 (33.3)	8 (66.7)	**2.83 (1.37-5.86)	1.41 (1.45-2.65)
80-89	0 (00.0)	2 (100.0)	***4.24 (2.31-7.80)	*2.85 (1.17-6.97)
Formal education level				
Degree	31 (94.0)	2 (6.0)	1	1
None	18 (36.7)	31(63.3)	**10.44 (2.67-40.76)	9.02 (0.92-23.12)
Primary	31 (29.3)	75 (70.8)	*11.67 (3.02-45.07)	15.33 (0.99-30.69)
Secondary	49 (76.6)	15 (23.4)	3.87 (0.94-15.94)	2.17 (0.13-10.05)
Tertiary	74 (92.5)	6 (7.5)	1.24 (0.26-5.83)	0.90 (0.61-3.43)
Occupation				
Business	112 (59.3)	77 (40.7)	1	1
Casual work	5 (31.2)	11 (68.8)	**1.69 (1.16-2.45)	1.67 (1.04-2.69)
Professional	56 (91.8)	5 (8.2)	*0.20 (0.09-0.47)	0.82 (0.34-1.99)
None	30 (45.5)	36 (54.5)	*1.34 (1.01-1.77)	1.27 (0.85-1.89)
Personal factors				
Knowledge of HTN				
Poor knowledge of HTN	19 (44.2)	24 (55.8)	1	1
Good knowledge of HTN	184(63.7)	105 (36.3)	**0.68 (0.48-0.88)	0.82 (0.58-1.16)
Health literacy				
Poor health literacy	51 (36.2)	90 (63.8)	1	1
Good health literacy	152 (79.6)	39 (20.4)	***0.32 (0.24-0.43)	***0.44 (0.30-0.64)
Adherence to HTN drugs				
Poor adherence	86 (47.8)	94(52.2)	1	1
Good adherence	117 (77.0)	35 (23.0)	***0.44 (0.32-0.61)	*0.70 (0.50-0.90)
Socioeconomic status (Percentile)				
≥ 75% (Upper socioeconomic status)	90 (64.3)	50 (35.7)	1	1
51%-74% (Middle socioeconomic status)	87 (59.6)	59 (40.4)	1.13 (0.84-1.52)	*0.75 (0.57-0.91)
≤ 50% (Low socioeconomic status)	26 (56.5)	20 (43.5)	1.22 (0.82-1.81)	0.74 (0.50-1.10)
Behavioral factors				
Alcohol consumption				
No	90 (73.8)	33 (26.2)	1	1
Yes	113 (53.8)	97 (46.2)	**1.76 (1.26-2.45)	0.78(0.54-1.11)
Vegetable consumption per week				
Vegetable consumption for ≥4 days	91 (80.5)	22 (19.5)	1	1
Vegetable consumption for <4 days	112 (51.1)	107 (38.9)	*2.51 (1.68-3.74)	*1.53 (1.01-2.33)
Raw salt consumption				
More often	42 (38.2)	68 (61.8)	1	1
Less often	36 (61.0)	23 (39.0)	*0.63 (0.44-0.90)	1.04 (0.76-1.44)
Active smoking				
No	189 (64.1)	106 (35.9)	1	1
Yes	14 (37.8)	23(62.2)	***1.73 (1.29-2.32)	**1.64 (1.20-2.25)

4.4. Discussion

With the increasing burden of NCDs among PLHIV, we need to optimize the integration of NCD management into already existing HIV care platforms. In this study, the prevalence and factors associated with uncontrolled HTN among hypertensive HIV-infected patients subjected to integrated HIV/HTN care at MNRH from January 2019 to December 2021 were determined. Key findings were the 38.9% prevalence of uncontrolled HTN, an independent statistically significant association between uncontrolled HTN and vegetable consumption for < 4 days per week (38.9%), good health literacy (20.4%), active smoking (62.2%), and middle socioeconomic status (40.4%).

Discussion of findings on the prevalence of uncontrolled HTN among hypertensive stable adult PLHIV in integrated HIV/HTN care.

This study pointed out a high burden of uncontrolled HTN among hypertensive HIV-infected adults on HIV/HTN integrated care; this finding highlights the burden at hand for the Ministry of Health, health care providers, and implementing partners towards improving the effectiveness of integrated HIV/HTN care in Uganda. The prevalence of uncontrolled HTN revealed in this study was slightly higher than that found in a similar study in Nigeria (Jackson et al., 2022). The variance could be attributed to the differences in the straining of health systems in terms of medical supplies, transport means, and individual socioeconomic levels by COVID-19 in the respective countries. The low prevalence of uncontrolled HTN could still be due to the inclusion of patients with unsuppressed viral load in the Jackson et al (2022) study. For example, a South African study by Brennan et al (2018) showed that patients with advanced HIV disease were less likely to have uncontrolled HTN. On the contrary, the prevalence obtained in this study was much lower compared to the 83.7% revealed in the SSA systematic review study by Mohamed et al (2021). The discrepancy could be due to the differences in the geographic sites in which the studies were conducted. The majority of the participants in the present study were urban dwellers where accessibility to medical supplies is much easier compared to rural areas where the majority of study participants in Muhamed et al (2021) study dwelled. The divergence between the results could also be due to the inclusion criteria differences between the present study and individual studies included in the systematic review. The result underlined a higher prevalence of uncontrolled HTN among hypertensive PLHIV compared to the prevalence of uncontrolled HTN in the general population revealed in a Ugandan comparative cross-sectional study by Musinguzi

et al. (2015). The high prevalence emphasized the importance of strengthening health education and promotion campaigns directed towards behavioral change strategies among hypertensive PLHIV as the integration of HTN in the HIV care platform takes shape in Uganda.

Discussion of findings on the factors associated with uncontrolled HTN among hypertensive stable adult PLHIV in integrated HIV/HTN care.

The current study identified five independent factors that were associated with uncontrolled HTN among stable PLHIV with HTN established in integrated care. Vegetable consumption of less than 4 days per week, active smoking, male gender, socio-economic status, and health literacy showed statistically significant associations with uncontrolled HTN in the study population.

Consistent with Holanger et al. (2021), PLHIV who were actively smoking, regardless of the number of cigarettes smoked, were 64% more likely to have uncontrolled HTN while in integrated HIV/HTN care relative to their counterparts who were nonsmokers. Smoking induces endothelial dysfunction, vasoconstriction, insulin resistance, and dyslipidemia with resultant uncontrolled HTN (Craig et al., 1989). Kvaavik et al. (2004) also found out that smokers are more sedentary and have less healthy diets, and this is in addition to the fact that unfavorable lifestyles and diets are also associated with poorer compliance with medical treatment (Aggarwal and Mosca, 2010). This perhaps explains the strong association between active smoking and uncontrolled HTN among the target population in the present study. Therefore, actively smoking PLHIV were at risk of developing HTN target organ complications secondary to uncontrolled HTN leading to early morbidity and mortality hence suggesting the need for targeted regular screening for organ complications among active smokers.

In this study, consumption of vegetables for less than 4 days per week was found to be independently associated with uncontrolled HTN. For instance, the PR of uncontrolled HTN among PLHIV who consumed vegetables for less than 4 days per week was 1.53 times that of PLHIV who consumed vegetables for greater or equal to 4 days per week. This finding was consistent with the Siervo et al. (2015) systematic review study on the Dietary Approaches to Stop Hypertension (DASH) that revealed that consumption of regular vegetables leads to significant improvement in both systolic and diastolic pressure. Although the findings on the DASH diet were not limited to PLHIV, they were also not restricted to HIV-negative subpopulations. Therefore, the findings in the present study can also be considered coherent with the DASH study. Regular

consumption of vegetables is associated with significant reductions in total cholesterol and LDL concentrations in blood, which lowers further pre-existent atherosclerosis hence leading to accelerated blood pressure lowering (Sally et al. 2016). Hence, a diet rich in vegetables potentially lowers blood pressure leading to the prevention of hypertensive heart diseases, thus reducing premature deaths and straining the already compromised health care services.

This study further pinpointed that the prevalence of uncontrolled HTN was 49% more likely in males living with HIV than in females of the same serostatus. This ramification was coherent with the finding of a rural Uganda prospective cohort study by Kwarisiima et al. (2019) which revealed that hypertensive HIV-infected men on HIV/HTN integrated care were less likely to have controlled HTN. This could be due to both poor health-seeking behavior and adherence to treatment among men (Bourne et al., 2010). A study by Oguoma et al. (2021) revealed a high prevalence of obesity among men and its relationship with uncontrolled HTN. This also attempts to explain the relationship between the male gender and uncontrolled HTN established in this study. Therefore, this suggests that hypertensive HIV-infected men should be accorded intensive monitoring programs following the initiation of HTN treatment.

Having good health literacy was independently found to be safeguarding against uncontrolled HTN among the study population. PLHIV with poor health literacy had a twofold PR to have uncontrolled HTN compared to PLHIV with good health literacy. This finding concurred with the results of a prior study in the USA which showed that PLHIV with low health literacy were at high risk of uncontrolled HTN (Anjali et al., 2009). PLHIV with good health literacy had the potential to make appropriate health decisions and to measure medication dosages (Berkaman et al., 2010). Having good health literacy was associated with the consumption of a protective diet and engaging in activities that led to weight reduction and HTN control (Nutbeam, 2008). Therefore, multi-sectorial involvement in building a literate population would result in effective consumption and utilization of health care resources with a resultant reduction in the number of disability years lost hence improved economic productivity of the citizens.

Socioeconomic status was found to be statistically associated with uncontrolled HTN among hypertensive HIV-infected adults in integrated care. The prevalence of uncontrolled HTN was 25% less among hypertensive PLHIV under middle socioeconomic status relative to those under high socioeconomic status. This finding was contradictory to the findings of studies by Yusuf et al. (2020) and Banerjee et al. (2017) which showed that low socioeconomic status has also been associated with uncontrolled HTN. The contradiction could be to due differing levels of COVID-19 stress across different levels of socioeconomic status concerning the respective sources of income. Liu et al., (2017) and X. Q. Wang et al., (2020) studies alluded to the importance of stress in uncontrolled NCDs like HTN. In this present study, the majority of the hypertensive PLHIV under middle socioeconomic status were public servants who had minimal or no interruption in their sources of income when compared to the business fraternity during the COVID-19 outbreak. This perhaps provides an insight into the provision of targeted interventions on continuity of treatment during emergencies.

CHAPTER FIVE

5.0. Conclusion and Recommendations

5.1. Conclusion

1) The prevalence of uncontrolled HTN among hypertensive PLHIV in integrated care in Uganda is still high notwithstanding the one-roof provision of HIV and HTN care. More than 1in 3 hypertensive PLHIV in integrated HIV/HTN treatment have uncontrolled HTN. This elevated burden of uncontrolled HTN gives ground for the most important consideration of hypertensive PLHIV at both policy formulation and healthcare provision levels.
2) The factors associated with the burden of uncontrolled HTN among hypertensive HIV patients on integrated care in Uganda are active smoking, vegetable consumption < 4 days per week, male gender, socio-economic status, and poor health literacy. Good adherence to HTN treatment is crucial for HTN control among hypertensive HIV-infected adults in integrated care. Conclusively, modifiable social factors are accountable for the elevated burden of uncontrolled HTN among hypertensive PLHIV in integrated care suggesting the need for enhanced behavior change campaigns at both health facility and community level.

5.2. Recommendations

1) The burden pointed out in this study rationalizes the need for doubled efforts by MoH and health care providers to prioritize hypertensive PLHIV when it comes to policy and guidelines synthesis geared towards the integration of HTN care into HIV care platforms in the country. For example, the modifiable factors associated with uncontrolled HTN can be mitigated through targeted health education and promotion packages directed towards behavioral and lifestyle modification among hypertensive PLHIV.
2) This study highlighted the importance of consuming vegetables < 4 days per week. The PR of uncontrolled HTN among PLHIV who consumed vegetables for less than 4 days per week was 1.53 times that of PLHIV who consumed vegetables for greater or equal to 4 days per week. Therefore, there is a need for enhanced encouragement of hypertensive PLHIV to continuously include vegetables on their daily menus. This could be implemented through routine health education and promotion talks at the points of care and through community engagements in the form of health outreaches.

3) Hypertension control among this subcategory of patients was found to be gender sensitive. The prevalence of uncontrolled HTN was 49% more likely in males living with HIV than in females of the same serostatus This further highlights the importance of prioritization through targeted interventions. For example, a combination of integrated counseling sessions, individual-based intensive adherence counseling, and adherence reminding strategies like pre-appointment reminders and real-time calling that have been found effective in HIV care can also be employed by healthcare providers to improve HTN control among hypertensive HIV-infected men.
4) Furthermore, the study revealed that PLHIV who were active smokers were 64% more likely to have uncontrolled HTN while in integrated HIV/HTN care relative to their counterparts who were nonsmokers. This suggests the need for active screening of smoking among hypertensive PLHIV during clinic reviews; this should be coupled with behavioral change interventions like individual or group counseling sessions geared towards smoking cessation.
5) Additionally, this study revealed that the importance of good healthy literacy in the control of HTN among PLHIV cannot be overestimated. Therefore, the government through MoH and healthcare providers should focus on improving the health literacy of patients at all points of care through the provision of understandable health information on HTN management, effective communication, and structured health education. The health communication and education interventions should be focused on individual health and lifestyle modification.

CHAPTER SIX

6.0. Study limitations

The results of this study should be interpreted in light of some limitations:

1) The inability to screen for comorbidities like chronic kidney disease, endocrine diseases like thyrotoxicosis, adrenal gland diseases, and heart conditions commonly leads to malignant forms of HTN (Muhamed et al., 2021). The co-existence of these comorbidities might have tremendously biased our research findings, especially the prevalence of uncontrolled HTN. However, the effects of these comorbidities were minimized by excluding hypertensive PLHIV with an already existing diagnosis of any of the cited above comorbidities during the stage of secondary data collection from medical records.
2) The results of this study should also be interpreted in the face of the COVID-19 epidemic, which interrupted public transport and perhaps contributed to non-adherence to HTN treatment and subsequently led to the noted burden of uncontrolled HTN. It could also be possible that the study focused on only hypertensive PLHIV who had the potential to proceed with care despite the presence of COVID-19 which could potentially introduce a selection bias in the results. However, the feared selection bias could have been minimized by the fact that the study was conducted almost one year after the intense phases of COVID-19 when public functionality had normalized.
3) The study was also overtaken by events as over time, the Ugandan consolidated HIV management guidelines have been updated. Therefore, some of the definitions used in this study have been redefined. For example, in this study, a stable PLHIV was defined as a patient with a viral load ≤1000 copies/ml as per the old Uganda HIV management guidelines which have been redefined in the current guidelines as a PLHIV with a viral load ≤ 200 copies/ml or ≤400 copies/ml using plasma sample or dry blood sample respectively.

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Appendix

Questionnaire

Date……

Study ID: ……

Patient clinic identification number……

Cat1	**Socio-Demographic, individual, behavioral and health systems factors**		
No	**Questions**	**Circle the correct participant's answer**	**Specify where necessary**
1	How old were you on your last birthday? (In Years)		
2	What is the participant's gender? ***(To be abstracted from the patient's medical records)***	1) Male 2) Female	
3	What is your nationality?	1) Ugandan 2) Refuge/Asylum seeker	Others (specify) …….
4(a)	Where have you lived for the past 6 months? (Address)	Respondent's Village/cell ……	
(b)	What is the status of your address?	a) Urban b) Rural	
5	What is your Marital status?	1) Single 2) Married/cohabiting 3) Divorced/separated 4) Widow (er)	
6	What is your religion?	1) Catholic 2) Muslim 3) Protestant 4) Born again Christian 5) Orthodox 6) Seventh-day Adventist 7) None of the above	Others (specify) …….. …….
7	What is your highest level of formal education?	1) University degree 2) Tertiary level 3) Secondary level 4) Primary level 5) None of the above	
8	What is your occupation/Job?	1) Professional job 2) Business person 3) Peasant farmer 4) Casual labourer 5) None of the above	
9 (a)	Do you have children?	1) Yes 2) No	**If no, go to Qn. 10**
(b)	How many children do you have?		
(c)	How many children are still depending on you?		
10	Do you have other dependents?	1) Yes 2) No	
11	Do you receive any monetary support for your medical bills?	1) Yes 2) No	
12 (a)	Which type of house do you live in?	1) Permanent house 2) Semi-permanent 3) Temporary house 4) None of the above	
(b)	Do you own the house (in Qn 13)?	1) Yes 2) No	
13	What are your means of transport?	1) Private vehicle 2) Public (taxi, boda-boda) 3) Walking	
14 (a)	Do you do any physical exercise?	1) Yes 2) No	**If no, go to Qn.15 (d)**
(b)	Which physical activity do you commonly do?	1) Jim works 2) Jogging 3) Brisk walking	Others (specify) …… ……

		4) Swimming 5) Daily walking ≥ 30 minutes	
(c)	How many times a week do you exercise?		
(d)	Why don't you exercise?	1) No time to exercise 2) No resources to do it 3) No importance to exercise 4) No safe space to exercise 5) None of the above	Others (specify) …….. ……..
15 (a)	Do you add uncooked salt to your food?	1) Yes 2) No	**If no, go to Qn. 16**
(b)	How often do you do it?	1) Every day 2) Occasionally	If occasionally, how times a week? ……..
16 (a)	Do you smoke tobacco/cigarettes or other drugs?	1) Yes 2) No	**If no, go to Qn. 17**
(b)	How many sticks do you smoke daily?		
17 (a)	Do you take alcohol?	1) Yes 2) No	**If no, go to Qn. 18**
(b)	How often do you take alcohol?	1) Daily 2) Occasionally	
(c)	What type of alcohol do you take?	1) Waragi/spirits/whiskeys 2) Beers 3) Wines 4) None of the above	Others (specify) …….
(d)	How much alcohol do you take? (In shots/bottles)		
18 (a)	Have you ever been told that pressure drugs are out of stock?	1) Yes 2) No	**If no, go to Qn. 19**
(b)	What did you do?	1) Bought from a pharmacy/drug shop and took medicines daily 2) Waited until the next review 3) Stopped drugs for pressure up to now 4) Resorted to herbal medicines 5) I Bought and swallowed medicines only when I had money and felt bad	
19(a)	Which language (S) do you understand?	1) English 2) Luganda 3) Lusoga 4) Runyankole 5) Runyoro 6) Rutooro 7) All the above 8) None of the above	Others (specify)
(b)	Do you understand medical workers' instructions about your drugs?	1) Yes 2) No	**If yes, go to Qn. 19 (d)**
(c)	If no, why?	1) Language barriers 2) No instructions given 3) Medical workers are ever in a rush 4) Some medical workers are harsh and rude	Others (specify) ……. …….
(d)	How do you rate your communication with healthcare workers?	Receptive communication	Poor / Good
		Proactive communication	Poor / Good
		Interactive communication	Poor / Good
20(a)	Have you ever missed your appointment date?	1) Yes 2) No	
(b)	If yes, why?	1) Feared long waiting time at the hospital 2) No money for transport 3) The medical worker had not explained to me my next appointment 4) Impassable roads due to heavy rains	Others (specify) ……. …….
21 (a)	What is Hypertension?	1) High blood pressure 2) Low blood pressure 3) Normal blood pressure 4) None of the above	
(b)	What is the best type of meat to be eaten by the hypertension patient?	1) Red meat (beef, goats' meat, pork, mutton) 2) White meat (chicken, fish) 3) All the above 4) None of the above	

(c)	Do you eat vegetables or fruits?	a) Yes b) No	**If No, go to 25 (e)**
d)	How many days a week do you eat vegetables or fruits?		
(e)	What are the complications of hypertension if left untreated?	1) Premature death 2) Heart disease/heart attack 3) Strokes 4) Kidney failure 5) Visual disturbances 6) All the above 7) No complications	
Cat2	**Clinical characteristics**		
1	What is the current weight of the patient in kg?		
2	What is the Height of the patient? (cm) ***(To be abstracted from the medical records)***		
3	What is the patient's BMI? ***(Calculated from Weight and Height)***	…….. (Kg/m^2)	
4	What are the participant's blood pressure measurements during the most immediate two visits?	Recent visit **(abstracted from medical records)** ……. (mmHg)	Today's visit measurement ……(mmHg)
5(a)	Do you take your pressure drugs daily?	a) Yes b) No	
(b)	For how long has the patient been hypertensive? (Years)		
(c)	What are the documented names of pressure HTN drugs the patient is taking? ***(Abstracted from medical records)***		
6(a)	Is the participant having another known chronic disease? ***(Abstracted from medical records)***	Yes No	**If no, go to Qn.7**
(b)	Which chronic disease? ***(Abstracted from medical records)***	1) Diabetes 2) Kidney disease 3) Heart disease 4) Liver disease 5) Goiter 6) None of the above	
7	When were you diagnosed with HIV?	…….	No. of years of Positive living …….
8	For how long have you been on ART?		
9	What is the participant's current ART regimen? ***(Abstracted from the medical records)***		
10	What is the most recent viral load of the patient*? **(Abstracted from the medical records)***		

Thank you very much for your time!

Client informed consent form

PREVALENCE OF UNCONTROLLED HYPERTENSION AND ASSOCIATED FACTORS AMONG ADULT HIV-INFECTED PATIENTS ON INTEGRATED HIV AND HYPERTENSION CARE AT MULAGO NATIONAL REFERRAL HOSPITAL, UGANDA

Introduction

My name is Walugembe Fred. I am a student at Makerere University. Makerere University is one of the public universities; it's located in Kampala, Uganda's capital city, the central part of the country. The university is committed to advancing science by active conduction of research and training graduate students. I am conducting a study to help MoH and other policymakers understand how the best management of hypertension can holistically be integrated into HIV care programs.

Why are we asking you to participate in this study?

We want to understand the determinants of uncontrolled hypertension among hypertensive patients on integrated HIV/HTN care. We are asking you to participate in the study because you are a patient of hypertension receiving integrated HIV/HTN care from the Mulago ISS clinic. We would like to do in-depth learning about factors influencing hypertension control beyond the mere consumption of drugs.

What do we want to learn in this study?

In this study, we want to learn about the burden and factors associated with uncontrolled hypertension among hypertensive HIV patients on integrated HIV/HTN care.

How will this study help you?

Being in this study will not directly help you personally. What we learn from the study will raise awareness of the challenges you face within the scope of integrated HIV/HTN care. We hope it will guide policymakers toward which direction to take to improve holistic HIV/HTN integrated care. Your participation will not affect your access to healthcare services.

What will happen during the study?

We are speaking to adult hypertensive- HIV patients who have been receiving hypertension care from the Mulago ISS clinic. The interview will last about 40 to 60 minutes. We will ask you about your experience of receiving hypertension care, how the providers treated you and what information you received. The information collected today will be used to improve the quality of integrated HIV/HTN care. We will use

a structured questionnaire to receive information from you. The questionnaires shall be filled with the help of the research assistants.

What are the risks of this study?

There are a few risks that could come from participating in this study, and we will try to address them.

- You may feel uncomfortable with some questions we ask. You do not need to answer any question that makes you feel uncomfortable.
- We will do our best to protect your privacy by not talking with others about who is in the study, or repeating anything you tell us.
- We will keep your personal information secure by using a number instead of your name on study forms and other records. However, there is always a small chance that someone who is not allowed could see your personal information by mistake. If this happens, we will tell you.

There may be other risks that we do not know about yet. If we learn new information during the study that might affect your decision to stay in the study, we will tell you about it.

How will we use and protect your personal information

In this study, we will record some personal information about you. We need this information to show that you agreed to participate in the research. We will keep your personal information confidential.

The data may be made open to the public so that others can learn from it. If data are shared publicly, they will not be linked to you personally. We will remove your name and other identifying information when we share the study information with others.

Groups who oversee our research can see study records. These are people from the ethics committee(s), the sponsor, a research monitor, and government agencies like the Ministry of Health. They may see your name and other personal information. They are not allowed to share your personal information about you with anyone else.

We will store the study records in a locked cabinet where only the research team can access them. Study records stored on computers will be protected by a password that only the research team knows. The paper and computer records will not include your name.

What happens to your information when the study ends?

We will share what we learn in this study with others. We will remove your name and any personal information when we share the study information with others.

We will keep your information in secure password-protected computers and cloud-based storage systems. After the study is completed, we will destroy the written records. We may keep the information on the computer longer. This information will not have your name on it.

Your rights

You can say yes or no to joining this study. You can leave the study at any time. If you do not join or if you leave the study early, you will not have any penalties. You should not feel pressured to join or stay in the study.

You have the right to stop participating at any time. We may ask why you are leaving because it is helpful for us to know but, you do not have to tell us.

You also have the right to ask questions at any time throughout the process if something is unclear.

By signing this consent form, you do not lose any rights you normally have.

Who to contact if you have questions

This study has been approved by the Makerere University Research and Ethics Committee and the administration of Mulago Uganda National Council for Science and Technology in Uganda.

If you have any questions about this study, you can contact Walugembe Fred at +256-787419882/+256-752689140 or fredwalu50@gmail.com. If you have questions about your rights as a participant in this study, you can contact my supervisors: Dr. Aggrey David Mukose at +256701427800 or amukose@musph.ac.ug and Dr. Roy William Mayega at+256772412455 or rmayega@ranlab.org.

You will get a copy of this form to keep. You can also ask me any questions before or after the interview.

Do you have any questions now?

This study has been explained to me. I have had an opportunity to ask questions. I freely agree to participate in this study

Name (print):_____

Signature: _____

Date: _____

IF THE PARTICIPANT IS UNABLE TO READ, INCLUDE THEIR THUMBPRINT IN THE BOX ABOVE.

AN IMPARTIAL WITNESS MUST SIGN BELOW:

I agree that the information in the consent form was accurately explained, and understood by the subject. The participant freely consented to be in this evaluation.

Witness name (print): _____

Witness signature: _____

Date: _____

TO BE COMPLETED BY THE INTERVIEWER:

I have complied with the consent procedure. I have informed this individual about the nature, purpose, potential benefits, and possible risks associated with participating in this evaluation.

Name (print): _____

Signature: _____

Date: _____