Health Policy Brief: Towards Prevention of Risk Factors for Non-Communicable Diseases among People Living with HIV Infection in Rwanda

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by

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A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

in the Department of Physiotherapy,

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November 2017

Abstract

Background: People living with the HIV infection (PLWHI) can now live longer due to the availability and effective use of combination antiretroviral therapy (cART). Eastern and Southern Africa remains the region affected by HIV. Rwanda is one the Eastern Africa that has achieved high rates of antiretroviral therapy (ART) coverage, accounting 164,262 (78%) of all PLWHI in 2016. However, both HIV infection and continued use of life-long cART medications have been associated with a constellation of non-communicable diseases (NCDs). Additionally, HIV-infected (HIV+) persons are at increased risk of NCDs, especially cardiometabolic diseases (CMD), compared to HIV-uninfected (HIV-) counterparts. People living with HIV infection are at an increased risk for NCDs due to their HIV status and their resultant reduced immunity, the use of some cART, and contextual and sociodemographic factors. Fortunately, lifestyle factors including regular physical activity participation, diet modification, and smoking cessation could play a major role in preventing CMD, and in improving life expectancy for HIV+ individuals. However, these interventions are not always integrated in routine African clinical settings, particularly in Rwanda. Currently, health-related benefits of people living with HIV infection on established ART, has shifted from survival to a health-related quality of life outcome (HRQOL). Understanding behavioural and biological risk factors (such as tobacco use, harmful alcohol use, unhealthy diet (with low fruit and vegetable), physical inactivity, overweight and obesity, high blood pressure (BP) and abdominal obesity) for NCDs profile, predictors, and their influence on health-related quality of life is critical to maximise the quality of life and wellbeing for people living with HIV infection, especially in designing health education programmes and informing health policy. The aim of the current study is to provide evidence that informs the development of a Health Policy Brief on strategies to address behavioural and biological risk factors for NCDs

among people living with HIV infection in Rwanda based on the PRECEDE model. Specifically, this study aimed to (1) describe the associations and distribution patterns of behavioural and biological risk factors of NCDs among PLWHI in Rwanda; (2) assess knowledge of chronic lifestyle disease risk factors and their associated factors; (3) determine the associations between behavioural and biological risk factors for NCDs with physical and mental health-related dimensions of QOL; (4) identify motivators and barriers to physical activity participation and healthy diets; and (5) develop a health policy brief on strategies addressing behavioural and biological risk factors for NCDs among PLWHI.

Methods: An analytical cross-sectional design was employed in this study. A multistage sampling frame was developed and employed. The study setting was in selected public health centres in Rwanda. Public health centres were purposively selected from Kigali City, Southern and Eastern provinces. The study targeted people living with HIV infection who visited the outpatients' public health centres to receive ART, health care consultation, counselling support, laboratory testing, and determination of CD4+ cell count. Inclusion criteria were all adults ≥ 21 years with the ability to provide informed consent. A sample size of 806 PLWHI was included in the study. Ethical clearance was obtained from the relevant authorities at the University of the Western Cape and permission was obtained from the relevant Rwandan committees. The instruments used were the Medical Outcome Study HIV questionnaire, the World Health Organization's STEPS instrument (core and Expanded Version 1.4), the knowledge assessment questionnaire relating to risk factors for chronic diseases of lifestyle, and the Motivators and Barriers of Healthy Lifestyle Scale. Data was analysed using SPSS Statistics 23. Descriptive statistics for all variables were generated. Inferential statistics of independent-samples t-test,

Pearson's Chi-square, Multiple regression and Logistic regression were used. Alpha level was set at 0.05.

Results: A total of 794 participants were included in the study analyses. The mean age of the sample was 38 (±10.8) years and women accounted for 64.6% of the population (n=513). About 16.2% reported daily smoking, 31.4% reported alcohol use, and 95% reported insufficient consumption of vegetables and fruit, while 26.1% reported being physically inactive (<600 MET minutes/week). Overweight or obese (BMI≥ 25kg/m²) was 18.4%, and waist-hip-ratio (WHR) ≥ 0.95 in males was 15.6% and WHR ≥ 0.85 in females was 58.8%. High blood pressure i.e. systolic blood pressure of ≥140 mmHg, or diastolic blood pressure ≥90 mmHg was 24.4%. Tobacco use was associated with older age, separated and divorced participants, and lack of disclosure of HIV serostatus. Alcohol consumption was associated with males and never with married people. Physical inactivity was associated with females, high educational status, and lack of HIV serostatus. Urban residents were 2.3 times more likely to be overweight or obese than were rural residents, while a lower prevalence of overweight or obesity was observed in participants who had low CD4+ cell count (< 350 cells/mm^3). Increased WHR was less prevalent in males than females. People who were older than 50 years, self-employed, physically inactive, smokers, and who were on ART were more likely to be hypertensive. The results also reveal that mean physical health summary and mental health summary score values were 63.96±11.68 and 53.43±10.89, respectively. Hierarchical multiple regression analyses show that having abdominal obesity and being unmarried were associated with lower physical and mental health. In addition, having hypertension and low Cluster of Differentiation 4 counts (less 350 cell counts /mm^3) were independent predictors for lower physical health, while tobacco use and lack of HIV disclosure were independent predictors of mental health. The results also showed that the majority of the

participants (65.0%) had low levels of knowledge about non-communicable disease risk factors. The majority of the participants (75.7%) perceive non-communicable diseases to be preventable, whilst only 21.7% of participants reported having information on how to prevent non-communicable diseases. Good knowledge was significantly associated with high educational status, low Cluster of Differentiation 4 count (less 350 cells /mm^3) and normotension. Furthermore, the mean overall motivators and barrier scores were 28.29±6.3 and 22.59±3.96, respectively. The most frequently barriers to physical activity participation and healthy diet included lack of motivation, affordability, lack of information from healthcare providers, time, and the lack of understanding of what needs to be done. Additionally, the participants' desire to be healthy, the desire to manage their weight, and to have someone to encourage or help them and believe that God wanted them to take care of their bodies were the most commonly reported motivators. Participants with higher levels of education and higher monthly household incomes believe that there are motivators to engaging in a healthy lifestyle. In addition, participants who were urban residents, unmarried, unemployed, physically inactive, and who had high body mass indices had significantly more barriers to engaging in physical activity and healthy diet than their comparison group counterparts.

Conclusions: Findings from this study suggest that HIV-infected adults in Rwanda are at increased risk for non-communicable disease due to observed high burden of non-communicable disease risk factors coupled with poor knowledge to identify these non-communicable disease risk factors. In addition, these risk factors have a negative impact on health-related quality of life. Numerous barriers and motivators to physical activity participation and healthy diet were also identified. Therefore, measures to prevent future epidemic of non-communicable diseases,

especially cardiometabolic diseases in people living with HIV infection are warranted. Modalities for sustainable prevention efforts need to be aligned with evidence-based identified risk factors to enhance the health of HIV-infected people for better quality of life. It also suggests that the assessment of a health-related quality of life and its determinants may be fundamental in formulating feasible and effective strategies to support people living with HIV infection. To provide with the necessary information, health education programmes for the prevention of non-communicable diseases risk factors need to be culturally and health literacy appropriate for people living with HIV infection. Furthermore, the findings suggest that health care providers need to consider identified barriers and motivators when designing a comprehensive counselling programme to facilitate lifestyle changes for people living with HIV infection. The health policy brief that will be developed can inform the Government of Rwanda in general , and the Ministry of Health in particular, of the current situation of risk factors for non-communicable diseases in people living with HIV infection and advocate for non-communicable disease preventive interventions.

Key words

Non-communicable diseases, Risk factors, HIV infection, PRECEDE model, Prevention, Health-related quality of life, Physical health, Mental health, Knowledge, Motivators, Barriers, Physical activity, Healthy diet, Healthy lifestyle, Policy brief, Rwanda.

Declaration

I declare that "**Health Policy Brief: Towards Prevention of Risk Factors for Non-communicable Diseases among People Living with HIV infection in Rwanda**" is my own work, that it has not been submitted for any degree or examination at any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Name: _____ Date: _____

Signed: _____

Dedication

I dedicate this thesis to my wonderful wife, Marie Grace Kankindi; I really am blessed to have a wife like you. You had proved to me that you are the best for me. Thank you for everything, you give me wings.

I dedicate this work to my children Ange Nicole Kayitesi and Guilain Rugwiro, and to my wonderful family. May God bless you.

This work is also dedicated to my late parents Marianne Mukansanga and Stanislas Biraguma. I wish you were here with us. I miss you so much.

Acknowledgement

First and foremost, I wish to give all honour and praise to my Creator, for bestowing on me the necessary courage, good health, and mental ability to complete the study. I thankfully acknowledge the contributions extended to me during the preparation of this study. Most importantly, I thank the Government of Rwanda, through the Ministry of Education, for providing me with a scholarship for further studies. I am grateful to my institution, the University of Rwanda's College of Medicine and Health Sciences, for all the support rendered to me and granting me study leave to pursue these studies. I am sincerely grateful to my supervisors Prof Jose Frantz and Dr Eugene Mutimura for their guidance, encouragement, immense knowledge, and commitment that helped me to make this harvest fruitful. The prompt responses to questions and timely feedback made it easier for me to conduct the study. Thank you to the Regional Alliance for Sustainable Development who provided financial support to complete my studies. I wish to thank the late Prof Vyvienne Mkumbuzi for her guidance and advice in the early days when writing my research proposal. I extend profound thanks to all staff in the physiotherapy department at the University of the Western Cape; especially to Prof Anthea Rhoda, Prof Julie Phillips, and Marla Warner, Postgraduate Administrator.

I am grateful to all those who participated in this study, especially HIV+ people for their generosity and trust to allow me conduct this study with them. I am also highly indebted to the head of health centres and HIV health care providers working in different health centres who were always willing to provide much needed information about the health centres. I wish to thank Henry Epino et al. for granting permission to use the MOS-HIV questionnaire translated into Kinyarwanda. Thank you also to Isabella Morris who assisted with the editing of this PhD thesis and Innocent Karangwa who assisted with statistical analysis. I extend my sincere thanks

to my research assistants Jules Rutayisire Ndavutse, Marie Rose Mukasangwa, Alex Uwimana, Jean de Dieu, and Bosco for their commitment and dedication to getting the tasks done. I really am grateful to my colleagues at work, especially Assuman Nuhu and Jean Baptiste Sagahutu, thanks for all the motivation, invaluable moral support, and encouragement provided, especially through the challenging times, and thank you for your support at work.

I am also grateful to Jean Marie Namahoro, Beatrice Mironko, Boniface Hakizimana, Aimable Kanyamuhanga, Adrian Ndamyabera, Eugene Nizeyimana, Lela Mukaruzima, Speciose, and Daniel Nzatumwanayo and his family for their encouragement, moral support, care, and advice. I extend grateful thanks to my colleagues at UWC and others that I have not mentioned for their support and assistance in one way or another. To all my family, relatives, colleagues, and friends for their love, support, and understanding over the past three years. Finally, a big thank you to Grace, my wife, for always being there and for her support, motivation and drive, which inspired me to finally complete the study.

Table of content

List of tables

List of figures

Appendices

Appendix A Ethical clearance from the Senate Research Grants and Study Leave

List of abbreviations and acronyms

AJOL African Journals Online

AOR Adjusted Odds Ratio

APR	Adjusted Prevalence Ratio
AUD	Alcohol Use Disorders
AUDIT	Alcohol Use Disorders Identification Test
AIDS	Acquired Immune Deficiency Syndrome
AMI	Acute Myocardial Infarction
ART	Antiretroviral Therapy
AUD	Alcohol Use Disorders
BFR	Body Fat Redistribution
BMI	Body Mass Index
BP	Blood Pressure
cART	combination Antiretroviral Therapy
CD4	Cluster of Differentiation 4
CDL	Chronic Diseases of Lifestyle
CF	cognitive functioning
CHD	Coronary Heart Diseases
CI	Confidence Interval
CMD	Cardiometabolic Disease
COPD	Chronic Obstructive Pulmonary Disease
CVA	Cerebral Vascular Accidents
CVD	Cardio-Vascular Diseases
DBP	Diastolic Blood Pressure
EF	Energy/fatigue
GH	General health perception
GPAQ	Global physical activity questionnaire
HAART	High Active Antiretroviral Therapy
HBM	Health Belief Model
HC	Health Centre

HD	Health distress
HDFQ	Heart Disease Fact Questionnaire
HDL	High-density lipoprotein
HIV	Human Immunodeficiency Virus
HPV	Human papilloma virus
HRQOL	Health-related Quality of Life
HT	Health transition
IQR	Interquartile range
JBI	Joanna Briggs Institute
LIC	Low Income Country
LMIC	Low-and Middle-Income Country
MABS	Motivators and Barriers of Healthy Lifestyle Behaviors Scale
MBHB	Motivators and Barriers of Health Behaviours
MH	Mental health
MHS	Mental Health Summary
MOH	Ministry of Health, Rwanda
MOS	Medical Outcomes Study
MOS-HIV	Medical Outcome Study HIV
HTN	Hypertension
NCDs	Non-Communicable Diseases
ODI	Overseas Development Institute
P	Pain
PEO	Population/type of participants, exposure of interest/independent variable, and outcome or response/dependent variable
PF	Physical functioning
PHCs	Public Health Centres
PHS	Physical Health Summary

PICO	Population of interest, Intervention or exposure, Comparison, and the Outcomes of interest
PLWHI	People Living With HIV Infection
PRISMA	Preferred Reporting Items for Systematic Review and Meta-Analyses
QOL	Quality Of Life
RASD	Regional Alliance for Sustainable Development
RF	Role function
SBP	Systolic Blood Pressure
SciDev.Net	Science Development Network
SF	Social function
SSA	Sub-Saharan Africa
SPSS	Statistical Package for the Social Sciences
STEPS	STEPwise approach to surveillance of NCD risk factors (WHO)
T2D	Type 2 Diabetes
UR	University of Rwanda
UR-CMHS	University of Rwanda's College of Medicine and Health Sciences
WC	Waist Circumference
WHO	World Health Organization
WHR	Waist-Hip Ratio

Chapter One

Introduction

1.1 Background

The management of the human immunodeficiency virus (HIV) infection has improved with recent advances in treatment with combination antiretroviral therapy (cART) that is more readily available to people living with HIV infection (PLWHI) (Napravnik et al., 2013). As a result, life expectancy and quality of life (QOL) for PLWHI have improved (Murray et al., 2014; Basavaraj, Navja & Rashmi, 2010). Globally, the estimated number of PLWHI was 36.7 million [30.8 million-42.9 million] and 19.5 million were accessing antiretroviral therapy (ART) in 2016 (UNAIDS, 2017). Eastern and Southern Africa remains the region affected by HIV, with 61% adults on ART (UNAIDS, 2017). More than half (59%) of the total number of PLWHI in Eastern and Southern Africa are women and girl. Rwanda has achieved high rates of ART coverage, accounting 164,262 (78%) of all PLWHI in 2016 and 93% of retention in care after 12 months on treatment due to the successes of Rwanda's national HIV programme (Nsabimana et al., 2017a). In addition, a recent study conducted in Rwanda aimed to characterise HIV incidence across Rwanda indicates that an overall incidence of HIV was 0·27 per 100 person-years (95% CI 0·18−0·35) (Nsabimana et al. 2017b). The authors acknowledge that the incidence of HIV in Rwanda was higher than that previously estimated from models, with outbreaks seeming to contribute to the ongoing epidemic. In addition, PLWHI in Rwanda are expected to have a higher expectancy if a new policy "Treat All" launched in 2016 is implemented properly, where all identified PLWHI would immediately begin ART irrespective of immunological or clinical

status (WHO, 2016). This is confirmed in the study aimed to assess the effect of increased access to ART on life expectancy among HIV-positive patients (Nsabimana et al., 2015) where life expectancy at 20 years of age in the period of 1997–2007 was 20·4 additional years (95% CI 19·5–21·3); for the period of 2008–11, life expectancy had increased to 25·6 additional years (95% CI 24·8–26·4). This highlights the benefit to PLWHI of early enrolment in care and initiation of ART. However, improved life expectancy for PLWHI is associated with various chronic diseases, which increase with chronic immune activation, antiretroviral therapy (ART) medication side effects, co-infections, and the ageing process in the HIV population.

Currently, deaths from acquired immune deficiency syndrome (AIDS)-related illness are reduced. However, chronic conditions associated with modifiable risk factors including cardiovascular diseases (CVD), diabetes, and cancers are public health concerns in PLWHI (Hirschhorn, Kaaya, Garrity, Chopyak & Fawzi 2012; Currier et al., 2008). Risk factors for non-communicable diseases (NCDs) include the behavioural and biological risk factors such as tobacco use, harmful alcohol use, unhealthy diet (with low fruit and vegetable intake and high intake of fat, sugars, and salt), physical inactivity, obesity, high blood pressure (BP), elevated blood glucose, and abnormal blood lipid levels (World Health Organisation [WHO], 2002). The behavioural lifestyle risks in PLWHI may aggravate morphologic and metabolic disturbances (Shah et al., 2005). These biological risks may lead to insulin resistance (pre-diabetes), diabetes mellitus, hypertension, dyslipidemia, and several forms of CVDs such as coronary heart diseases (CHD), cerebral vascular accidents (CVA) (stroke) or heart failure.

Numerous international studies have shown that NCDs and their risk factors were significantly more prevalent in PLWHI than HIV- (HIV+) people, in particular hypertension (Triant, Lee, Hadigan & Grinspoon, 2007; Gazzaruso et al., 2003), tobacco use (Lifson & Lando, 2012; Crothers et al., 2009) and alcohol use (Figueroa-Cosme, Lopez-Cordova, Capriles-Qoiros, 2010). In addition, there are HIV-related factors that could increase the risk for NCDs in PLWHI, apart from the traditional risk factors shared by the general population. These risk factors include immune suppression or advanced AIDS disease, the presence of co-existing viral infections, social deprivation, and longer duration exposure to ART (Haregu, Oldenburg, Sestwe, Elliott & Nanayakkara, 2012). Literature also highlights that there are a number of non-infectious diseases related to ageing and lifestyle in PLWHI that affect the respiratory, cardiac, and endocrine systems (Dawson, Rom, Dheda & Bateman, 2013) and the authors suggest that NCD interventions related to health-compromising behaviours and adopting health-enhancing behaviours should be included in the HIV care continuum. Rodriguez-Penney et al. (2013) studied the synergistic effects of age and HIV infection on medical co-morbidity burden and concluded that the prevalence and clinical impact of co-morbidities in older PLWHI underscored the importance of early detection and treatment efforts that might enhance HIV disease outcomes.

Previous studies confirm that PLWHI who are on HIV treatment and adhere to medication regimes, as prescribed by their health care providers, still have a higher than expected risk of several non-AIDS disorders, such as CVD, kidney disease, liver disease, malignancy, and some neurological diseases (Bloomfield et al., 2014; Deeks, Lewin & Havlir, 2013). It is therefore of the utmost importance to examine potentially modifiable behavioural risk factors in PLWHI, as

they are at increased risk for biological risk factors for NCDs (Malaza, Mossong, Barrnighausen & Newell, 2012; Bloomfield et al., 2011). Nigatu, Oldenburg, Elliott, Setswe, and Woldegiorgis (2013) conducted a systematic review to describe the incidence of NCDs among PLWHI, and, based on their findings, the authors suggest that policies and interventions for PLWHI should place specific emphasis on NCD risk factors' prevention. However, the same authors acknowledge that the studies included in the systematic review were from high-income countries, and thus they could not reflect the magnitude and determinants of NCDs in high HIV prevalent areas of low- and middle-income countries (LMICs). Epidemiologic studies with a variety of designs to inform healthcare policy could thus play an essential role to prevent the oncoming NCD epidemic in PLWHI of LMICs. Studies focusing on NCD incidence, NCD risk factors prevalence and their impact among PLWHI, as well as those comparing mortality rates and morbidity outcomes in PLWHI, and those without HIV are required (Narayan et al., 2014).

With health-related benefits of PLWHI on ART, the focus on health care for those living with HIV infection has shifted from survival to outcomes-related to their health-related quality of life (HRQOL) (Miners et al., 2001; Call et al., 2000). Available evidence indeed indicates that NCDs and risk factors associated with it frequently affect QOL and the health status of PLWHI (Magafu et al., 2013; Crothers et al., 2005). Among other serious health threats for NCDs, behavioural risk factors include behavioural and physiological pathways to impact on the acquisition, further transmission, and then progression of the HIV disease. For example, alcohol use undermines the immune system, increasing a person's susceptibility to contracting and then countering HIV and other infections, as well as adherence to the medication (Schneide, Chersich, Temmerma, Degomme & Parry, 2014). Research has also highlighted that PLWHI who smoke

are more likely than non-smokers with HIV to contract serious illnesses, including chronic obstructive pulmonary disease (COPD), heart disease, and stroke, as well as lung cancer, head and neck cancer, cervical cancer, and anal cancer (Shirley, Kaner & Glesby, 2013). Other available studies conducted in this area have generally focused on a single risk factor for NCDs and HRQOL, and have been carried out in developed countries (Korthuis et al., 2008; Turner et al., 2001). In general, the scarcity of data on the true impact of NCDs and their risk factors on long-term mortality and morbidity among PLWHI in LMICs was acknowledged in literature (Dawson et al., 2013). Studies on inter-relationships of biological and lifestyle or behavioural factors on HRQOL among PLWHI, and interventions to improve their HRQOL are important scientific contributions to inform public policy and practice to enhance the continuum of care for PLWHI.

Bearing in mind that currently there is no cure for HIV infection, and the high risk of NCDs due to biological determinants as well as health risk behaviours among PLWHI, well-designed studies are warranted in the area of HIV and NCDs comorbidities. Understanding emergent NCDs and lifestyle-related diseases in PLWHI is necessary but not sufficient to reduce the burden of NCDs in PLWHI. Contrary, the greatest impact can be achieved by creating healthy public policies that promote healthy lifestyles or discourage NCDs risk factors and control, and reorienting health systems to address the needs of PLWHI. Many of the NCDs have been demonstrated to be preventable by addressing modifiable risk factors (Mayige, Kagaruki, Ramaiya & Swai, 2011), albeit no focused strategy is available to address NCDs and their risk factors in PLWHI (Sogarwal & Mehra, 2015). Additionally, preventive strategies, including lifestyle interventions, are not sufficiently integrated into primary care settings and in the HIV

care continuum. Thus, the present study will complement the scarce knowledge by offering the opportunity to inform a theory-based focused strategy that has the potential to be effective in addressing behavioural and biological risk factors for NCDs among PLWHI.

1.2 Research Dissemination and Uptake in the Health Sector

Summarising good quality research evidence on strategies to address NCDs' risk factors in PLWHI is the first step to reduce NCDs risk factors in this population, but its impact alone is not enough to make a significant outcome on mitigating the mortality and morbidity due to NCDs and their risk factors in PLWHI. The next step is to translate research evidence into practice and policy to ensure that good quality research evidence is really used. 'Dissemination' is defined as a planned process that involves consideration of target audiences and the settings in which research findings are to be received and, where appropriate, communicating and interacting with wider policy and health service audiences in ways that will facilitate research uptake in decision-making processes and practice (Wilson, Petticrew, Calnan & Nazareth, 2010). There are a number of different tools to disseminate research findings. Disseminating tools among others include research reports, peer review papers, press releases, and policy briefs. Each tool of research dissemination has its own advantages and disadvantages. According to Waddell (2001), researchers and various kinds of decision-makers each operate in different social and organisational settings that rely on different kinds of evidence, preferably received through different kinds of communications formats. The following section focuses on policy briefs.

The policy brief is a short document of a particular issue, the policy options to deal with it, and recommendations of research projects to a non-specialist readership (Jones & Walsh, 2008). It is a concise standalone document that prioritises a specific policy issue and presents the evidence in non-technical and jargon-free language. A policy brief is intended to facilitate or refine evidence with the intention of influencing the thinking and actions of policy actors as they take decisions in complex policy processes (Eisele, 2006). For many years, a policy brief has often been recommended as the main research communication tool for both scholarly and advocacy-based organisations seeking to influence policymakers (Masset, Gaarder, Beynon & Chapoy, 2013; Beynon et al., 2012; Young & Quinn, 2007). Additionally, in a study conducted by The Overseas Development Institute (ODI) and the Science and Development Network (SciDev.Net), 79% of policymakers and researchers from developing and developed countries do think that policy briefs are valuable communications tools (Walsh & Jones, 2007), thus justifying the popularity and demand for a policy brief. Furthermore, in their background note, Jones and Walsh (2008) concluded that a policy brief, if carefully designed, can be a powerful tool for communicating research findings to development policy audiences.

The value of a policy brief needs to be viewed not only in terms of presenting quality evidence, but also in translating new knowledge into context-relevant messages and guidance for policy-makers. Improved research communication is therefore critical, not only between researcher and policy-maker communities, but also among the broader public (Jones & Walsh, 2008). It is critical to foster close collaboration between researchers and policy-makers from the outset, rather than disseminating research results at the end of a project, to reach consensus on the key questions to be addressed and to promote understanding of research methodologies as well as

ownership of findings. A policy brief, as a short, jargon-free summary of research findings, has become an increasingly popular tool for researchers trying to achieve policy influence (Eisele, 2006) and it could be more relevant to policy-makers due to time constraints. However, evidence from well-designed studies is one of the key ingredients of effective policy briefs. Thus a policy brief for this study is important to inform policy-makers about evidence-based strategies for the prevention and control of NCD risk factors in PLWHI.

1.3 Theoretical Framework for the Study

Painter, Borba, Hynes, Mays, and Glanz (2008) conducted a systematic review to describe the use of theory in health behaviour research, and they suggested that behavioural researchers should apply theories that reach beyond the level of individuals to impact health behaviours problems in organisations and communities. To assist in the full understanding of the burden of NCDs, their risk factors, and determinants in PLWHI, the PRECEDE-PROCEED model is suggested as a comprehensive model in planning for health education and health promotion strategies. This study was guided by the revised version of the PRECEDE-PROCEED Model, developed by Green and Kreuter (2005). The model has two components, namely PRECEDE (for Predisposing, Reinforcing, and Enabling Constructs in Educational/Ecological Diagnosis and Evaluation) and PROCEED (for Policy, Regulatory, and Organisation Constructs in Education and Environmental Development). It serves to guide health promotion and health education research or policy-related interventions. This model can be used as one component only or in a combination. The PRECEDE model component related to the assessment and diagnosis stages is proposed to guide this study focusing on determinants of NCDs in PLWHI, in order to generate information that will be used to guide subsequent decisions about behavioural

changes towards better lifestyles for PLWHI. It consists of four planning phases, including social, epidemiological, behavioural, environmental, educational, ecological, administrative, and policy assessment. It merges the epidemiological, behavioural and environmental assessment phases into one phase to offer a more efficient planning model. It provides an opportunity to skip phases when appropriate evidence already exists for those phases (Green & Kreuter, 2005). This thesis concentrates on the first three phases of the PRECEDE model (Figure 1.1):

Phase 1: Social assessment and situation analysis: Exploring health-related QOL determinants

Phase 2: Epidemiology and behavioural assessment: Analysis of risk factors associated with health problems

Phase 3: Educational and ecological assessment: Analysis of determinants of risk behaviours (predisposing factors such as knowledge, attitude, belief, exiting skills, and self-efficacy; reinforcing factors such as social support and peer influence; and enabling factors such as the availability, accessibility, and affordability of health care and community resources, laws, and policies).

The model also supports the use of various information sources to address the problem (Bartholomew, Parcel, Kok, Gottlieb & Fernández, 2011). It can incorporate existing theories including as health belief model, self-efficacy and Social Cognitive theory (Green & Kreuter, 2005) and constructs into a comprehensive systematic overview to describe factors influencing health outcomes, and it provides a comprehensive structure for health needs assessments, thus justifying the need for the PRECEDE model to assess health-related behaviours and environments that affect health and QOL needs, since it provides a comprehensive map for

applying theories in evidence-based practice to plan the most suitable strategies to answer health problems and improve QOL. The PRECEDE model has been used in different populations including PLWHI (Millard et al., 2014; Aldiabat & Le Navenec, 2013; Hislop et al., 2003). Briefly, PLWHI are at greater risk for higher prevalence and severity of pulmonary tuberculosis, CVD, and AIDS-related cancers. Policy development and preventive strategies are needed to package and monitor lifestyle risk factors for the prevention of NCDs in PLWHI. Modalities for sustainable behavioural change towards better lifestyles for PLWHI need be aligned with evidence-based research, guided by the PRECEDE model to enhance the health of PLWHI for a better QOL. The model suggests that predisposing factors, reinforcing factors, and enabling factors have an effect on behaviour and the environment; thus through behaviour and environment, predisposing, reinforcing, and enabling factors have an impact on QOL (Green & Kreuter, 2005). Thus, health risk behaviours can be eliminated by self-regulatory effort, and by adopting healthy lifestyle behaviours; however, changing behaviour may be possible when the environment is supportive of that change due to the availability of policy initiatives.

The PRECEDE model's fourth phase, namely administrative and policy assessment and intervention alignment is beyond the scope of this thesis. However, the information obtained from phases 1-3 will be used to design a policy brief that can influence policy-makers.

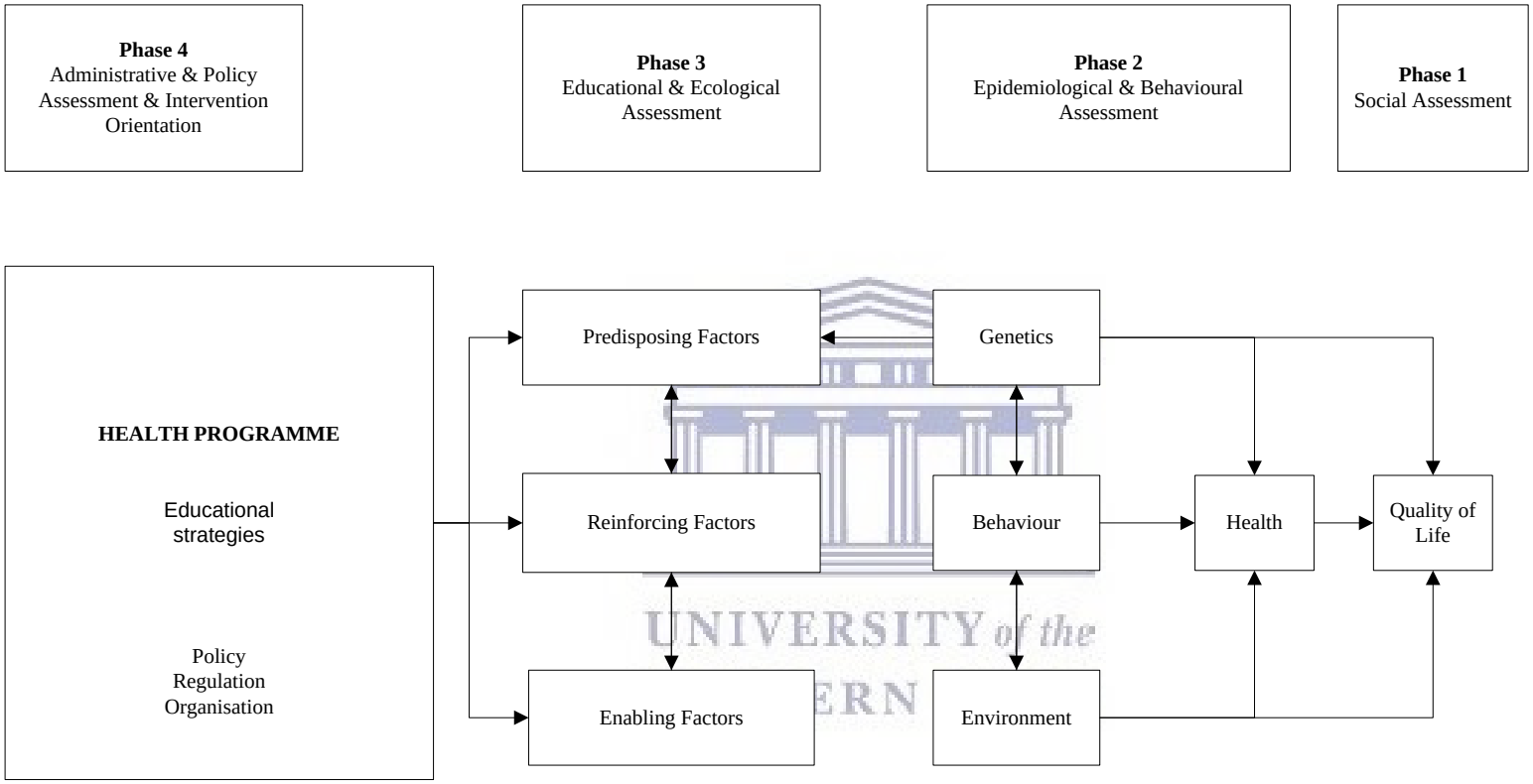


Figure 1.1: PRECEDE model phases (Green & Kreuter, 2005)

1.4 Statement of the Problem

Like other Sub-Saharan Africa (SSA) countries, Rwanda bears an increasing burden of NCDs, and a high proportion of NCDs are associated with lifestyle risk behaviours that contribute to higher incidents of cancers, CVDs, and type 2 diabetes (T2D). People living with HIV-infection are at increased risk for NCDs, due to the HIV disease and reduced immunity, the use of some antiretroviral therapies, as well as contextual and sociodemographic factors. Assessing the epidemiological situation by identifying the distribution of risk factors among different population groups in a country is the first of the three WHO's recommended planning steps for prevention and control of NCDs and their risk factors (Msyamboza, Ngwira, Dzowela, Mvula, Kathyola, Harries & Bowie, 2011). Identification of risk factors and their quantification, as well as the knowledge of NCDs' risk factors of the population is of great importance in order to calculate the avoidable burden of disease, and in framing cost-effective strategies for prevention (Demaio, Dugee, Amgalan, Maximenco, Munkhtaivan, Graeser, Kryger, Oyunbileg, Jousilahti, De Courten & Enkhtuya, 2011; Strong, Mathers, Epping-Jordan & Beaglehole, 2006). Additionally, Haregu (2012), in his systematic review, points out that prevention and control strategies of common NCDs should also be integrated to HIV prevention, care, and treatment programmes to address the eminent needs of PLHIV. The same author emphasises these integrated approaches to service delivery require integrated policies and systems. NCD policy in Rwanda provides strategies for NCD prevention in the general population. However, there are other HIV-related determinants. Thus, specific NCDs and their risk factor prevention strategies in HIV+ are warranted. Thus, a policy brief can provide potential solutions based on the new evidence generated during this study.

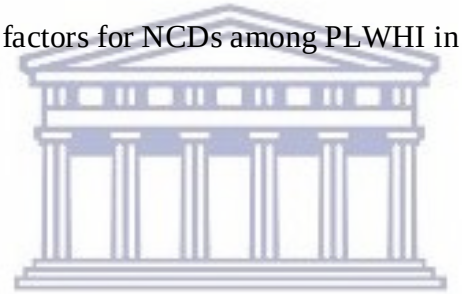
1.5 Research questions

1. What are the sociodemographic and HIV-related predictors of behavioural and biological risk factors for NCDs among PLWHI in Rwanda?

2. What are the relationships between behavioural and biological risk factors for NCDs and physical and mental HRQOL?

3. What are the personal and environmental factors that influence behavioural and biological risk factors for NCDs in PLWHI?

4. What should be the components of a health policy brief that provides scientific evidence for behavioural and biological risk factors for NCDs among PLWHI in Rwanda?



1.6 Aim

To provide evidence to inform the development of a health policy brief on strategies addressing behavioural and biological risk factors for NCDs among PLWHI in Rwanda

1.7 Objectives

1. to describe the associations and distribution patterns for behavioural and biological risk factors for NCDs among PLWHI in Rwanda

i.) by assessing the prevalence of behavioural and biological risk factors for NCDs among PLWHI;

ii.) by estimating the association of behavioural risk factors with sociodemographic and HIV-specific factors: biological risk factors and behavioural risk factors among PLWHI; and

iii.) by identifying factors that predict behavioural and biological risk factors among PLWHI;

2. to identify physical and mental health-related dimensions of QOL among PLWHI and determine their association to behavioural and biological risk factors for NCDs;

3. to assess knowledge of chronic diseases of lifestyle risk factors and their associated factors among adults living with HIV infection;

4. to identify motivators and barriers to physical activity participation and healthy diets and their influence on behavioural and biological risk factors for NCDs; and

5. to develop a health policy brief on strategies addressing behavioural and biological risk factors for NCDs among PLWHI.

1.8 Significance of the Study

In accordance with the Global Action Plan for the Prevention and Control of NCDs 2013-2020, the creation of health-promoting environments can reduce modifiable risk factors for NCDs (WHO, 2014). While Maher, Harries, Zachariah, and Enarson (2009) propose a programmatic standardised approach to the delivery of primary care intervention for patients with NCDs, the goal of their framework is to reduce the burden of morbidity, disability, and premature mortality

related to NCDs through a primary care strategy based on identifying and addressing modifiable risk factors, screening for common NCDs, and diagnosing, treating, and following up on patients with common NCDs, using standard protocols. However, the researcher's concern is to inform national policies and guide treatment programmes about the determinants and negative effects of behavioural and biological risk factors for NCDs on the QOL of PLWHI. Their understanding of these factors is crucial in order to effectively curtail NCDs in PLWHI who are at risk for NCDs. Existing evidence indicates that the integration of research evidence into healthcare decision-making is a multifaceted and challenging process that is influenced by numerous factors, including policy-makers' experience, available resources, the policy context, etc. (Harvey & Kitson, 2015; Davies, 2005). This implies the need for a communication approach that takes various competing factors into account. This study intended to provide evidence that informs the development of a health policy brief on strategies that address behavioural and biological risk factors for NCDs among PLWHI in Rwanda. The purpose of this health policy brief is to provide a proposal for Rwanda's leaders to build support, organise resources, and achieve effective policy implementation to address behavioural and biological risk factors for NCDs among PLWHI. This research can also influence teaching and education in physiotherapy education, as it will provide us with the evidence to teach the strategies that could be used to impact the lives of those PLWHI.

1.9 Operational Definitions

A policy brief is short document that presents the findings and recommendations of a research project to a non-specialist readership (Jones & Walsh, 2008). It can be used to provide background evidence to inform a policy dialogue among stakeholders, and can in turn, result in the articulation of preferred policy option(s) (Lavis, Permanand, Oxman, Lewin & Fretheim, 2009).

Risk factors for NCDs refer to an attribute, characteristic, or exposure of an individual, which increases their likelihood of developing an NCD (Bonita, de Courten, Dawyer, Jamroziki & Winkelmann, 2001).

Quality of life is defined as "individuals' perception of their position in the context of the culture and value system in which they live and in relation to their goals, expectations, standards and concerns" (WHOQOL Group, 1995).

HRQOL is considered as part of the individual's QOL that is primarily determined by his or her health status, it's the functional effects of an illness and its consequent therapy upon a patient/client and as perceived by the patient/client (Mbada, Onayemi, Ogunmoyole, Johnson & Akosile, 2013).

PLWHI is understood as a general term referring to all people infected with HIV, whether or not they show symptoms of the infection**.**

Knowledge refers to the state or condition of understanding the fact or subject, and being able to apply it.

1.10 Outline of Thesis Chapters

This study will present each objective as a chapter by introducing the chapter, results, and discussions to highlight the path to the next phase. A detailed methodology focusing on each objective will be described in Chapter Four.

Chapter One provides the background and rationale for the study. The aims and objectives of the study are stated. The overall aim of the study is to provide evidence to inform the development of a health policy brief on strategies addressing behavioural and biological risk factors for NCDs among PLWHI in Rwanda. A description and importance of a policy brief is provided. The theoretical framework used for the study is also described.

Chapter Two presents a review of relevant literature pertinent to this study. It focuses on the impact of NCDs and their risk factors on morbidity, mortality, and quality outcomes of PLWHI. Profile and predictors of behavioural and biological risk factors for NCDs among PLWHI are also presented.

Chapter Three presents a systematic review of studies that assess the associations between HIV serostatus and behavioural lifestyle risk factors for NCDs.

Chapter Four considers the methodology applied in this study, including research methods and the logic behind the used method. It explains the research setting and the whole procedure of how the data was collected and analysed. Finally, ethical considerations applied in this study are explained.

Chapter Five describes HRQOL and associated factors among PLWHI in Rwanda. The HRQOL was measured by the MOS-HIV Health Survey.

Chapter Six presents a description of the behavioural and biological risk factors for NCDs among PLWHI in Rwanda. To identify these factors, the WHO-STEPS were administered to assess the prevalence and predictors of these factors.

Chapter Seven responded to the third objective, which is pertinent to the knowledge of chronic diseases in terms of lifestyle risk factors and their associated factors among adults living with HIV infection in Rwanda.

Chapter Eight identifies motivators and barriers to engaging in physical activity and healthy diets among PLWHI in Rwanda. Thereafter, key findings from this study to guide interventions to prevent a future epidemic of NCDs in PLWHI are summarised.

Chapter Nine presents the development of the health policy brief.

Chapter Two

Literature Review

2.1 Introduction

A growing body of evidence suggests that there is an increased rate of NCDs and the risk factors associated with them in PLWHI. This narrative literature review provides the relevant literature pertaining to the impact of NCDs and their risk factors on morbidity, mortality, and quality outcomes of PLWHI. Profile and predictors of behavioural and biological risk factors for NCDs among PLWHI are also reviewed in this chapter. The literature review was gathered by searching data bases such as PUBMED, HINARI, Science Direct, Medline, Scopus, Ebsco web. In addition, Google and Google scholar were used to find the relevant full text studies, and a manual search was carried out for potential titles in the bibliographies of relevant reviews. Key words or text words used individually and in combination included as search terms were: 'HIV or human immunodeficiency virus' or 'AIDS or 'acquired immunodeficiency syndrome' and 'behavioural lifestyle' or 'behavioural risk' or 'modifiable risk' or 'tobacco or alcohol intake', or 'fruit intake' or 'vegetable intake' or 'physical activity' or 'exercise' or 'sedentary lifestyle' or 'knowledge' and 'non-communicable diseases' or 'NCDs' and 'epidemiology' or 'prevalence' or 'distribution' or 'odds ratio' or 'prevalence studies' or 'cross-sectional studies' or 'survey', HIV or human immunodeficiency virus' or 'AIDS or 'acquired immunodeficiency syndrome' and 'HRQOL' or 'health-related quality of life' or 'QOL' or 'quality of life' or 'physical health' or 'mental health',' barriers' or 'motivators' and 'physical activity' or ' healthy diet' or ' healthy lifestyle', policy brief, Rwanda.

2.2 The Impact of Non-communicable Diseases and the Risk Factors Associated with it on Morbidity, Mortality and Quality of Life Outcomes of People Living with HIV Infections

NCDs include CVD, cancers, chronic respiratory diseases, and diabetes (WHO, 2005), and are recognised as chronic diseases of lifestyle associated with the increased rate of urbanisation, adaptation to a sedentary lifestyle, and poor nutritional habits associated with economic development (Dalal et al., 2011). These changes are influenced by the sociodemographic transition that has rapidly occurred in LMIC, the rate of which has been anticipated to be 73% of the NCD deaths in 2020 (Boutayeb & Boutayeb, 2005; WHO, 2005). The global increase of NCDs in LMICs represents a major challenge to health services and to social and economic development (Islam et al., 2014). Social determinants of health occur in developing countries, determinants such as low-income levels, poor knowledge and literacy, poor health resources and infrastructure, and unsanitary environments, which increase the risk for NCDs (WHO, 2005). In countries with limited healthcare infrastructure, NCDs exert a significant morbidity and mortality burden, and many patients access care at late stages of the diseases or do not have access to health care facility (Mayige et al., 2012).

There is an extensive body of literature showing that NCDs are becoming increasingly prevalent in PLWHI. A systematic review conducted a decade ago, to summarise evidence on the incidence and prevalence of diabetes comorbidity among PLWHI, has reported prevalence rates ranging from 2.85% to 14.9%, and incidence rates ranging from 5.72 to 23.8 per 1000 person-

years (NigatuHaregu, Oldenburg, Setswe & Elliott, 2012). However, the authors acknowledge a high level of variability in the reported incidence and prevalence rates of T2D comorbidity. Additionally, there is increased risk of NCDs in PLWHI in comparison to those who are not infected with HIV. Brown et al. (2005) found that the rate of incidents of T2D was 4.7 cases per 100 person-years among PLWHI men using high active antiretroviral therapy (HAART), compared to 1.4 cases per 100 person-years among those not infected with HIV (rate ratio=4.1; 95% confidence interval, 1.85-9.16, adjusted for age and body mass index (BMI). Another study suggested that the increase in prevalence of T2D in PLWHI as opposed to those subjects who are not infected with HIV almost doubled and was up to fourfold higher among obese subjects or those aged > 50 years (Galli et al., 2010). Triant et al. (2009) conducted a study to determine acute myocardial infarction (AMI) rates and cardiovascular risk factors in HIV+ compared to HIV- patients in two tertiary care hospitals, their findings suggest that AMR rates and CVD risk factors were increased in HIV+ patients in comparison to HIV- patients, especially among HIV+ women. Evidence from these studies highlights the need for specific strategies to prevent and control NCDs in the long-term care of PLWHI. Moreover, Hemkens, and Bucher (2013) describe important recent developments regarding the epidemiology of CVD in HIV infection, ART-related metabolic changes, and cardio-protective anti-inflammatory mechanisms, and summarise management strategies for CVD risk reduction; they have confirmed that PLWHI are at increased risk for CVD due to ART, which may induce dyslipidemia, reduce insulin sensitivity, and promote body fat redistribution that additionally contribute to risk of CVD. They conclude that timely initiation of ART with consequent viral suppression is likely to reduce CVD events and to offset potential side effects from ART-induced metabolic changes. The rapid emergence of NCDs as the major disease of public health in high HIV-prevalent areas (Nigatu, 2012), and

LMIC are expected to share a high magnitude of HIV infection and the burden of NCD comorbidity due to associated increases in the incidence of NCDs (IDF, 2009). Based on shared similarities between HIV and NCDs as chronic diseases, integrating prevention and management of NCDs and their risk factors into HIV clinical care and treatment services is a priority for policy and practice. Available evidence from Kenya confirms the feasibility to integrate NCD care for PLWHI along with HIV- patients (Edwards et al., 2015).

It is evident that behavioural risk factors, especially tobacco use and harmful use of alcohol, have a considerable impact on the morbidity, mortality, and QOL of PLWHI in high-income countries. In a large prospective observational cohort of 867 HIV+ male veterans, and smokers on cART were twice more likely to die than non-smokers, and more likely to suffer from increased respiratory symptoms, chronic obstructive pulmonary disease (COPD), and bacterial pneumonia (Crothers et al., 2005). In addition, HIV+ women who smoke, are twice as likely to acquire bacterial pneumonia and three times more likely to acquire human papilloma virus (HPV), which can lead to cervical cancer, an AIDS-defining condition (Feldman et al., 2006). Turner et al. (2001) describe the impact of cigarette smoking on HROL, and the results indicate that current smoking was independently associated with lower scores for general health perception, physical functioning, bodily pain, energy, role functioning, and cognitive functioning (all with *p* , 0.05). Evidence from a systematic review study indicates that adverse effects related to smoking in PLWHI include a heightened risk for lower respiratory tract infections, COPD, lung cancer, and other malignancies, in addition to the burden of CVD, decreased QOL, and adversely affecting the immunologic response to ART (Rahmanian et al., 2011). There is a need

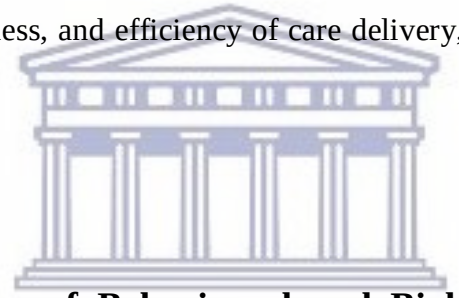
to ascertain effective smoking cessation strategies in this population. Kariuki et al.'s (2016) systematic review findings suggest that combined behavioural and pharmacotherapy treatments appear to be beneficial to HIV+ smokers, and they highlight the need for additional rigorous research that will advance the field and impact long-term smoking outcomes, as well as address other risk factors that contribute to smoking behaviour. Another study that sought to examine the association of alcohol use disorders (AUD) with adherence to and HRQOL outcomes of ART for HIV/AIDS patients (Tran, Nguyen, Do, Le Nguyen & Maher, 2014) showed that AUD is prevalent, and negatively affects adherence to and HRQOL outcomes of ART services in injection-driven HIV epidemics. Screening and intervention are recommended for AUD, especially during the stable periods of ART. Other social and psychological interventions might also enhance patients' responses to and outcomes of ART in Vietnam. Thus, it is evident that while risk factors remain a problem for NCDs, the problem is compounded in PLWHI. Currently, several studies have been conducted on the prevalence of various NCDs risk factors among PLWHI (Kagaruki et al., 2014; Edward, Oladayo, Omolola, Adetiloye & Adedayo, 2013; Muronya, Sanga, Talama, Kumwenda & van Oosterhout, 2011). These studies have consistently revealed the high prevalence of different NCDs risk factors in both HIV+ subjects who are naïve and who are on ART. However, there are inadequate studies to measure the impact of NCDs' risk factors among PLWHI in Rwanda and other SSA countries.

HRQOL is a valuable term used to narrow the scope of QOL. This term focuses on the effects of health, illness, and treatment on QOL. According to Kaplan and Ries (2007), HRQOL measurements provide valuable feedback about therapeutic interventions, and they are essential

in the analyses of cost-effectiveness. In this regard, measuring HRQOL in PLWHI may prove helpful in understanding the burden of HIV infection itself and the adverse effects of antiretroviral drugs in this population. Available evidence indicates that HIV+ subjects report lower QOL compared to HIV- subjects. Pedersen et al. (2015) investigated QOL and associated factors in a group of HIV+ patients with suppressed viral replication and with low comorbidity, compared to healthy controls; the results indicated that HIV+ patients reported lower QOL compared to the controls. Female gender and the depression score were associated with lower MHS, while years of education, depression score, and BMI were associated with lower PHS in HIV+ patients. Authors concluded that even PLWHI with good adherence to ART and with a low level of comorbidity reported a lower QOL compared to their counterparts. These findings are related to an earlier study that used a different questionnaire (Agrawal, Mourya, Shrestha & Agrawal, 2014).

Additionally, another study highlighted that physical functioning and emotional well-being were significantly worse in PLWHI in comparison to people who suffer from other chronic diseases, except depression (Hays et al., 2000). Following this, a growing body of scientific evidence indicates that HRQOL among PLWHI has been associated with different factors in LMIC. A study conducted in Western Uganda to examine predictors of QOL among patients who had received ART for a period of at least six months, showed that CD4 cell counts ≥ 200 and high scores on informational social support were associated with higher PHS, while past or recent alcohol consumption was associated with lower scores on MHS (Bajunirwe et al., 2009). This is also complemented by Stangl, Wamai, Mermin, Awor, and Bunnell (2007) who, over a 12-

month period, examined trends and factors associated with QOL among a prospective cohort of 947 HIV+ adults initiating ART; the results revealed that at enrolment, the physical and mental health summary scores were 39.2 and 40 respectively. Factors associated with QOL at ART initiation include various sociodemographic, psychosocial, and clinical factors. However, financial dependence on others remained a predictor of QOL after controlling time to initiation of ART. Hence, the identification of various predictors for HRQOL, including sociodemographic, clinical, and psychosocial factors, might help maximise HRQOL of PLWHI. Thus, in this regard, further research may help to understand the impact of NCDs, and risk factors associated with it, on HRQOL of PLWHI in LIMC. This evidence is important in order to facilitate the quality, effectiveness, and efficiency of care delivery, and to enhance the health of PLWHI for a better QOL.



2.3 Profile and Predictors of Behavioural and Biological Risk Factors for Non-communicable Diseases among People Living With HIV Infections

Most NCDs share modifiable and preventable risk factors, e.g. tobacco use, unhealthy diet, physical inactivity, the harmful use of alcohol, obesity, high cholesterol, high BP, and elevated blood glucose. The next paragraph focuses on the prevalence and associated factors of behavioural and biological risk factors for NCDs in PLWHI on ART and the ART-naïve.

With the availability and accessibility of ART medication, PLWHI are no longer susceptible to wasting, to the contrary they are increasingly overweight or obese. Semu et al.'s (2016) study

aimed to describe the prevalence and risk factors for obesity among PLWHI adults in Dar es Salaam, Tanzania, and they report that out of a total of 53 825 people, 16% of women and 8% of men were overweight, while 7% and 2% were obese, respectively. In multivariate analyses, older age, a high CD4 count, high haemoglobin levels, female gender, and being married were all characteristics associated with obesity and being overweight. Crum-Cianflone et al. (2010) assessed weight trends during the HIV epidemic, and they examined factors associated with weight changes among individual patients during HIV infection. Of 1 682 patients, 2% were underweight, 37% were overweight, and 9% were obese at the time of being diagnosed with HIV. Multivariate predictors of a higher BMI at diagnosis included the more recent year of HIV diagnosis, older age, African American race, and earlier HIV stage (all p,0.05). The majority of patients (62%) gained weight during HIV infection. Multivariate factors associated with a greater increase in BMI during HIV infection included the more recent year of diagnosis, lower BMI at diagnosis, a higher CD4 count, a lower HIV RNA level, the lack of AIDS diagnosis, and longer HIV duration (all p,0.05). Nucleoside agents were associated with less weight gain, while other drug classes had no significant impact on weight change in the HAART era. Evidence from reviewed studies confirms a gradual increase in being overweight or obesity in PLWHI. This suggests that weight monitoring and management programmes should be an integral part of HIV care.

Goar, Audu, Agbir, and Dochalson (2011) estimated the prevalence of alcohol use disorders in HIV+ patients and to assess the sociodemographic factors associated with it; they found that the estimated prevalence of alcohol-related problems was 39.4% with 28.8% harmful drinking and

10.6% hazardous drinking (alcohol abuse); 33.1% had started drinking before they were diagnosed with HIV and 6.3% after diagnosis. Male sex ($p< 0.001$), poor education ($p< 0.001$) and low income ($p=0.002$) were significantly associated with alcohol use disorders. The study revealed that alcohol use disorders are high among HIV+ patients who are males with low socio-economic status. In addition, Kelso, Sheps, and Cook (2015) summarised the current literature and the strength of evidence regarding alcohol consumption as a risk factor for CVD among PLWHI; their results showed that the prevalence of a CVD diagnosis or event ranged from 5.7-24.0%. The weighted pooled crude effect sizes were 1.75 (95% CI 1.06, 3.17) for general and 1.78 (95% CI 1.09, 2.93) for heavy alcohol use on CVD. The pooled adjusted effect size was 1.37 (95% CI 1.02, 1.84) for heavy alcohol use on CVD. Pooled estimates differed by CVD outcome and alcohol measure; alcohol consumption was most significant for cerebral/ischemic events. Researchers recommended that HIV clinicians should consider risk factors that are not included in the traditional risk factor framework, particularly heavy alcohol consumption. Neglect of this risk factor may lead to an underestimation of risk, and thus under-treatment among PLWHI. Thus, screening and treating alcohol problems in PLWHI are highly recommended.

Tobacco use is highly prevalent in PLWHI in LMIC and high income countries (HIC). Different studies assessed the prevalence of tobacco use and its associated factors. Iliyasu et al. (2012) found that approximately one quarter of respondents were either current (7.8%) or ex-smokers (17.9%). Smoking rates among HIV+ women were extremely low. HIV+ men were at least three times as likely to smoke as their female counterparts living with HIV: adjusted odds ratio (AOR)

3.16, 95% CI (95% CI) 2.17–7.32. In addition, patients with tertiary education were at least twice as likely to smoke compared with their counterparts without formal education (AOR 2.63, 95% CI 1.08–6.67). Another study showed that the prevalence of current smoking was 28.9%. For both sexes, smoking was independently associated with heavy alcohol drinking and marijuana use. Among women, smoking was associated with living alone, not being married and illiteracy; and among men, being 40 years or older, low income and using crack. Compared with ex-smokers, current smokers were younger and more likely to be unmarried, heavy drinkers and marijuana users (Batista et al., 2013). This is also complemented by Zyambo et al., (2015) who suggested that Smoking was common among PLWHI, with several psychosocial factors associated with current and former smoking. All studies reviewed have overwhelming agreement to incorporate smoking cessation interventions in HIV clinic settings.

Various studies conducted exclusively in PLWHI on ART demonstrated variations in the prevalence of NCDs risk factors**.** Muronya et al., (2011) did a study to obtain initial data on multiple NCDs and CVD risk factors in adult Malawian ART patients in an urban setting; their results indicated that 67.6% took insufficient fruit and vegetable intake, 45.9% had raised BP, 45.4% had increased waist-hip ratio, 31.0% had raised total cholesterol levels, and 27.0% had low physical activity. In addition, prevalence rates of tobacco use, alcohol use and elevated glucose levels were less than 3%. In multivariate analyses, higher age was associated with low physical activity, raised BP, being overweight, and increased waist-hip ratio. Conversely, a recent study conducted in a large sample of PLWHI on ART in Vietnam showed the prevalence relatively high of 36.1% of current smokers. Males were more likely to currently smoke than

females (OR = 23.4, 95% CI = 11.6-47.3) (Nguyen et al., 2015). Whereas the study conducted in Rwanda aimed to determine the anthropometric profile and physical activity levels among PLWHI on ART, the findings showed that 70% were physically inactive and 40% were considered overweight or obese (Frantz & Murenzi, 2015). Thus, variability in the prevalence of physical inactivity among PLWHI on ART highlights the need for further research in this area.

The predominance of some NCDs risk factors was also acknowledged by Hejazi, Huang, Lin and Choong (2014), they found that the prevalence of hypertension was 45.60% among PLWHI on ART at a Malaysian public hospital of which 86.5% of the hypertensive group were male (n=134). Their results showed that increase in age (OR 1.051, 95% CI, 1.024-1.078), higher BMI (OR 1.18, 95% CI 1.106-2.71), bigger waist circumference (OR 1.18, 95%CI 1.106-2.71), higher waist-hip ratio (OR 1.070, 95%CI 1.034-1.106), higher fasting plasma glucose (OR 1.332, 95% CI 0.845-2.100) and percentage energy intake from protein >15 (OR 2.519, 95%CI 1.391-4.561) were significant risk factors for hypertension ($p<0.001$). After adjusting for other variables, increasing age (AOR 1.069, 95% CI 1.016-1.124, p=0.010), being male (AOR 3.026, 95% CI 1.175-7.794, p=0.022) and higher BMI (AOR 1.26, 95% CI 1.032-1.551, p=0.024) were independently associated with hypertension. The common conclusion drawn from these studies is that none of HIV-related factors such as ART type, longer duration of ART, or immunologic factors associated with tobacco use or hypertension. Contrary longer duration of ART was a protection for being overweight.

On the other hand, women living with HIV infection on ART are more likely to be overweight or obese. Malaza et al.'s (2012) study conducted in South Africa confirmed that women had a

significantly higher median BMI than men (26.4 vs. 21.2kg/m2, p, 0.001). The prevalence of obesity (BMI≥30kg/m2) in women (31.3%, 95% CI, 30.2-32.4) was 6.5 times higher than in men (4.9%, 95% CI 4.1-5.7). Whereas Edwards et al. (2013) found that being overweight, generalised obesity, abdominal obesity, and increased WHR were present in 69 (26%), 18 (6.8%), 48 (13.1%), and 108 (40.8%) Nigerian PLWHI, respectively, and these variables were significantly higher in women than men. Diverse NCDs risk factors in PLWHI diverge significantly between women and men. Thus, gender-specific intervention programmes are required in the prevention of NCDs among PLWHI.

Regarding the association of HIV and ART with different NCDs' risk factors, the results are controversial. The magnitude of NCD risk factors is significantly higher among PLWHI on ART compared to those who are not on ART (Kaguruki et al. 2014). In Soboka, Tesfaye, Feyissa, and Hanlon (2014) and Medina-Torne, Ganesan, Barahona, and Crum-Cianflone (2011) studies there were no statistical significances between PLWHI on ART and PLWHI ART-naïve people regarding hypertension and harmful alcohol. The study by Wandera et al., (2015) shows that alcohol misuse was more likely among PLWHI who were ART-naïve; the adjusted prevalence ratio [APR] was 1.65, p=0.043 for males, and 1.79, p=0.019 for females), and those with self-reported poor adherence (APR for males=1.56, p=0.052, and for females=1.93, p=0.0189). The authors concluded that the high prevalence in PLWHI was associated with self-reported medication non-adherence, non-disclosure of HIV+ status to sexual partner(s), and risky sexual behaviours among male subjects. Another study detected that low high-density lipoprotein (HDL) and alcohol consumption were significantly higher in HIV+ people, while abdominal obesity was significantly higher in HIV- people (Mashinya, Alberts, Colebunders & Van

Geertruyden, 2014). A high prevalence of hypertension was also observed in PLWHI compared to HIV- people (Gazzaruso et al., 2003; Peck et al., 2014). Finally, Ogunmola et al. (2014) did not find differences in the prevalence rates of hypertension and obesity among PLWHI and HIV-people. Further studies to determine whether NCD risk factors differ according to HIV serostatus will help to adapt an evidence-based intervention targeting PLWHI.

2.4 Determinants of NCD Risk Factors among PLWHI

Determinants of NCD risk factors are classified under predisposing, enabling, and reinforcing, based on the PRECEDE model (Green & Kreuter, 2005). Predisposing factors known as antecedents to behaviours include knowledge, perceived susceptibility and severity, perceived benefits, barriers, existing skills, and self-efficacy. Enabling factors are considered as antecedents to behavioural or environmental change and include availability, accessibility, low cost of unhealthy consumer products, and new skills, laws, and policies. Reinforcing factors are regarded as positive or negative influences, and feedback from others, which include social support and health professional support; all of these factors encourage or discourage health-related behaviours. The following paragraphs describe studies linking determinants of NCD risk factors and PLWHI, with an emphasis on the constructs examined in this thesis.

Knowledge about risk factors for NCDs is an essential step to modify behavioural lifestyle for NCDs. According to the Health Belief Model (HBM), PLWHI may adopt preventive health behaviours if they perceive themselves at risk for NCDs, and if they perceive serious

consequences of NCDs on their health (Rosenstock, Strecher & Becker, 1994). However, few studies are available in literature that attempt to determine the relationship between HBM constructs, including knowledge, risk perception, self-efficacy, and NCDs' risk factors in PLWHI. Kamitani, Fukuoka, and Dawson-Rose (2015) conducted a cross-sectional study to investigate knowledge, self-efficacy, and self-perceived risk regarding CVD and acute coronary syndrome in a sample of Asian PLWHI. The authors found that the sample had limited knowledge and low self-perceived risk, but had high self-efficacy. Acculturation and stigma independently predicted knowledge and self-efficacy, respectively. The authors were of the view that PLWHI with poor knowledge and low-self-perceived risk for NCDs may not modify their lifestyles to reduce risk factors for NCDs. Another study conducted in the USA aimed to describe CVD risk factors of knowledge and risk perception in HIV+ adults, the results showed that the mean score on the Heart Disease Fact Questionnaire was 19 ± 3.5, and the mean total score on the Perception of Risk of Heart Disease Scale was 53.1 ± 5.9 (Cioe, Crawford & Stein, 2014). The authors concluded that the CVD risk factor of knowledge was adequate while risk perception was inaccurate, and they recommended improving risk perception and developing CVD risk reduction. Conversely, a recent study conducted in the largest HIV care programme in western Kenya has shown that the knowledge of risk factors was low with a mean score of 1.3 out of a possible 10. Most of the participants (77.7%) could not identify any warning signs for heart attack, while a strong predictor of CVD was higher education (6.72, 95% CI 1.98-22.84, P < 0.0001). Self-risk perception towards CHD was also low (31%) and the majority had inappropriate attitudes towards CVD risk reduction (Temu et al., 2015). The researchers suggested that behavioural change interventions are imperative. Thus, there is clearly a need for more research in developing countries to develop context-specific interventions.

Undertaking the risk factors of NCDs and their modifiable risk factors is a more efficient and sustainable approach to enhancing health-related benefit among PLWHI (Nguyen et al., 2011). By adopting a healthy lifestyle, such as avoiding smoking, alcohol, maintaining a healthy diet, and participating in physical activities, PLWHI are more likely to prevent lifestyle-related diseases and live longer with an improved QOL (Stein et al., 2008). Available evidence indicates that healthy lifestyle interventions have beneficial effects on health outcomes in HIV+ and non-HIV+ populations (Santos-Parker, LaRocca & Seals, 2014; Botros, Somarriba, Neri & Miller, 2012; Chudyk & Petrella, 2011; Somarriba, Neri, Schaefer & Miller, 2010). A previous study has shown that physical activity, dietary modification, and weight management are essential in HIV management (Derman, Dreyer & Schwellnus, 2010). Researchers in both high and middle income countries have also demonstrated that physical activity and dietary interventions are useful in improving NCD risk factors among PLWHI (Roos, Myezwa, Van Aswegen & Musenge, 2014; Stradling et al., 2012; Hand, Jaggers, Lyerly & Dudgeon, 2009). These findings were confirmed in a study conducted in Rwanda. Mutimura, Crowther, Cade, Yarasheski, and Stewart (2008) conducted a six-month, randomised control trial to test whether or not cardiorespiratory exercise training improves metabolic and anthropometric parameters and enhances cardiorespiratory fitness parameters in PLWHI in Rwanda. The results showed that exercise training positively modulated body composition and metabolic profiles and improved cardiorespiratory fitness in their sample. The researchers suggested that physical training is safe, inexpensive, and effective to address risk factors for NCDs associated with HIV and its treatment. Another study by Pullen et al. (2014) examined the effect of a 12-week rehabilitation program on morphology, cardiopulmonary fitness, strength, neurologic balance, immune markers (CD4 cell count), and quality of life in a 43-year-old woman living with HIV in Nigeria.

The results have shown that a 12-week intervention of manual therapy with aerobic and resistive exercise had positive effects in several categories of impairment in a 43-year-old woman with HIV who was compliant with her medication. Evidence from these studies highlights the role of physiotherapy in enhancing the lives of people living with HIV infection. Thus, with the increase in the number of PLWHI, and the infection transitioning to become "chronic illness", physiotherapists have the opportunity to provide necessary leadship in rehabilitation of such individuals.

Regardless of the proven benefits of healthy lifestyle interventions, research has indicated that PLWHI did not adhere to physical activity and diet recommendations (Petróczi, Hawkins, Jones & Naughton, 2010). However, factors influencing non-adherence to a healthy lifestyle have not been well documented. Other authors stress that individual and environmental factors, including barriers and motivators to practice healthy lifestyles, should be an explicit part of health education and evidence-based guidelines (McGuire, Anderson & Fulbrook, 2014). A few studies have attempted to identify factors that influence practicing healthy lifestyles among PLWHI in general (Capili, Anastasi, Chang & Ogedegbe, 2014; Petróczi et al., 2010). A study conducted in South Africa focused primarily on physical activity, with the aim of investigating the personal and environmental factors that cause barriers and they facilitated physical activity in a home-based pedometer walking programme, as a means of highlighting adherence challenges in a cohort of South African PLWHI on ART (Roos, Myezwa & van Aswegen, 2015). The authors found that the barriers to physical activity include physical complaints, e.g., low-energy levels, psychological complaints such as stress levels, family responsibilities such as being the primary caregivers, the physical environment, including adverse weather conditions, the social

environment, such as domestic abuse and crime, and workplace challenges, such as being in a sedentary job. Facilitators and promoters of physical activity include support and encouragement from friends and family, religious practices during worship, and community environment involvement such as having access to parks and sports fields. Another recent study conducted in Rwanda also highlighted that the barriers to physical activity participation among PLWHI who are receiving HAART, includes a lack of motivation, and a lack of time, as well as a fear of exacerbating the disease (Frantz & Murenzi, 2015). Thus, understanding the personal and environmental factors that motivate or hamper healthy lifestyle behaviours are crucial to changing lifestyles, to promoting PLWHI's health, and in ensuring the effectiveness of healthy lifestyle interventions. Therefore, there is a need for advocacy and formulation of prevention strategies for NCDs and their risk factors in PLWHI, with emphasis on behavioural and lifestyle changes.

2.5 Summary

Following recent advances in the treatment of HIV, which include a cART that are more available to PLWHI, the management of HIV infection has improved, especially in Africa. As a result, life expectancy and the QOL for PLWHI have improved. Epidemiologic distribution and predictors of risk factors for NCDs in PLWHI and the impact of NCDs' risk factors on morbidity, mortality, and quality outcomes of PLWHI were addressed in this chapter. Unfortunately no clear evidence exists regarding the association between HIV and behavioural risk factors of NCDs. For this reason, a systematic review of behavioural lifestyle risk factors for NCDs among HIV+ and HIV- individuals will be presented in the next chapter.

Chapter Three

Behavioural Lifestyle Risk Factors for Non-Communicable Diseases among HIV + and uninfected Adults: a Systematic Review

3.1 Introduction

Life expectancy for PLWHI has increased, while mortality attributed to AIDS-related diseases has decreased considerably since the introduction of cART (Murray et al., 2014). However, mortality rates in HIV+ people may definitely remain slightly higher than those seen in the HIV- population (Sabin, 2013). Apart from the known predictors of life expectancy, including a low CD4 count, late initiation of cART, and poor adherence to ART, non-AIDS-related diseases play a major role in predicting life expectancy for those infected with HIV. Associated with improved life expectancy, PLWHI are more exposed to CVD due to the HIV infection itself, ART, and accumulated cardiovascular risks similar to the general population, including high BP, diabetes, dyslipidemia, and tobacco use, which is more prevalent in HIV+ subjects than those who are uninfected (Vidrine, 2009). Available evidence indicates that chronic diseases of lifestyle, including CVD, T2D, chronic lung disease, and some types of cancer are emerging as some of the important causes of death and co-morbidity in PLWHI (Farahani, Mulinder, Farahani & Marlink, 2016; Nou, Lo & Grinspoon, 2016; Triant, 2013). Additionally, HIV+ persons are at increased risk of NCDs, especially CVD, compared to HIV- people (Triant, 2013; Islam, Wu, Jansson & Wilson, 2012). Thus, lifestyle modification, including regular physical activity, diet modification, and smoking cessation, might play a major role in preventing CMDs and improving life expectancy for those infected with HIV.

Understanding lifestyle risk behaviours among various populations is a major step towards improving a healthy lifestyle and mitigating consequences related to NCDs, since behavioural changes and lifestyles are non-pharmacological strategies for the control and prevention of NCDs in the general population (King, Meader, Wright, Graham, Power, Petticrew, White & Sowden, 2015). In this regard, interventions that target multiple risk factors may be a more efficient way of preventing NCDs. Despite innovation in research and empirical evidence of success in clinical management of HIV infection and related comorbidities among PLWHI, risk factors for NCDs remain a major concern. This indicates the need to investigate potentially modifiable risk factors in PLWHI, as they are more prone to biological risk factors for NCDs (Bloomfield et al., 2011; Malaza, Mossong, Barrnighausen & Newell, 2012). Additionally, there is limited evidence that assists in tackling the challenges of NCDs, especially CMD in African countries (Samb et al., 2010). This could imply that it would be even more limited for the large number of PLWHI, especially in SSA countries. For example, Renzaho (2015) examined challenges associated with dealing with diabetes within the development agenda in SSA countries; the results revealed several challenges, including poor documentation of risk factors, demographic transitions (rapid urbanisation and ageing) and the complementary role of traditional healers.

Despite the available research evidence showing that PLWHI are more prone to NCDs (McDonald & Kaltman, 2009; Islam et al., 2012), a few studies have compared behavioural lifestyle risk factors for NCDs in HIV+ and HIV- individuals. It remains unclear if there is a significant difference in behavioural lifestyle risk factors for NCDs in individuals who are HIV+

compared to those who are HIV-, and among those receiving ART compared to those who are not on ART. Hence, without this information, an increased risk of NCDs in PLWHI cannot be attributed to the HIV serostatus or the ART status, and this may hamper targeted intervention strategies that combating NCDs in PLWHI. These issues indicate the need for a systematic review that attempts to investigate the behavioural lifestyle risk factors for NCDs according to the HIV serostatus and the ART status. Harder (2014) also highlights a range of reasons to conduct a systematic review of observational studies, including providing evidence to inform researchers, guideline developers, and policy-makers concerning the burden of diseases, e.g. NCDs. Therefore, the purpose of this review was to systematically identify and review studies on behavioural lifestyle risk factors (tobacco use, harmful alcohol use, low fruit and vegetable consumption, and physical inactivity) among HIV+ adults compared to HIV- adults, and the HIV+ patients on ART compared to ART-naïve participants.

3.2 Methods

This systematic review is based on the methodology proposed in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher, Liberati, Tetzlaff & Altman, 2009). Moola et al. (2015) provide guidance to conduct systematic reviews of association that address etiological issues and outline the standardised approach to conduct these reviews that provide a rigorous and transparent method including forming review questions and objectives, inclusion criteria, critical appraisal, data synthesis, and meta-analysis. The next section describes the main steps to conduct a systematic review related to disease risk factors, question data, and shows how these steps are adopted in the current study.

3.2.1 Study eligibility

The systematic review of studies to answer questions of etiology should follow the PEO mnemonic (population/type of participants, exposure of interest/independent variable, and outcome or response/ dependent variable) to develop answerable research questions (Moola et al., 2015). Research questions are formulated based on the PICO strategy including the population of interest (P), intervention or exposure (I), comparison (C), and the outcomes of interest (O) for systematic reviews of effects. Both the PEO and PICO strategies are accompanied with some background information about the problem and the reasons to include or exclude participants in the review (The Cochrane Collaboration, 2005). Data from the systematic review reporting the synthesis of evidence related to association is suitable in the current study in order to facilitate the formation of hypotheses concerning risk or preventive factors for NCDs and the prevention and control in PLWHI.

Review question: What are the differences in behavioural lifestyle risk factors (tobacco use, harmful alcohol use, low fruit and vegetable consumption, and physical inactivity): i) between HIV+ and HIV- adults; and ii) HIV+ participants on ART vs. ART-naïve participants?

The inclusion criteria for the review were observational studies that were accessed as full texts. Published and empirical studies, using quantitative study design and research methods, were included. Such studies were observational, including cross-sectional, longitudinal analyses with baseline cross-sectional data and case control. Studies were included if they involved a comparison of HIV+ and HIV- individuals or comparable ART+ and ART- naive groups. This study included adults aged ≥ 18 years. Outcome measures were mainly behavioural lifestyle

risks, including tobacco use, physical inactivity (insufficient or lack of physical activity), harmful or hazardous or dependent alcohol use, and unhealthy diets such as high fat, salt, and sugar intake and low fruit and vegetable intake. Studies reporting data only on HIV+ or on HIV- subjects (non-comparative studies) were excluded. Studies carried out prior to 2000, with a study population ≤ 18 years, and reported as abstracts only were excluded. The eligibility criteria for the inclusion of studies in the review are illustrated in Table 3.1.

Table 3.1: Eligibility criteria for inclusion of studies in the review

Population	Adults only. Study inclusion requires that at least one of the study groups includes HIV+ individuals.
Exposure/ Issue	Interaction between traditional lifestyle risks and HIV/ART status
Outcome	Prevalent behavioural lifestyle risk factors of NCD events including, tobacco use, unhealthy diets, physical inactivity, and harmful alcohol use.

3.2.2 Data Sources and Search Strategy

Data for this review was based on information obtained from the following databases: Pubmed; Cinahl; Scopus (Elsevier); African Journals Online (AJOL); and Web of Science. In addition,

Google and Google scholar were used to find the relevant full text studies, and a manual search was carried out for potential titles in the bibliographies of included studies and relevant reviews.

The following main search terms were used: 'HIV or human immunodeficiency virus' or 'AIDS or 'acquired immunodeficiency syndrome' and 'behavioural lifestyle' or 'behavioural risk' or 'modifiable risk' or 'tobacco or alcohol intake', or 'fruit intake' or 'vegetable intake' or 'physical activity' or 'exercise' or 'sedentary lifestyle' and 'non-communicable diseases', or 'NCDs' and 'epidemiology' or 'prevalence' or 'distribution' or 'odds ratio' or 'prevalence studies' or 'cross-sectional studies' or 'survey'.

All searches were limited to studies published and written in English from January 2000 to January 2015 that reported on HIV and behavioural lifestyle risk factors for NCDs. The year 2000 was chosen to coincide with the introduction of the WHO STEPwise Approach to Surveillance (STEPS) chronic disease surveillance programme. This range was also chosen to take into consideration the most recent published studies on behavioural lifestyle risk factors for NCDs.

3.2.3 Study Selection

The initial search was led by the principal investigator and included reviews for each study title and abstract for inclusion. Identified full articles and their reference lists were assessed by two

reviewers for eligibility criteria. When discrepancies arose, consensus was reached through discussion. Studies not meeting all eligibility criteria were not included in the final review. Consensus for eligibility between the two reviewers was 100%.

3.2.4 Methodological Quality Assessment

A critical appraisal is a systematic process used to identify the strengths and weaknesses in terms of internal validity and the risk of bias of selected research articles in the review, in order to assess the usefulness and validity of research findings (Moola et al., 2015). There are numerous tools available for the critical appraisal of quantitative study designs, and the tools are considered to be suitable to appraisal studies with the intention of answering research questions related to the association (The Joanna Briggs Institute's [JBI], 2014). The JBI Prevalence Critical Appraisal Checklist (Munn, Moola, Riitano & Lisy, 2014) was applied by the main researcher and two research assistants to assess the quality of studies included in this review. Of the 10 criteria on the checklist, a study that met none to four of the criteria was considered to have a low methodological quality assessment, while the ones that met five to 10 of the criteria was considered to have a high quality assessment. The questions asked and how they were measured is reported in Table 3.2. Each question was answered as either "Yes", "No", or "Unclear".

Table 3.2: The Joanna Briggs Institute Prevalence Critical Appraisal Checklist

Criteria	Yes	No	Unclear	Not applicable

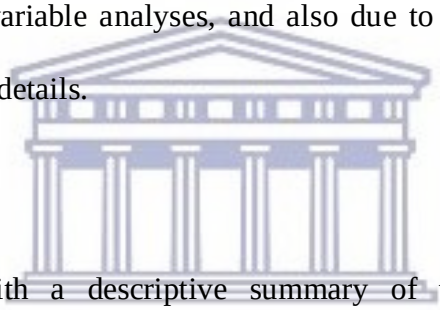
Was the sample representative of the target population?
Were study participants recruited in an appropriate way?
Was the sample size adequate?
Were the study subjects and the setting described in detail?
Was the data analysis conducted with sufficient coverage of the identified sample?
Were objective, standard criteria used for the measurement of the condition?
Was the condition measured reliably?
Was there appropriate statistical analysis?

3.2.5 Data Extraction

It is advisable to use a standard data extraction tool to obtain the necessary information about study findings from the selected studies (Elamin, Flynn, Bassler, Briel, Alonso-Coello, Karanicolas, Guyatt, Malaga, Furukawa, Kunz & Schünemann, 2009). Data from the eligible studies was extracted using a data extraction tool adapted from the JBI Data Extraction form. Potentially relevant articles were selected by screening the titles and screening the abstracts; where necessary, the full article was retrieved and screened to agree on whether or not it met the inclusion criteria, such as when abstracts were not accessible or did not provide sufficient data. The information that was extracted included the study characteristics (first author, country, year of publication), study population characteristics (age and gender composition, HIV serostatus), study methods (study design, study period, sample size), and outcomes (number and percentage of NCD behavioural lifestyle risk factors) in both HIV+ and HIV- subjects.

3.2.6 Data Synthesis

Data synthesis is undertaken in the review process with the aim of summarising the findings from the included studies (Tacconelli, 2010). There are different approaches to present the review findings, such as narrative, graphical, tabular, summary and meta-analysis (Munn, Tufanaru & Aromataris, 2014). The selection of a method depends on the heterogeneity or homogenous nature of the data extracted. Nevertheless, in some cases, meta-analysis might be appropriate but not possible. Similarly, Moola et al. (2015) believe that the meta-analysis of association studies addressing etiological issues may seldom be possible due to the differences in the factors controlled in multivariable analyses, and also due to poor reporting in the original studies, with a lack of adequate details.



The data synthesis began with a descriptive summary of the statistics of the study's characteristics extracted from the included studies. Characteristics of the studies to be included were presented in diagrammatic and narrative summaries. Main topics related to behavioural lifestyle risk factors for NCDs (tobacco use, low fruit and vegetable intake, physical inactivity, and harmful alcohol use) were reported. Outcome measures were expressed as percentages (%) taken directly from the included studies and accompanied by their statistical significance. Thus, a narrative synthesis was chosen in this review, where words and text are used to summarise and explain the findings of the synthesis process. This approach is appropriate in the current review, due to the fact that secondary or mediating outcomes were examined, instead of primary outcomes only. Thus, heterogeneity is more likely in this review.

3.3 Results

3.3.1 Study selection

Initially 562 publications were identified from the selected electronic databases. After identifying and discarding duplicates, the remaining 542 records were screened for eligibility based on their titles and abstracts. Among these, 475 references were excluded because they were outside of the scope of this review. A further 20 full-text articles were excluded for various reasons. After this process, 47 full-text articles were assessed for eligibility based on their methodological quality. Finally, 35 records were identified as relevant for the purposes of this study related to HIV and ART status and behavioural lifestyle risk for NCDs. Figure 3.1 represents the flow of articles finally included.

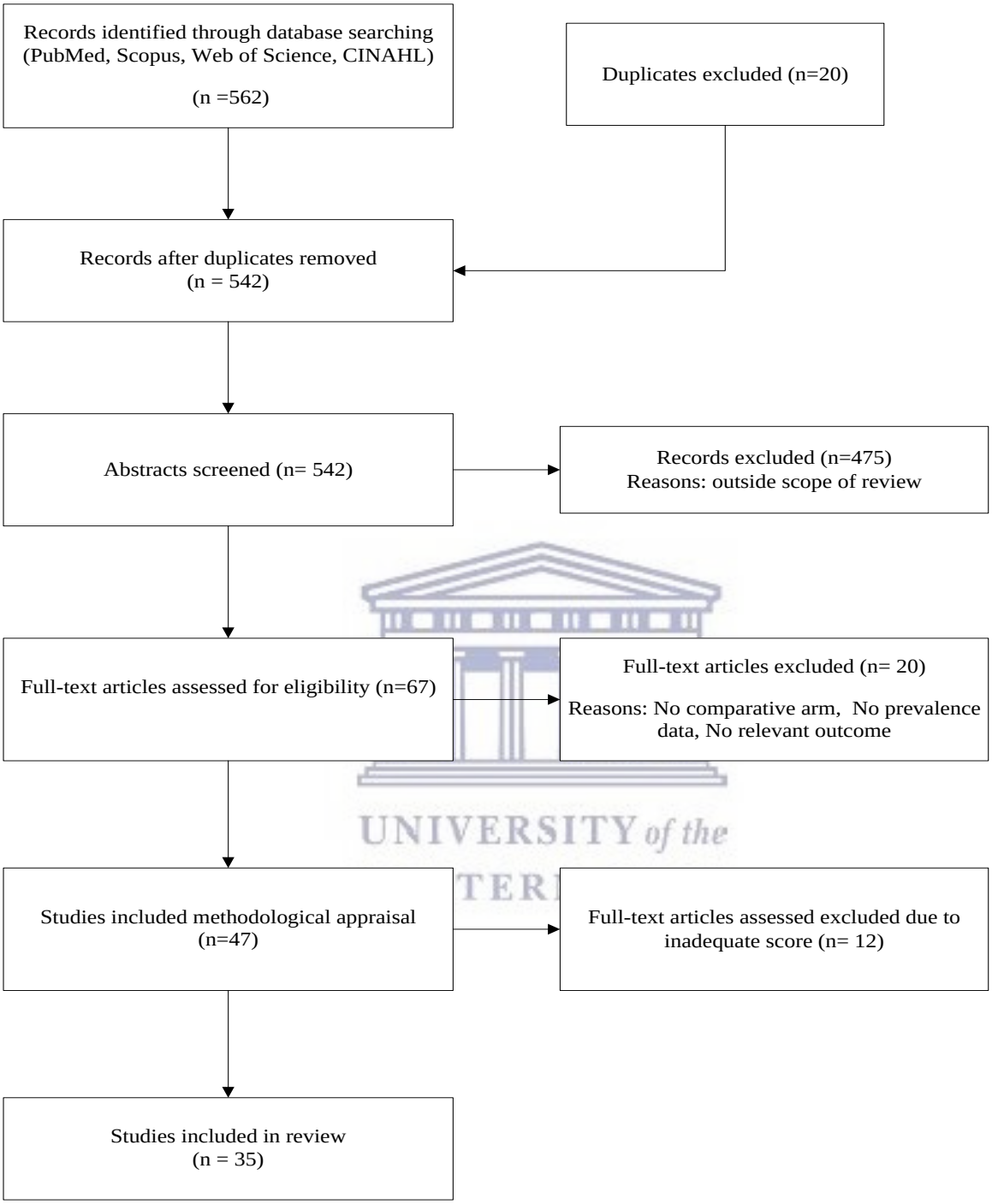


Figure 3.1: Flow diagram of the literature search according to PRISMA

3.3.2 Methodological Quality of the Studies

Rigorous guidelines are necessary when conducting systematic reviews. The JBI Prevalence Critical Appraisal Checklist was applied to rate the quality of included studies. The checklist comprises 10 criteria, including ensuring a representative sample, an appropriate recruitment, an adequate sample size, an appropriate description and reporting of study subjects and setting, ensuring adequate data coverage of the identified sample, ensuring the condition was measured reliably and objectively, ensuring appropriate statistical analysis, and ensuring confounding. Based on the answers of the above-mentioned questions, a cut-off score of 50% was used. Among the 47 full-text articles included in the methodological appraisal, the methodological quality score of 35 of the included studies was satisfactory. Table 3.3 illustrates a summary of the methodological quality scores of the included studies.

Table 3.3: Methodological quality score summary

Author (year)	Was the sample representative of the target population?	Were study participants recruited in an appropriate way?	Was the sample size adequate?	Were the study subjects and the setting described in detail?	Was the data analysis conducted with sufficient coverage of the identified sample?	Were objective, standard criteria used for the measurement of the condition?	Was the condition measured reliably?	Was there appropriate statistical analysis?	Are all important confounding factors/subgroups/differences identified and accounted for?	Were subpopulations identified using objective criteria?	**Total**
Aboud et al., 2010	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	8/10
Baekken et al., 2009	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	8/10
Bergersen et al., 2004	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	8/10
Boodram et al., 2009	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	6/10
Butt et al., 2009	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	No	No	Yes	7/10
Crothers et al., 2006	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	7/10
Crothers et al., 2013	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	8/10
Crothers et al., 2009											
Edward et al., 2013	No	Yes	Yes	No	No	Yes	Unclear	Yes	No	Yes	5/10
Farley et al., 2010	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	6/10
Fillipas et al 2008	Unclear	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	7/10
Freiberg et al., 2010	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	8/10
Howard et al., 2006	No	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	6/10
Hsue et al., 2010	No	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	8/10

Jericó et al., 2005	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	8/10
Justice et al., 2006	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	7/10
Kaguruki et al., 2014	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	8/10
Kooij et al. 2014	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	6/10
Kunasaki et al.,2014	Yes	Yes	Yes	Yes	Yes	Unclear	No	Yes	Yes	Yes	8/10
Mashinya et al., 2014	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	7/10
Monroe et al., 2015	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	7/10
Muhammad et al., 2013	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Unclear	Yes	7/10
Onen et al., 2010	No	Yes	No	Yes	Yes	Yes	Yes	No	No	Yes	7/10
Oosthuizen et al., 2006	Yes	Yes	Yes	Yes	No	Unclear	Yes	Yes	No	Yes	7/10
Oursler et al., 2011	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	8/10
Peltzer et al., 2014	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	8/10
Schillaci et al., 2013	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	6/10
Schouten et al 2014	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	6/10
Schwartz et al., 2012	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	No	No	No	5/10
Silva et al., 2009	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	8/10
Smith et al., 2004	Unclear	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	7/10
Soboka et al., 2014	Yes	Yes	Yes	Yes	No	Unclear	Yes	Yes	No	Yes	7/10
Stein et al., 2012	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9/10
Van Rooyen et al., 2014	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	8/10
Womack et al., 2014	Yes	No	No	Yes	Yes	Yes	Yes	No	Unclear	Yes	6/10

3.3.3 Description of the Studies

Behavioural lifestyle risks for NCDs studied in the current review include tobacco use, harmful alcohol use, physical inactivity, and low fruit and vegetable intake. However, definitions for these outcomes are different across the articles identified. Additionally, some studies presented results for more than one outcome, and the majority of selected studies recruited both men and women. A total of 54 921 participants were enrolled in the included studies, including 25 608 (range: 77-3 683) HIV- infected, 25 613 (range: 76-3641) HIV-, 2 458 (range: 100-705) HIV+ on ART, and 1242 (range: 51-317) HIV+ ART naïve. The mean age ranged from 34.8 to 54 years in HIV+, from 32.5 to 55 years in HIV-, from 32.81to 41 years in HIV+ on ART, and from 32.36 to 41 years in HIV+ ART naïve. Concerning gender, this review included 25 644 men and 24 534 women. All the included studies were published between 2006 and 2015, most of them– 27 out of 35–published after 2009. In almost all of the studies, study subjects were selected from HIV clinics where they sought care. In almost all of the studies, the verification of behavioural lifestyle risk factors for NCD outcomes was self-reporting.

Fifteen of the studies were conducted in the USA (Boodram et al., 2009; Butt et al. 2009; Crothers et al., 2006; Crothers et al., 2013; Crothers et al., 2009; Freiberg et al., 2010; Howard et al., 2006; Hsue et al., 2010; Justice et al., 2006; Kunasaki et al., 2014; Monroe et al., 2015; Onen et al., 2010; Oursler et al., 2011; Schwartz et al., 2012; Womack et al., 2014), four in South Africa (Mashinya et al., 2014; Oosthuizen et al., 2006; Peltzer et al., 2014; Van Rooyen et al., 2014), two in Norway (Baekken et al., 2009; Bergersen et al., 2004), three in Nigeria (Edward et al., 2013; Farley et al., 2010; Muhammad et al., 2013), two in the UK (Aboud et al., 2010; Smith

et al., 2004), two in the Netherlands (Schouten et al., 2014; Kooij et al., 2014), one in Tanzania (Kaguruki et al., 2014), one in Italy (Schillaci et al., 2013), one in Spain (Jericó et al., 2005), one in Australia (Fillipas et al., 2008), one in Germany (Stein et al., 2012), one in Brazil (Silva et al., 2009) and one in Ethiopia (Soboka et al., 2014) . All the included studies reported comparative prevalence data on behavioural lifestyle for NCDs, of which 25 were cross-sectional and 10 were longitudinal studies with baseline cross-sectional data. Twenty-two identified studies addressed the comparative prevalence of tobacco use, 13 studies addressed harmful alcohol use, and eight studies addressed physical inactivity in HIV+ and HIV- participants. Additionally, six identified studies addressed the comparative prevalence of tobacco use, four addressed harmful alcohol use, and two studies addressed physical inactivity in HIV+ on ART and ART-naïve adults. Only one study reported on insufficient fruit and vegetable intake that met the inclusion criteria. Descriptive data extracted from the 35 reviewed studies are grouped according to HIV serostatus (HIV+ and HIV-) (Table 3.4) and ART status (ART+ and ART- naïve groups) (Table 3.5).

Table 3.4: Characteristics of studies with HIV+ vs. HIV- participants

Study author (s)/Year	Country	Study design	Health risk behaviour (definition)	HIV+/ ART use				HIV-				**Measure of association**
				Sample size	**Female n (%)**	**Mean Age**	**Prevalence n (%)**	**Sample size**	**Female n (%)**	**Mean age**	**Prevalence n (%)**	Percentage (%) P-value
Baekken et al., 2009	Norway	Longitudinal	Tobacco use (Smoker)	77	Male: 65 (84.4) Female: 12 (15.6)	50.9	30 (39.0)	76	Male: 54 (71.1) Female:22 (28.9)	47.6	24 (31.5)	Higher prevalence rates of tobacco use in HIV+ than HIV- (39.0% vs. 31.5%, p=0.34
Bergersen et al., 2004	Norway	Cross-sectional	Tobacco use (Daily smoking)	283	Male: 224 (79) Female: 59 (21)	41	155 (54.8)	438	Male: 346 (79) Female:92 (21)	40	132 (30.1)	Daily smoking was almost half as prevalent in HIV- as compared to HIV+ people (54.8% vs.30.1%,p<0.001)
Boodram et al., 2009	USA	Cross-sectional	Tobacco use (Current smoker)	2157	Male: 0 (0) Female: 2157 (100)	35.6	1103 (51)	730	Male: 0 (0) Female : 730 (100)	32.5	412 (57)	Fewer HIV+ compared to HIV-women reported current smoking (51% vs. 57%, p=0.02
			Harmful alcohol use (moderate-heavy drink ≥ 3 drinks per week)	2157	Male: 0 (0) Female: 2157 (100)	35.6	471 (22)	730	Male: 0 (0) Female : 730 (100)	32.5	205 (29)	Fewer HIV+ compared to HIV-women reported current moderate-heavy alcohol consumption (22% vs. 29%, p<0.001)
Butt *et al.* 2009	USA	prospective study	Harmful alcohol use (> 60 drinks per month)	3,227	Male:3146 (97.5) Female: 81 (2.5)	49.6	436 (13.5)	3,240	Male:2984 (92.1) Female: 256 (7.9)	50.8	525 (16.2)	HIV+ patients consumed less alcohol (13.5% vs. 16.2, P=0.01)
Crothers et al., 2006	USA	Prospective observational	Tobacco use (Current smoker: those who reported the current or any use of cigarettes within the last 4 weeks)	1014	Male: 1014 (100) Female: 0 (0)	50	466 (46)	713	Male: 713 (100) Female: 0 (0)	55	257 (36)	The prevalence of cigarette smoking was equally high in both groups; however, HIV+ subjects were significantly more likely to be current smokers than HIV- subjects (HIV+ subjects, 46%; HIV- subjects, 36%; p< 0.001).
			Harmful alcohol use (alcohol abuse)	1014	Male: 1014 (100) Female: 0 (0)	50	243 (24)	713	Male: 713 (100) Female: 0 (0)	55	128 (18)	HIV+ subjects were more likely to have a history of alcohol abuse (24% vs.18%,respectively; p=0.001)
Crothers et al., 2013	USA	Cross-sectional	Tobacco use (current smokers if they had smoked within the past 12 months)	300	Male: 300 (100) Female: 0 (0)	54	141 (47)	289	Male: 289 (100) Female: 0 (0)	54	101 (35)	More HIV+ men were current smokers compared to HIV- men (47% vs. 35%, p=0.007)
Crothers et al., 2009	USA	Longitudinal	Tobacco use (Current smokers	1034	Male: 1024 (99) Female: 10 (1)	50	476 (46)	739	Male: 717 (97)	55	259 (35)	HIV+ subjects were significantly more likely to

			were defined as those who reported current or any use within the last 4 weeks)						Female: 22 (3)			be current smokers compared to HIV- subjects (46% HIV+ vs. 35% HIV-, $p < .001$).
Fillipas et al 2008	Australia	Cross-sectional	Physical inactivity (low (inactive) – individuals who did not meet criteria for moderate or high categories on the IPAQ)	191	Male:177 (92.7) Female: 14 (7.3)	43.9	49 (25.7)	70	Male: 49 Female:21 (30)	41.6	24 (34.3)	HIV+ participants reported higher levels of physical activity, spending more time and expending more time and energy in weekly physical activity than the HIV- group (25.7 vs. 34.3)
Freiberg *et al.*2010	USA	Cross-sectional	Tobacco use (Current smoking was defined as a yes response to; "Do you now smoke cigarettes?")	2422	-	49.1	1315 (54.3)	2321	-	50.8	1093 (47.1)	HIV+ veterans had a significantly higher prevalence of smoking (54.3% vs. 47.1, $p < 0.001$)
			Harmful alcohol use (hazardous drinking was defined as > 14 drinks per week or binge drinking)	2422	-	49.1	804 (33.2)	2321	-	50.8	717 (30.9)	HIV+ veterans had a significantly higher prevalence of current hazardous consumption ($p<0.001$)
Howard *et al.* 2006	USA	Cross-sectional	Harmful alcohol use (a positive CAGE test for alcohol)	364	Male: 364 (100) Female: 0 (0)	54	176 (48)	279	Male: 279 (100) Female : 0 (0)	54	125 (45)	Nearly half (47%) of the men had a positive CAGE test for alcoholism, with no difference according HIV status.
			Physical inactivity (exercise for <20 minutes on >1 day per week)	364	Male: 364 (100) Female: 0 (0)	54	255 (70)	279	Male: 279 (100) Female : 0 (0)	54	199 (71)	The majority of the participants, both HIV+ and HIV-, were not physically active (70% and 71%, respectively) with no difference according to HIV status
Hsue *et al.* 2010	USA	Cross-sectional	Tobacco use (Current smoker)	196	Male: 167 (85) Female: 29 (15)	47	71 (36)	52	Male:46 (89) Female: 6 (11)	45	14 (26)	36% of the HIV+ patients were current smokers, compared to 26% of the uninfected controls ($p=0.13$).
Jericó *et al.* 2005	Spain	Prospective cross-sectional	Tobacco use (Current smoker)	710	Male: 511 (72) Female: 199 (28)	42.0	479 (69.5)	802	Male: 553 (69) Female: 249 (31)	42.6	245 (30.5)	Current smoking was common among HIV+ patients, compared to HIV- patients (69.5%

												vs.30.5%,p=0.001)
Justice *et al.* 2006	USA	Longitudinal	Tobacco use (Current smoker: last week)	2979	Male: 2919 (98) Female: 60 (2)	49	1519 (51)	3019	Male: 2777 (92) Female: 242 (8)	50	1238 (41)	Half of the HIV+ patients (51%) and slightly less than half the controls (41%) reported current cigarette smoking ($p < 0.0001$).
			Harmful alcohol use (Current alcohol consumption (last 12 months)	2979	Male: 2919 (98) Female: 60 (2)	49	1907 (64)	3019	Male: 2777 (92) Female: 242 (8)	50	1902 (63)	The majority of both groups reported current alcohol consumption (64% and 63%, respectively (p=0.4)
			Physical inactivity (No exercise)	2979	Male: 2919 (98) Female: 60 (2)	49	417 (14)	3019	Male: 2777 (92) Female: 242 (8)	50	332 (11)	Exercising less than once week was reported by 14% of HIV+ patients and 11% of HIV- comparators (p=0.002)
Kooij et al. 2014	Netherla nds	Longitudinal	Tobacco use (Current smoker)	581	Male: 512 (88.5) Female: 69 (11.5)	52.7	172 (32.4)	520	Male: 441 (84.8) Female: 79 (15.2)	52.0	122 (24.3)	HIV+ individuals were more likely to smoke than HIV- individuals (p=0.02)
			Physical inactivity (0 day per week for moderate physical activity: 30 min)	581	Male: 512 (88.5) Female: 69 (11.5)	52.7	109 (21.0)	520	Male: 441 (84.8) Female: 79 (15.2)	52.0	65 (13.0)	HIV+ individuals were more likely not to participate in moderate physical activity (30min) than HIV- individuals (p=0.002)
Kunasaki *et al.* 2014	USA		Tobacco use (Current smokers were those who had smoked within 4 weeks)	3683	Male: 3595 (97.6) Female: 88 (2.4)	49.3	1974 (53.6)	3641	Male: 3368 (92.5) Female: 273 (7.5)	50.5	1664 (45.7)	Current smoking was common among HIV+ patients, compared to HIV- patients (53.6%vs.45.7%,p=0.0001)
			Harmful alcohol use (Hazardous alcohol use: Alcohol Use Disorders Identification Test (AUDIT-C score ≥ 4 for men and ≥ 3 for women).	3683	Male: 3595 (97.6) Female: 88 (2.4)	49.3	1632 (44.3)	3641	Male: 3368 (92.5) Female: 273 (7.5)	50.5	1751 (48.1)	Fewer HIV+ individuals compared to uninfected individuals reported hazardous alcohol use (44.3% vs. 48.1%, p<0.001)
Mashinya *et al.* 2014	South Africa	Cross-sectional	Tobacco use (Daily smoking cigarette)	89	Male: 26 (29.2) Female: 63 (70.8)	49.7	16 (18)	178	Male: 52 (29.2) Female: 126 (70.8)	49.7	27 (15.2)	Equally high prevalence rates of tobacco use (18% vs. 15.2%)
			Harmful alcohol use (alcohol	89	Male: 26 (29.2) Female: 63	49.7	26 (29.2)	178	Male: 52 (29.2)	49.7	35 (19.7)	More HIV+ than HIV- women consumed alcohol

			consumption within past 30 days)		(70.8)				Female:126 (70.8)			(25.4% vs. 11.9%, *p*-value < 0.05)
Monroe et al., 2015	USA	Cross-sectional	Physical inactivity (low category of IPAQ)	596	Male: 596 (100) Female: 0 (0)	51	150 (25)	685	Male: 685 (100) Female: 0 (0)	55	158 (23)	The proportions of men in the low (25% in HIV+ vs. 23% in HIV-), moderate (26% vs. 27%), and high (49% vs. 49%) PA categories were similar according to HIV status (p=0.74)
			Tobacco use (Current smoker)	596	Male: 596 (100) Female: 0 (0)	51	179 (30)	685	Male: 685 (100) Female: 0 (0)	55	130 (19)	There was a significant difference in the prevalence of current smoking between HIV+ and HIV-participants (30% vs. 19%, p <0.001)
Onen *et al.* 2010	USA	Prospective cross-sectional	Alcohol use (Current alcohol use)	121	Male: 100 (82.8) Female: 21 (17.2)	55.8	75 (62)	114	Male: 94 (82.8) Female: 20 (17.2)	55.8	76 (66.7)	Alcohol use was comparable between HIV+ and HIV- individuals (62% vs. 66.7%, respectively, p=0.45; OR:0.82 (0.48-1.39)
Oosthuizen *et al.* 2006	South Africa	Cross-sectional	Tobacco use (Smoker)	216	Male: 96 (44.4) Female: 120 (55.6)	34.8	75(34.7)	1605	Male: 685 (42.7) Female: 920 (57.3)	37.9	544 (33.9)	HIV+ and HIV-subjects did not differ significantly with regard to tobacco use
			Alcohol use (Alcohol intake (g/d))	216	Male: 96 (44.4) Female: 120 (55.6)	34.8	27 (12.7)	1605	Male: 685 (42.7) Female: 920 (57.3)	37.9	146 (9.10)	Alcohol intake tended to be higher in HIV+ subjects than HIV-subjects (12.7% vs. 9.10, p=0.08)
Oursler *et al.* 2011	USA	Cross-sectional	Tobacco use (Current smoker)	3107	Male: 3029 (97.5) Female: 78 (2.5)	49.5	1650 (53.1)	3147	Male: 2898 (92.1) Female: 249 (7.9)	50.7	1380 (43.8)	The prevalence of current smoking was significantly higher in HIV+ patients compared to HIV- patients (p < 0.001)
			Physical inactivity (Never weekly exercise)	3107	Male: 3029 (97.5) Female: 78 (2.5)	49.5	369 (12.8)	3147	Male: 2898 (92.1) Female: 249 (7.9)	50.7	330 (10.5)	HIV-infected patients reported exercising less frequently than uninfected patients (p=0.03)
Peltzer *et al.* 2014	South Africa	Cross-sectional	Tobacco use (Current smoking was defined as a yes response to; "Do you currently use one or more of the following tobacco products (cigarettes, snuff, chewing tobacco,	143	Male: 42 (29.4) Female: 101 (70.6)	-	26 (18.2)	199	Male: 86 (43.2) Female: 113 (56.8)	-	41 (15.6)	Current tobacco use was not related to HIV status (p=0.52)

			cigars, etc.)?"									
			Harmful alcohol use (Hazardous alcohol use: (AUDIT-C score ≥ 4 for men and ≥ 3 for women).	143	Male: 42 (29.4) Female: 101 (70.6)		31 (21.7)	199	Male: 86 (43.2) Female: 113 (56.8)		48 (24.1)	Hazardous or harmful or dependent alcohol use was not related to HIV status (P=0.60)
Schillaci *et al.* 2013	Italy	Cross-sectional	Tobacco use (Cigarette smoking)	100	Male: 72 (72) Female: 28 (28)	48.4	46 (46)	325	Male: 224 (69) Female: 101 (31)	47.8	65 (20)	Among HIV+ patients, the proportion of smokers was higher than in HIV- patients (46% vs. 20%, P < 0.001)
Schouten et al 2014	Netherlands	Cross-sectional	Tobacco use (Current smoker: smoked during the last month)	540	Male: 476 (88.1) Female: 64 (11.9)	52.9	173 (32.0)	524	Male: 446 (85.1) Female: 78 (14.9)	52.1	129 (24.6)	Significantly more HIV+ participants were current smokers (32.0% vs. 24.6%; p = 0.007)
			Physical inactivity (Not to meet at least 5 days per week at least 30 minutes of moderate physical activity)	540	Male: 476 (88.1) Female: 64 (11.9)	52.9	301 (55.7)	524	Male: 446 (85.1) Female: 78 (14.9)	52.1	246 (47)	Significantly more HIV+ participants were physically inactive (55.7% vs. 47.0%; p = .005)
Schwartz *et al.* 2012	USA	Longitudinal multicentre	Harmful alcohol use (Alcohol use)	526	Male: 0 (0) Female: 526 (100)	35.8	48 (9.1)	132	Male: 0 (0) Female: 132 (100)	34.6	27 (20.5)	Self-reported alcohol use (20.5% vs. 9.1%; p<0.01) was greater in the HIV- compared to the HIV+ women.
Stein et al., 2012	Germany	Cross-sectional	Physical inactivity (Inactive to perform sport)	124	Male: 109 (88) Female: 15 (12)	37	48 (38.7)	159	Male: 140 (88) Female: 19 (12)	33	41 (25.8)	The proportion of patients actually performing physical activity was significantly lower (p=0.028) within the HIV+ group (61.3%) than within the HIV- group (74.2%).
Van Rooyen *et al.* 2014	South Africa	Cross-sectional	Tobacco use	118	Male: 38 (32) Female: 80 (68)	47.3	37 (31)	142	Male: 53 (37) Female: 89 (63)	48.3	68 (48)	The HIV+ participants had significantly lower prevalence of current smoking (p < 0.01)
Womack *et al.* 2014	USA	Prospective, longitudinal, observational cohort	Tobacco use (Current smoker)	710	Male: 0 (0) Female: 710 (100)	43.2	420 (59.2)	1477	Male: 0 (0) Female: 1477 (100)	44.0	597 (44.4)	HIV+ individuals had a higher prevalence of tobacco use than HIV- individuals (59.2% vs. 44.4, P< 0.001)
			Harmful alcohol use (ICD-9 codes, Alcohol abuse/dependence)	710	Male: 0 (0) Female: 710 (100)	43.2	98 (13.8)	1477	Male: 0 (0) Female: 1477 (100)	44.0	74 (5.0)	HIV+ subjects were more likely to have a history of alcohol abuse than HIV- subjects (13.8% vs. 5.0%; p < 0.001).

Table 3.5: Characteristics of studies with HIV+ on ART vs. ART-naïve participants

Study author (s)/Year	Country	Study type	Behavioural lifestyle Risk factor(s) definition	HIV+ on ART treatment				HIV+ ART-naïve				Measure of association
				Sample size	**Female (%)**	**Mean Age**	**Prevalence (%)**	**Sample size**	**Female (%)**	**Mean age**	**Prevalence (%)**	**Percentage (%) P-value**
Aboud *et al*.2010	UK	Cross-sectional	Tobacco use (Smoking)	705	Male: 509 (72.2) Female: 196 (27.8)	41	250 (35.5)	258	Male: 204 (79.1) Female: 54 (20.9)	41	107 (41.5)	HIV+ individuals on ART and HIV+ who were ART-naïve did not differ significantly with regard to tobacco use (35.5% vs. 41.5%, P=0.087)
Edward *et al*. 2013	Nigeria	Cross-sectional	Physical inactivity (Engagement in physical activities (both recreational and work) that lasted <30 min per day for <3 times/week)	214	Male: 68 (79.1) Female: 146 (81.6)	39.1	142 (66.4)	51	Male: 18 (20.9) Female: 33 (18.4)	36.8	33 (64.7)	There was no significant difference (P=0.82)
Farley et al., 2010	Nigeria	Cross-sectional	Harmful alcohol use (an AUDIT score ≥8)	222	Male: 67 (30) Female: 155 (70)	-	20 (9)	177	Male: 62 (35) Female: 115 (65)	-	27 (15)	47 (12%) participants had an AUDIT score ≥8, and this was more frequent among ART-naive participants (*P* .06)
Kaguruki *et al*. 2014	Tanzania	Cross-sectional	Tobacco use (Current tobacco users (smoke and smokeless tobacco users).	354	Male: 114 (32.2) Female: 240 (67.8)	40.6	10 (38.5)	317	Male: 84 (26.5) Female: 233 (73.5)	36.7	16 (61.5)	There was no significant difference (P=0.99)
			Alcohol use (Used alcohol in the last 12 months)	354	Male: 114 (32.2) Female: 240 (67.8)	40.6	106 (48.0)	317	Male: 84 (26.5) Female: 233 (73.5)	36.7	115 (52.0)	Current alcohol drinking habit was significantly more observed among participants not on ART compared to those on ART (52.0% vs. 48.0%, p = 0.048)
			Low fruit and vegetable intake (Consumed vegetables/fruits <5 days in a week)	354	Male: 114 (32.2) Female: 240 (67.8)	40.6	240 (51.1)	317	Male: 84 (26.5) Female: 233 (73.5)	36.7	230 (48.9)	There was no significant difference (p=0.104)
			Physical inactivity (Never participate on vigorous intensity activity: included not participating in running, cycling, digging, and manual construction work,	354	Male: 114 (32.2) Female: 240 (67.8)	40.6	168 (52.3)	317	Male: 84 (26.5) Female: 233 (73.5)	36.7	153 (47.7)	There was no significant difference (P=0.448)

			brisk walking).									
Muhammad *et al.* 2013	Nigeria	Cross-sectional	Tobacco use (Cigarette smoking)	100	Male: 46 (46) Female: 54 (54)	32.81	10 (10)	100	Male: 48 (48) Female: 52 (52)	32.36	8 (8)	There was no significant difference (P=0.621)
Silva et al., 2009	Brazil	Cross-sectional	Tobacco use (Cigarette smoking)	243	Male: 145 (59.7) Female: 98 (40.3)	41.0	62 (25.5)	76	Male: 50 (65.8) Female: 26 (34.2)	34.8	23 (30.3)	There was no significant difference. Those on ART tended to be less likely to smoke cigarettes (p=0.250)
Smith et al., 2004	UK	Cross-sectional	Tobacco use (current smoker)	298	Male: 253 (85) Female: 45 (15)	34	129 (43)	96	Male: 82 (85) Female: 14 (15)	34	47 (49)	There was significant difference. Those on ART tended to be less likely to smoke cigarettes (P=0.06)
			Harmful alcohol use (consuming alcohol above the weekly recommended UK limit of 14 units/week for women and 21 units/week for men)	298	Male: 253 (85) Female: 45 (15)	34	18 (6)	96	Male: 82 (85) Female: 14 (15)	34	11 (11)	There was a significant difference. Those on ART tended to be less likely to consume alcohol above the recommended limit (P=0.08)
Soboka et al., 2014	Ethiopia	Cross-sectional	Harmful alcohol use (an AUDIT score ≥8)	322	Male: 118 (36.8) Female: 204 (63.2)	35.5	105 (32.6)	167	Male: 61 (36.8) Female: 106 (63.2)	35.5	64 (38.6)	There was no significant difference in the prevalence of AUDs in persons receiving ART compared to those who were ART naïve (32.6% vs. 38.6%).

3.3.4 Lifestyle Risk Behaviours for NCDs in HIV+ and HIV-Individuals

As shown in Table 3.4 and Table 3.5, characteristics of selected studies were recorded by exposure measures (HIV serostatus and ART status) in order to show whether or not there were significant differences in the prevalence of behavioural lifestyle risks between groups based on HIV serostatus and ART status. The prevalence of tobacco use ranged from 18 to 69.5% in HIV+ individuals, from 15.2 to 57% in those who were HIV-, from 10 to 43% in HIV+ on ART and from 8 to 61% in HIV+ individuals who were ART naïve. The prevalence of harmful alcohol use ranged from 9.1 to 64% in HIV+ individuals, from 5 to 66.7% in HIV- individuals, from 6 to 48% in HIV+ individuals on ART and from 11 to 52% in HIV+ individuals who were ART naïve. The prevalence of physical inactivity ranged from 12.8 to 70% in HIV+ individuals, from 10.5 to 71% in HIV- individuals, from 52.3 to 66.4% in HIV+ individuals on ART and from 47.7 to 64.7% in HIV+ individuals who were ART naïve. The mean prevalence of low fruit and vegetable intake for ART positive and ART negative comparators is 51.1% and 48.9% respectively. No study addressed the comparative prevalence of low fruit and vegetable intake between HIV+ and HIV- individuals. The main results of this review are presented below to indicate the association between HIV serostatus and each behavioural risk factor studied.

3.3.4.1 Tobacco Use

Out of 35 studies selected, 26 studies have highlighted associations between tobacco use and HIV serostatus (n=21) and ART status (n=5). The majority of studies (n=14, 67%) found that the prevalence of tobacco use was significantly higher in HIV+ individuals (Monroe et al.,

2015; Kooij et al., 2014; Kunasaki et al., 2014; Schouten et al., 2014; Womack et al., 2014; Crothers et al., 2013; Schillaci et al., 2013; Oursler et al., 2011; Freiberg et al., 2010; Crothers et al., 2009; Crothers et al., 2006; Justice et al., 2006; ; Jericó et al., 2005; Bergersen et al., 2004) whereas only two studies (Van Rooyen et al., 2014; Boodram et al., 2009) reported that the prevalence of tobacco use was significantly higher in HIV- compared to HIV+ individuals. In the five remaining studies, the prevalence of tobacco use was high in HIV+ subjects, but HIV+ and HIV-subjects did not differ significantly with regard to tobacco use (Mashinya et al., 2014; Oosthuizen et al., 2006; Peltzer et al., 2014; Hsue et al., 2010; Baekken et al., 2009). Additionally, the results showed that there was no significant difference in the prevalence of tobacco use between ART+ and ART- groups across five studies (Kaguruki et al., 2014; Muhammad et al., 2013; Aboud et al., 2010; Silva et al., 2009; Smith et al., 2004).

3.3.4.2 Harmful Alcohol Use

Among the 17 studies that examined harmful alcohol use in relation to HIV serostatus and ART status, the results were uncertain. Four studies highlighted that those who live with HIV are more prone to harmful alcohol use compared to those who are HIV- (Mashinya et al., 2014; Womack et al., 2014; Freiberg et al., 2010; Crothers et al., 2006). On the other hand, the same number of studies showed that the prevalence of harmful alcohol use was low in HIV+ subjects (Kunasaki et al., 2014; Schwartz et al., 2012; Boodram et al., 2009; Butt et al., 2009). However, five studies showed no statistical differences in the prevalence of harmful alcohol use between the HIV+ and HIV- groups (Peltzer et al., 2014; Onen et al., 2010; Howard et al., 2006; Justice et al., 2006; Oosthuizen et al., 2006). In three studies, harmful alcohol was not

related to ART status, and one study indicated that fewer HIV+ subjects on ART compared to HIV- ART-naive subjects reported harmful alcohol use.

3.3.4.3 Physical Inactivity

Ten studies provided a comparison of physical inactivity prevalence according to HIV serostatus and ART status. Five studies found that HIV+ individuals were more likely to be physically inactive (Schouten et al., 2014; Kooij et al., 2014; Stein et al., 2012; Oursler et al., 2011; Justice et al., 2006) and only one study indicated that HIV+ participants reported higher levels of physical activity, spending more time and expending more time and energy in weekly physical activity than the HIV- group (Fillipas et al., 2008). Two studies showed that the majority of the participants, both HIV+ and HIV-, were not physically active, and there was no statistically significant difference according to HIV serostatus (Monroe et al., 2015; Howard et al. 2007). With reference to ART status, there was no statistically significant difference in relation to physical inactivity highlighted in two of the studies (Kaguruki et al., 2014; Edward et al., 2013).

3.3.4.4 Low fruits and vegetable intake

Only one study has been identified to assess the association between low fruit and vegetable intake and ART status (Kaguruki et al., 2014). The results indicated that the prevalence of insufficient fruit and vegetable intake was evenly distributed among ART groups, with no significance difference between these groups.

3.4 Discussion

The review assessed whether or not there were significant differences in the prevalence of behavioural lifestyle risks between groups based on HIV serostatus and ART status. This review indicates that physical inactivity is more common among HIV+ subjects than those who are uninfected. A recent study of self-reported physical activity over time in patients enrolled in the Suiss HIV Cohort Study revealed that the percentage of patients reporting sedentary activity at work increase from 23% to 26% (Schäfer et al., 2017). Schäfer et al. (2017) believe that integrating physical activity counselling into routine HIV care and treatment and promoting physical activity among PLWHI has the potential to improve the general state of health and quality of life for those living with HIV and reduce their risk of CMDs. These findings are supported by other studies that indicate that physical inactivity in HIV+ subjects is due to HIV progression as well as the side effects of combined antiretroviral therapy with associated comorbidities, including peripheral neuropathy and depression (Liu et al., 2006; Ciccolo, Jowers & Bartholomew 2004). This is viewed as a significant public health concern, thus highlighting the need for behaviour changes in this population. Physical activity is a well-known strategy to prevent and control metabolic disturbances and morphologic changes associated with HIV infection itself and ART (Segatto et al., 2011; Fillipas, Cherry, Cicuttini, Smirneos & Holland, 2010). This re-emphasises the role played by physiotherapists to address the needs of persons with or at risk of NCDs. Despite, physiotherapists being well-equipped to plan and implement physical activity strategies in PLWHI, by preventing and managing NCDs related to physical inactivity in different population subgroups, referral for physiotherapy is still dependent on medical doctors. This clearly indicates the importance of raising awareness about the role of physiotherapy in health care delivery, especially in preventing and treating

NCDs, so that appropriate and timely referrals can be made. In this regard, inter-professional education may remove misconceptions about the profession and facilitate collaborative, inter-professional teamwork.

Tobacco use is also well-acknowledged as one of the most important modifiable risk factors for different conditions, including pulmonary tuberculosis, CVDs, and AIDS-related cancers (Shirley, Kaner & Glesby, 2013) and more as a predictor of low life expectancy than HIV itself in PLWHI (Helleberg et al., 2015). Hence, the high prevalence of tobacco use in PLWHI than in HIV- subjects in this review is a public health problem that needs attention. Following on this, integration of interventions that target smoking prevention and smoking cessation treatment in HIV care and treatment may improve QOL outcomes and life expectancy for those infected with HIV. Thus, regular attendance at HIV care and treatment facilities may facilitate the adoption and adherence of smoking cessation. More studies are needed to identify factors that influence tobacco use in PLWHI so that health care providers can design appropriate interventions. Furthermore, training health care providers in tobacco treatment and counselling methods is necessary to boost their confidence in preventing and treating tobacco use for those living with HIV. Efficacy and effectiveness studies of tobacco use cessation interventions for PLWHI would be greatly appreciated.

This review also reveals a high prevalence rate of alcohol consumption in both HIV+ and uninfected subjects. These findings highlight the need for community interventions addressing alcohol abuse. However, the similarity of harmful alcohol use prevalence rate in HIV+ and HIV- subjects should be interpreted with caution, because the majority of HIV+ participants

were sampled from health facilities and the self-report method was widely used in included studies. Thus, those infected with HIV were more likely to under-report alcohol use due to the fact that they were not comfortable to disclose their alcohol use in an area where alcohol use is prohibited while taking ART, due to interactive toxicity considerations. A recent narrative review confirms that that there are important drug interactions between alcohol and ART, or therapies for opportunistic infections and other co-morbidities (Schneider, Chersich, Temmerman, Degomme & Parry, 2014). This is also complemented by previous studies that reported that alcohol use was associated with non-adherence to ART and exacerbated the disease course for HIV+ subjects (Schneider et al., 2014; Parry, Rehm & Morojele, 2010). This suggests that screening of alcohol use and alcohol-related problems should be integrated into HIV care. Thus, screening using valid and reliable tools such as the AUDIT score that identifies hazardous and harmful alcohol use among PLWHI, may facilitate the referral process for further rehabilitation.

Furthermore, health care providers may assist PLWHI both on ART and those who are ART-naïve with information related to the detrimental effects of alcohol consumption. This discussion should include relevant topics, including how alcohol accelerates HIV disease progression, how alcohol is associated with low immune system, and that increases vulnerability to opportunistic infections. Moreover, health care providers should support PLWHI with strategies to enhance self-efficacy to modify alcohol drinking behaviours, in addition to providing them with more information on harmful effects of alcohol while on ART. Health care providers working in HIV clinics need more training on the subject of alcohol and HIV infection, so that they can provide guidance in this matter with confidence. Additionally,

one study reported that consuming few fruit and vegetables did not differ between HIV+ and those uninfected subjects. However, due to the well known benefits of fruit and vegetable for good health and in prevention of NCDs (Li, Fan, Zhang, Hou & Tang, 2014; Wang et al., 2014), these findings highlight the need for developing interventions that increase fruit and vegetable intake. In this regard, more emphasis should be placed on discussing the benefits of fruit and vegetable intake for good health and in the prevention of NCDs. Additionally, the dietary guidance on fruit and vegetable to be taken for beneficial effect should also be a topic of discussion.

The review attempted to investigate the behavioural lifestyle risk factors associated with NCDs in PLWHI, however, the following limitations are acknowledged. The search was restricted to articles published in English between January 2000 and December 2016. Studies including adult participants aged 18 years and above were considered. This review only emphasised four behavioural lifestyle risk factors. Aggregation of the prevalence of behavioural lifestyle risk factors for NCDs in HIV+ and HIV- subjects into a single summary figure was not done due to the heterogeneity of the included studies. This is explained by the variation among the reported prevalence rates, in addition to the variation in definitions of behavioural lifestyle risk factors across the studies.

3.5 Conclusion

The findings of this review reveal that physical inactivity and tobacco use are more prevalent in HIV-infected than uninfected subjects, while the association between alcohol consumption and HIV serostatus was inconclusive. Additionally, the prevalence of tobacco use, alcohol use,

and physical inactivity was high, and comparable in both HIV+ subjects on ART and those HIV+ subjects who are ART-naïve. The review identified no study comparing low fruit and vegetable intake according to HIV serostatus. In SSA, which has the highest global HIV infection rates, policy development and preventive strategies are needed to package and monitor lifestyle risk factors for NCD prevention for HIV+ adults, specifically tobacco use risks that result in higher prevalence and severity of pulmonary tuberculosis, CVDs, and AIDS-related cancers. In Rwanda, as in other SSA countries, life expectancy of PLWHI has increased dramatically as a result of cART. PLWHI can now live longer but with increasing rates of NCDs. Thus, prevention of NCD comorbidities in PWLHI is crucial to maintain and gain health-related benefits and to maximise the HRQOL in the long-term management of PLWHI. Further research into the prevalence of NCD risk factors, predictors, and measures of their impact in adults living with HIV may provide evidence to help healthcare providers and policy-makers to design and implement lifestyle behaviour change interventions for PLWHI. The next chapter discusses the methodology that is used in a study on NCD risk factors in adults living with HIV in Rwanda.

Chapter Four

Methodology

4.1 Introduction

This chapter outlines the methods followed to meet the following objectives:

1. to describe the associations and distribution patterns for behavioural and biological risk factors for NCDs among PLWHI in Rwanda
   i. by assessing the prevalence of behavioural and biological risk factors for NCDs among PLWHI;
   ii. by estimating the association of behavioural risk factors with sociodemographic and HIV-specific factors: biological risk factors and behavioural risk factors among PLWHI; and
   iii. by identifying factors that predict behavioural and biological risk factors among PLWHI;
2. to identify physical and mental health-related dimensions of QOL among PLWHI and determine their association to behavioural and biological risk factors for NCDs;
3. to assess knowledge of chronic diseases of lifestyle risk factors and their associated factors among adults living with HIV infection;
4. to identify motivators and barriers to physical activity participation and healthy diets and their influence on behavioural and biological risk factors for NCDs; and

5. to develop a health policy brief on strategies addressing behavioural and biological risk factors for NCDs among PLWHI.

A description of the research setting and study population is given as are the research instruments that were used. The data analysis process and the ethical considerations of the study are also described.

4.2 Research Setting

There are four primarily rural and one urban province in Rwanda, the latter being Kigali City province. The study was conducted in four randomly selected public health centres namely Remera, Kabusunzu, Nyagasambu, and Kamonyi from three purposively selected provinces: Kigali City, and the Southern and Eastern provinces of Rwanda. Public health centres were chosen over other health facilities as they are the most community-based decentralised HIV healthcare facilities. This is intended not only to increase the geographic coverage of HIV clinical care services for the provision of ART, but also to decrease the burden of providing HIV services at existing more tertiary and secondary level facilities while optimising the HIV care continuum for PLWHI. The study was carried out in outpatient HIV clinics from the selected public health centres that provide HIV services. As government-funded health centres, selected health centres share similar medical care protocols with other public health centres in the country.

4.3 Study Design

The study design is a quantitative cross-sectional design and provides an overall strategy to integrate the various components of the study in a coherent and logical way. This ensured that the research problem was effectively addressed, and a systematic methodology for data collection followed, measurements taken, and data analysis effectively undertaken. Quantitative research designs are classified into two main categories, namely descriptive or experimental research designs. A descriptive research design was used for this study; the researcher observed particular characteristics of the sample population as they occur, with no manipulation of any sort or interference (Chiappelli, 2014). A descriptive design is reserved to use numerical data and statistical analysis to provide systematic information about a phenomenon, and it attempts to determine the extent of associations between two or more variables (Burns & Grove, 2005). Subjects were measured once. Cross-sectional studies, known as cross-sectional analysis or transversal studies are observational studies that are valuable for exploring many exposures and outcomes at one time, and are relatively easy and economical to conduct (Olsen & George, 2004). Cross-sectional studies are suited to providing prevalence data which is helpful in assessing the health care needs of populations (Bonita, Beaglehole & Kjellström, 2006). This information is particularly useful for governments when making decisions regarding health policies. In addition, they give baseline data upon which hypotheses regarding risk or preventive behaviour factors in disease development and progression can be formulated. Therefore, it was an appropriate study design in this study to answer research questions related to the profile and predictors of NCD risk factors, as well as its association to HRQOL of PLWHI, with the purpose of developing preventive strategies for NCDs in this population.

4.4 Study Population and Sampling

4.4.1 Population

The target population of the study was composed of PLWHI attending selected public health centres in Rwanda. A research population refers to a well-defined group of individuals or objects that share many common characteristics, and are the main focus of a scientific inquiry (Kothari, 2004). The PLWHI attending the outpatient public health centres to receive ARV drugs, engage in health care consultation, counselling support, and who require laboratory testing-including those who needed assessment of their CD4 cell counts-were included in this study. The inclusion criteria for PLWHI were all adult males and females aged over 21 years who were able to provide written, informed consent. Both HIV+ patients on ART and HIV+ patients who were ART naïve were included. On the other hand, PLWHI attending private outpatient HIV clinics were not included, due to the fact that private and public healthcare systems are different (Basu, Andrews, Kishore, Panjabi & Stuckler, 2012). PLWHI in private health care are predominantly from a high socioeconomic status group and they may not represent the general population. Furthermore, pregnant women, PLWHI under the age of 21 years, and those who had mental illness and communication disorders were also excluded. Based on patient registers at the selected public health centres, the numbers amounted to 5 286 during the period of data collection.

4.4.2 Sampling Frame

A multistage sampling frame was employed. Multistage sampling refers to sampling plans where the sampling is conducted in stages using smaller and smaller sampling units at each

stage (Nafiu, Oshungade & Adewara, 2013). Multistage sampling can be a complex form of cluster sampling. Cluster sampling is a type of sampling that involves dividing the population into groups (or clusters). Thereafter, one or more clusters are randomly selected and everyone within the chosen cluster is sampled. Advantages of multistage sampling include the cost and the speed in which a survey can be completed, the convenience of finding a survey sample, and the fact that multistage sampling is usually more accurate than cluster sampling for the same size sample. Multistage sampling was chosen for this study since a list of all PLWHI in Rwanda was not available. This means that a good sampling frame for a dispersed PLWHI is undefined and the cost to reach a sampled element is very high. Thus, HIV+ subjects in a population can commonly be defined in a hierarchical manner. With respect to health centres, there were people living with HIV in HIV clinics, HIV clinics in health centres, health centres in districts, and districts in provinces.

Additionally, a non-probability sampling method was used for the selection of rural and urban residents. For this reason, purposive sampling of two provinces, namely the Southern and Eastern provinces, to represent rural Rwanda, and Kigali City to represent urban Rwanda was initially done. Each province (big cluster) contains a number of districts (small clusters) and each district contains health centres (sub-clusters). In this case, purposive sampling referred to a selection of the sample based on the researcher's knowledge of the population, its elements, and the nature of the research's aim (Babbie, 1999). This sampling technique was relevant for this study as the researcher used his own judgement in the selection of the sample members, assuming that rural residents have hugely different lifestyles to urban residents in terms of type of work and type of diet. This was followed by a simple random selection of one district from

each of the selected provinces, and two districts from Kigali City. Then, purposive sampling of all health centres that offer HIV care and treatment in each selected district was done, followed by a simple random sampling of one health centre in each selected district. The final number included four health centres. All consenting HIV+ patients aged 18 years and above attending the outpatient clinics at the selected health centres were recruited for the study. Figure 4.1 is the schematic diagram of the multistage sampling procedure.

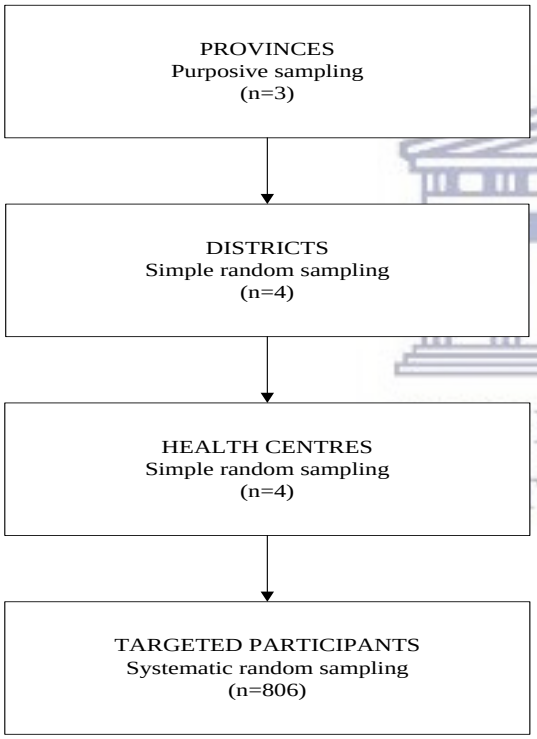


Figure 4.1: Diagram of multistage sampling procedure

4.4.3 Sampling Technique

The study participants were selected by using a systematic random sampling technique. Due to the large size of the population, the researcher cannot frequently test every individual in the population because it would be too costly and too time-consuming. This is the reason why researchers rely on sampling techniques. Among other types of probability sampling, systematic random sampling is a technique whereby each member of the study population is either assembled or listed, a random start is designed, or then members of the population are selected at equal intervals (Suresh, Thomas & Suresh, 2011). Systematic sampling is chosen due to its simplicity, the assurance that the population is evenly sampled and systematic random sampling assists the researcher to add a degree of system into the random selection of subjects (Castillo, 2009). Thus, based on the daily client attendance list for the specific day, every second client that came for ARV drugs or follow-up care at the outpatient HIV clinic during the period of November 2014 to June 2015 was approached to participate in the study. In the case where the selected subject chose not to participate in the study, the next client on the list was approached. A total number of 806 participants were targeted among the 5 326 eligible participants in selected health centres based on the sample size determined below.

4.4.4 Sample Size Determination

Patient registers at the four selected health centres were used to create sampling frames of all eligible patients per health centre. Sample size calculation was based on the relative contribution of eligible participants identified in each selected health centre. In this case, the sample size estimation was determined using the following formula $n=Z^2P\ (1-P)/d^2$ (Daniel,

1999). Where n = sample size, Z = Z statistic for a level of confidence of 95%, Z value is 1.96, d = precision of 5%, P = Prevalence or proportion of the population estimated to have a particular characteristic. There is no similar study about risk factors for NCDs in PLWHI in Rwanda, and due to the multivariate nature of the NCD risk factors, there was no realistic estimate for the prevalence of combined NCD risk factors. According to Macfarlane (1997), in a case of uncertainty about the value of P, it is better to use 50%, as it would give a larger sample size. Thus, the researcher assumed that 50% of PLWHI would have at least one of the NCD risk factors. Thus, n= $(1.96)^2$ x0.5 (1-0.5)/ $(0.05)^2$. This resulted in a minimum sample size of 384. In order to increase statistical power, to consider incomplete interviews and to incorporate a design effect within health centres, the sample was multiplied by two, as there is no previous information about design effect; this increased the sample size to 768. The sample size was also increased by 5% (38 cases) to allow for possible incomplete interviews. Therefore, the representative sample size of PLWHI was 806. Table 4.1 illustrates the number of participants from each selected health centre site.

Table 4.1: Number of participants from each selected health centre site

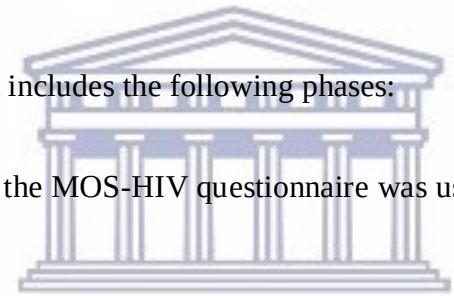
Health centre	Number of adults under HIV care and treatment	Weights	Sample size
1. Remera	2183	0.411	330
2. Kabusunzu	1564	0.294	234
3.Nyagasambu	903	0.169	137
4. Kamonyi	676	0.126	105
Total	**5326**		**806**

4.5 Data Collection Methods

The methods used to collect data for the study are outlined below. Data for PLWHI were collected quantitatively using different questionnaires. The questionnaires were administered by research assistants who obtained information from participants via face-to-face interviews. Physical examination was done to obtain the additional variables required. Description, validity, and reliability of research instruments and the methods pertaining to the development of a healthy policy brief are provided in the following sections. In order to meet the aim and objectives of this study, the PRECEDE model component guided the methodology of this study.

The PRECEDE model aspect includes the following phases:

Phase 1: Social Assessment: the MOS-HIV questionnaire was used to determine health-related QOL and associated factors.



Phase 2: Epidemiological and Behavioural Assessment: the WHO STEPS instrument (core and Expanded Version 1.4) was used to assess behavioural and biological risk factors for NCDs.

Phase 3: Educational and Public Health Assessment to guide context-specific dissemination plan: A knowledge assessment questionnaire relating to risk factors for NCDs and the Motivators and Barriers of Healthy Lifestyle Scale were used to assess predisposing, reinforcing, and enabling factors associated with risk factors for NCDs.

Phase 4: administrative and policy assessment and intervention alignment: Designing a health policy brief based on the key findings and recommendations from each of the abovementioned phases.

4.5.1 Research Instruments

Interview administered questionnaires and physical measurements were used to collect the data. Each of the questionnaires used in the study is described below.

4.5.1.1 Phase 1: Exploring Health-related Quality of Life Determinants

There are several instruments that can be used to measure HRQOL of PLWHI. However, only a few of them were approved as the most appropriate instruments. Both generic instruments such as SF-12, SF-36, EuroQol, and Health Utilities Index, and HIV-specific instruments such as MOS-HIV and FAHI should be used (Clayson et al., 2006; Grossman, Sullivan & Wu, 2003). These authors suggested that the choice of HRQOL instrument can be based on the brevity of the instrument and the usefulness of information it provides. The MOS-HIV was selected for use in this study due to the fact that is brief, available in a Kinyarwanda version, and is frequently used in PLWHI for comparison purposes between studies.

The MOS-HIV questionnaire: The health-related QOL was assessed with the MOS-HIV questionnaire (Appendix H). The MOS-HIV questionnaire was developed from the Medical Outcomes Study (MOS), and covers 35 items grouped into 11 health dimensions, including

general health perception (GH), physical functioning (PF), role function (RF), social function (SF), pain (P), cognitive functioning (CF), mental health (MH), energy/fatigue (EF), health distress (HD), QOL, and health transition (HT). MOS-HIV is brief; it takes no longer than 10 minutes to administer. The MOS-HIV also provides an overall physical and mental health summary score; with higher scores indicating a better overall physical and mental summary score (Revicki, Sorensen & Wu, 1998). The scores obtained for each dimension are transformed or standardised in order to make comparisons among various dimensions that may have different response categories. The score ranges from 0 (the lowest possible score) to 100 (the highest score). Data from various studies showed internal consistency reliability and validity of the MOS-HIV (Sekabira et al., 2012; Revicki et al., 1998; Wu, Revicki, Jacobson & Malitz, 1997).) According to Epino et al. (2012), the MOS-HIV has good internal consistency, with a Cronbach Alpha coefficient reported of .79.

4.5.1.2 Phase 2: Analysis of Risk Factors for NCDs

WHO's STEPS questionnaire: The risk factors for NCDs' analysis were assessed based on the WHO stepwise approach for the investigation of NCDs risk factors (WHO, 2001). The STEPS instrument comprises three steps, including a questionnaire based-assessment, simple physical measurements, and biochemical measurements. The present study only utilised the questionnaire assessment and the physical measures (Appendix G). Based on the WHO's stepwise approach, Step 1 provides information related to the questionnaire-based assessment, which includes sociodemographic characteristic data such as gender, age, marital status, educational level, employment status, monthly household income, disclosure of HIV status, residence location, tobacco use, alcohol consumption, physical activities, and diet habits

related to consumption of fruit and vegetables. Information related to HIV data such as duration of awareness of HIV diagnosis, CD4 cell count, ART status, duration on ART, type of ART regimen, and adherence to ART were collected from the participants' medical/clinical records to ensure the accuracy of the information. In Step 2 the anthropometric measurements such as weight, height, waist and hip circumference, and BP were taken. Additionally, the STEPS instrument for NCD risk factors is the standard instrument developed and disseminated by the WHO's STEPS programme for use after adaptation and translation, according to the requirements of the local settings. The WHO's STEPS questionnaire was used in East Africa among PLWHI (Kaguruki et al., 2014; Muronya et al., 2011) as well as in Rwanda in the general population (Ministry of Health [MOH], 2015).

4.5.1.3 Phase 3: Analysis of Determinants of Risk Factors for NCDs

a. The knowledge assessment questionnaire: Knowledge about risk factors for NCDs was measured with an adapted validated and reliable knowledge assessment questionnaire (Appendix I) about risk factors for chronic diseases of lifestyle (Frantz, 2008). The questionnaire comprised various sections of questions: five questions on hypertension; 11 questions on diabetes; and 10 questions on stroke. Thus, the knowledge questionnaire related to questions on hypertension, diabetes, and stroke, and the participants could obtain a maximum score of 5, 11, and 10 respectively, with a total score of 26 correct answers. Specifically, lifestyle changes, risk factors, and signs and symptoms were covered in this questionnaire. The reliability and validity of the knowledge assessment questionnaire relating to the risk factors for chronic lifestyle diseases have been reported to be appropriate. According to Frantz (2008),

the knowledge assessment questionnaire has good, acceptable psychometric properties, with a Cronbach Alpha coefficient of .80.

b. The Motivators and Barriers of Healthy Lifestyle Scale: Motivators and barriers to physical activity participation and healthy diet were measured with the Motivators and Barriers of Healthy Lifestyle Scale (MABS) (Appendix J) (Downes, 2010). The MABS assesses motivators and barriers of health behaviours, and identifies why an individual engages or does not engage in a healthy lifestyle. The MABS measures personal and environmental motivators and barriers of dietary and physical activity habits relevant to adult black people. The MABS was administered via face-to-face interview. The MABS consists of 19 items; nine positive items were included in the motivators dimension, and 10 negative items were included in the barriers dimension. Each item was scored by the participant as 1 = "strongly disagree", 2 = "disagree", 3 = "agree", and 4 = "strongly agree". Two separate scores are calculated by totalling the scores for each of the motivators and barriers dimensions separately. A higher score on the motivators dimension indicates the participants believe that there are more personal and environmental factors that facilitate healthy lifestyle behaviours than inhibitors, and a higher score on the barriers dimension indicates that an individual has more barriers to overcome than motivators. The maximum scores possible on the motivators and barriers dimensions are 36 and 40 respectively; the minimum scores on the motivators and barriers dimensions are nine and 10 respectively (Downes, 2010). The MABS demonstrates sound psychometric properties as a measure of factors that motivate or inhibit the practice of healthy lifestyle behaviours, with a Cronbach Alpha coefficient reported of 0.81 and 0.88 in the motivators and barriers dimensions respectively (Downes, 2010).

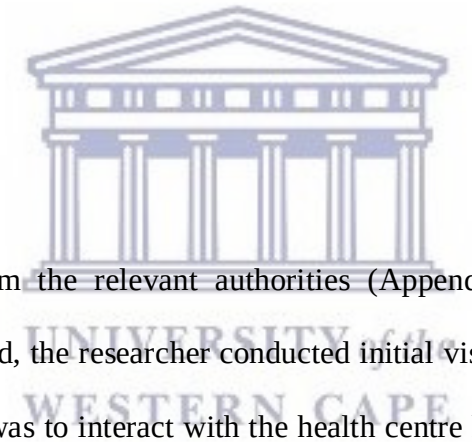
4.5.2 Instruments Translation and Adaptation of Questionnaires

Reliability and validity of the different questionnaires were highlighted under each section. However, these questionnaires were translated into Kinyarwanda. The following steps were undertaken to further ensure reliability and validity of these instruments.

A professional translator translated the questionnaires from English to Kinyarwanda, a local dialect spoken by all Rwandans. Thereafter, another independent translator translated the Kinyarwanda questionnaires into English to ensure validity of the instrument, and to check that accuracy was maintained. The final translated questionnaire was found to be similar to the original English questionnaire. A pre-test was conducted to check that the questions and answers were valid and reliable. The pilot study was undertaken on PLWHI in one health centre that was not included in the main study. All these measures were undertaken to determine how well respondents understood the questions and how long it would take them to answer the questions. The necessary modifications to the questionnaire were made after pre-test and piloting. Some questions were changed from the original questionnaire to meet the needs of the studied sample, while preserving their original meaning and purpose in a culturally-appropriate manner, especially in the WHO STEPS instrument, where some local examples were added to make the section related to risk factors and preventive behaviours more understandable.

In addition, well-trained research assistants measured and recorded the BP and anthropometric data following the WHO guidelines (WHO, 2014). Physical examinations were made using standardised techniques and calibrated equipment as described under the procedure section. An

automated sphygmomanometer calibrated automatically after a pause of one minute after each BP measurement whereas the weight scales and stadiometers were calibrated at the beginning and end of each examining day. Weight, height, waist and hip circumference, and blood pressure were taken two times for each participant. The average of two measurements of each variable was considered as the procedure to minimize the random error that is associated with the measurement (Pickering, Hall, Appel, Falkner, Graves, Hill, Jones, Kurtz, Sheps & Roccella, 2005.The time it took for participants to complete the questionnaire and for the research assistants to take physical measurements and consult data from the participants' medical records was between 45 minutes and one hour.



4.5.3 Procedure

Permission was sought from the relevant authorities (Appendices A, B, C & D). Once permission had been obtained, the researcher conducted initial visits to selected health centres. The purpose of these visits was to interact with the health centre heads and the outpatient HIV clinic staff about the research interests and purposes, and to request their permission for the study. Verification of the sample size of eligible participants in each selected health centre, planning of the venue, and logistics for data collection at each health centre, as well as the schedule for data collection in collaboration with the health centre administration were considered. Research assistants were recruited and trained on how to assist the researcher. A total of four recent graduates (females and males), including physiotherapists and nurses with previous research experience, constituted the informants team for this purpose. Training was conducted over two consecutive days by the researcher assisted by a lecturer who is

experienced in physiotherapy. The first day was reserved for familiarisation with the study objectives and protocols, with a focus on the study's objectives and their significance, how to obtain consent from research informants, and how to take anthropometric and clinic measurements. The second day was reserved for piloting and refining the questionnaire.

The researcher and a team of four research assistants visited selected health centres on different days between November 2014 and June 2015, based on a fixed schedule, which had been arranged between the researcher and the health centre administrative staff, until the sample size required at each selected health centre was reached. On each day of the data collection, the researcher introduced the research assistants to the participants prior to explaining the purpose of the study to the participants, after which participants voluntarily participated or abstained from participating. Data collection began by obtaining informed written consent from the participants.

The data was collected once-off for each participant at the following stations:

1. Verification of eligibility, completion of information related to HIV data such as duration of awareness of HIV diagnosis, CD4 cell count, ART status, duration on HAART, type of ART regimen, and adherence to ARV was collected from the participants' medical records, clinical data was taken from the clinical records, and questionnaires were completed via face-to-face interview.

2. Weight and height measurements were made. A digital scale measured weight in light clothes to the nearest 0.05kg, and a stadiometer was used to measure height to the nearest 0.1 cm. The BMI was calculated from height and weight measurements.

3. BP measurements were done using an automated sphygmomanometer Mars. Measurements of diastolic and systolic BP (SBP) were taken two times in a sitting position, with an interval of at least five minutes between measurements.

4. Waist and hip circumference measurements were taken with a flexible tape measure.

***Definitions used*:** 'currently daily smoker' was defined as someone who smokes tobacco on a daily basis, including cigarettes, cigars or pipes. Participants were defined as 'current drinkers' if they had consumed at least one drink of any alcoholic beverage during the past 30 days. 'Unhealthy diet' refers to insufficient consumption of vegetables and fruits. It means having less than five fruit and/or vegetable servings per day. Regarding physical inactivity, participants were firstly classified according to the Global Physical Activity Questionnaire (GPAQ) analysis framework, which assesses three categories of physical activity including a low, moderate, or high level (WHO, 2012). The three categories were then classified into physically active or physically inactive groups. The physically active group included participants classified as being in the moderate or high intensity category, and the physically inactive group included participants who were in the low intensity category. Based on the standard international classification (Centers for Disease Control and Prevention, 2013), BMI was calculated as weight in kilograms divided by height in metres squared. In this study, 'overweight' (combined overweight and obesity) was defined as having a BMI $\geq$ 25kg/m^2. The

WHR was calculated as the waist circumference divided by the hip circumference. 'Abdominal obesity' was defined as having a WHR greater than 0.95 for men and 0.85 for women. Finally, 'hypertension' or 'raised BP' is defined as a SBP of 140mm Hg or more, or a diastolic BP (DBP) of 90mm Hg or more, or taking antihypertensive medication.

4.5.4 Statistical Analysis

Data was analysed using SPSS Statistics 23. Descriptive statistics for all variables were generated. Continuous variables were summarised with mean and standard deviations. On the other hand, categorical variables were summarised with frequency and percentages. Data was presented in the form of tables and graphical representations. Behavioural and biological risk factors for NCDs were regarded as the primary outcome variables, while HRQOL, NCD risk factors, knowledge, and motivators and barriers were considered as secondary variables. Sociodemographic variables included gender, age, marital status, educational level, employment status, monthly household income, and residence location. HIV-related variables included duration of awareness of HIV diagnosis, CD4 cell count, ART status, and HIV status disclosure. In the bivariate analysis, a Chi-square test for independence was used to explore the relationship of the knowledge of NCD risk factors with sociodemographic and HIV-related factors, and that of NCD risk factors and NCD risk factor knowledge. While the independent-samples t-test was used to compare the mean score on motivators, barriers, the physical HRQOL, and the mental HRQOL dimensions for the two groups of participants**,** logistic regression was used to assess how well sociodemographic and HIV-related factors predict or explain NCD risk factors and knowledge of NCD risk factors. For multiple regression, both

hierarchical and standard multiple regression were used. A hierarchical multiple regression analysis was used to assess the ability of NCD risk factors to predict physical and mental health-related dimensions of QOL, after controlling sociodemographic and HIV-related factors. Whereas a standard multiple regression analysis was used to explore factors associated motivators and barriers dimensions, the models included all the variables that were found to be significant in the bivariate analysis.

4.6 Phase 4: Designing a Health Policy Brief

As mentioned in the Chapter One, the fourth phase to the PRECEDE model, namely the Administrative and Policy Assessment and Intervention Alignment is beyond the scope of this thesis. However, the information obtained from phases 1-3 was used to design a health policy brief that can influence policy-makers for necessary NCD prevention programmes among PLWHI. The health policy brief appears in Chapter Nine. This chapter summarises the key primary prevention strategies addressing risk factors for NCDs in PLWHI, by highlighting challenges and solutions based on the evidence drawn from the current study. Research topics based on the PRECEDE model phases are outlined in Figure 4.2

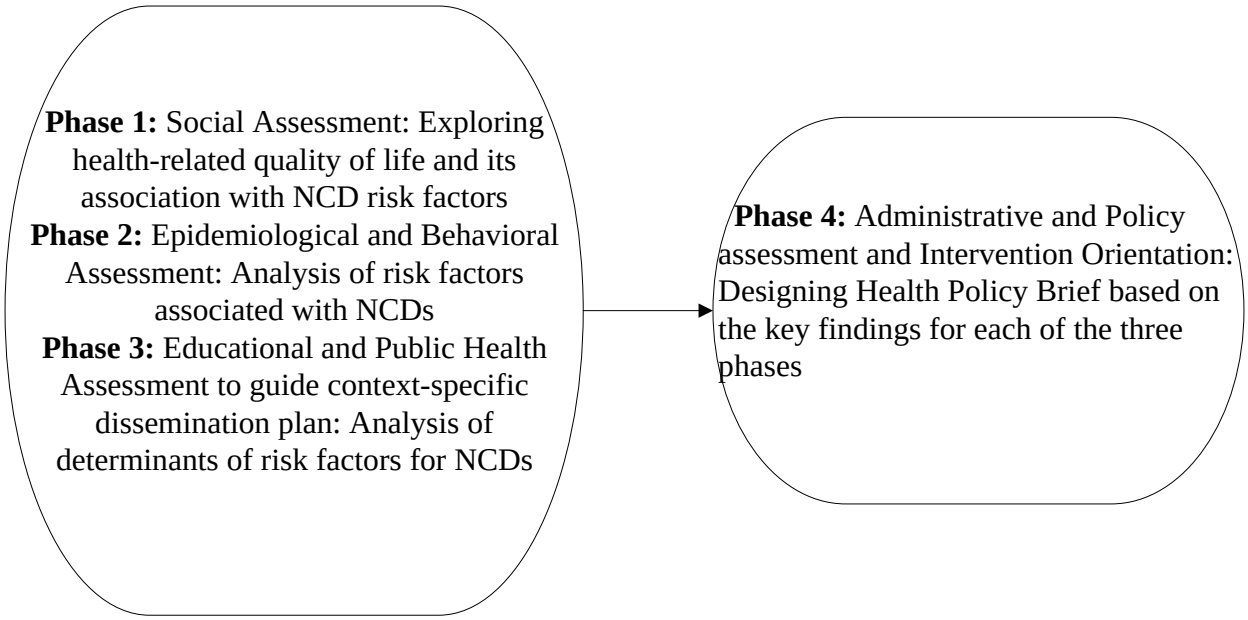


Figure 4.2: Study outline based on PRECEDE model

4.7 Ethical Considerations

Ethical clearance was obtained from the relevant authorities at the University of the Western Cape (Registration no: 13/6/34 - Appendix A), and permission was obtained from the relevant Rwandan committees (MINEDUC/S&/263/214 - Appendix D, NHRC/2014/PROT/0133 - Appendix B, 248/RNEC/2014 - Appendix C). Participants were informed of the nature and intention of the study in their language of choice. The participants were also informed of their right to withdraw from the process at any stage of the project, and that there was no harmful procedure involved. Written informed consent was obtained from volunteers before completing the questionnaires and prior to accessing their medical records. Participation was free and voluntary. Participants were assured of complete confidentiality throughout of the study, and their names were kept anonymous. No research participant was forced to answer questions which they feel uncomfortable answering. Only those who were willing to participate were

considered. Counselling was provided to all PLWHI prior to their participation in the research. In addition, females and males were accommodated in separate sections of the clinics to ensure privacy. The feedback of results and recommendations will be available to the relevant parties.

4.8 Summary

This chapter described different steps for the methodology used in this analytical cross-sectional study. Research methods and the logic behind the method used, as well as explanation on why certain methods or techniques were chosen, were described in systematic way. It explained the research setting and the whole procedure of how the data was collected and analysed. Finally, ethical considerations applied in this study were explained. The findings of the study are presented in the next chapter. Chapter 5 will include a detailed description of the study sample, together with a description of the results pertaining to the factors associated with HRQOL in adults living with HIV infection in Rwanda. In addition, a brief discussion will follow the results. The subsequent chapters (6-8) will provide the results and a discussion of the remaining objectives, without a description of the study sample already described in Chapter 5.

Chapter Five

Health-related quality of life and associated factors in adults living with HIV infection in Rwanda

5.1 Introduction

This chapter describes HRQOL and associated factors among PLWHI in Rwanda. The HRQOL was assessed with the MOS-HIV questionnaire (Appendix H) (Epino et al., 2012). Even though HIV is a chronic disease, the extensive use of ART has resulted in it being managed; available evidence supports the benefits of cART in improving HRQOL outcomes and life expectancy of those infected with HIV (Murray et al., 2014; Nakagawa, May & Phillips, 2013). However, achieving good ART adherence is central for long-term outcomes in PLWHI. Thus, identifying factors influencing ART adherence may help in understanding the strategies to enhance ART adherence for the purpose of improving HRQOL over time. However, ART does not fully restore immunity health, and a number of non-infectious diseases related to ageing and lifestyle in PLWHI affect respiratory, cardiac, and endocrine systems (Dawson et al., 2013). According to Rodriguez-Penney et al. (2013), the synergistic effects of age and HIV infection on the medical co-morbidity burden indicates that the prevalence and clinical impact of co-morbidities in older HIV+ adults underscores the importance of early detection and treatment efforts that might enhance HIV disease outcomes.

Currently, health-related benefits of PLWHI on ART have shifted from the survival to HRQOL outcomes (Miners et al., 2001; Call et al., 2000). Despite the fact that the life expectancy of

PLWHI has increased significantly (Nakagawa et al., 2013), identification of factors influencing HRQOL in this population is critical, as QOL of PLWHI may be affected by HIV progression, adverse effects of ART, and the aging process. In this case, more research is needed to gain a better understanding of the influences of soicodemographic, clinical, and psychosocial factors on HRQOL of PLWHI, and of interventions which may help in improving the HRQOL in this population.

'HRQOL' is a term referring to the impact of disease and treatment on QOL. It is a core concept that comprises mostly self-reported measures of physical and mental health dimensions, and it has become an increasingly popular subjective health evaluation method in chronic diseases. Assessing HRQOL helps to explain the disease burden and to assess the impact and quality of the health care system in follow-up consultations with patients who have chronic diseases (Kaplan & Ries, 2007). However, it is well known that the main purpose of the HIV Care Service is to improve and strengthen QOL of PLWHI. Hence, measuring HRQOL in the context of HIV infection is more important due to the chronic nature of HIV infection, the impact of ART, and the HIV infection itself. In this case, the HRQOL may determine the level of physical and psychological well-being of PLWHI. This assessment may provide valuable information for healthcare providers and policy-makers to complement information already collected from regular clinical practices for HIV care, such as monitoring of HIV viral load and CD4 cell count, which reflect the pathological abnormalities related to HIV. Thus, a HRQOL assessment may detect the problems affecting the progression of the disease, the patients' experiences of living with HIV, and may underscore the relevance of a multidisciplinary approach to HIV infection. In addition, previous researchers indicated that

the physical and mental HRQOL are lower among PLWHI, compared to the general population (Mrus et al., 2006; Bing et al., 2000). While earlier studies found that the physical and mental HRQOL in PLWHI were poorer in comparison to people suffering from other chronic diseases (Hays et al., 2000), many researchers are currently interested in identifying HRQOL determinants with the aim of maximising HRQOL of PLWHI.

A recent review of determinants of HRQOL in PLWHI revealed that HRQOL is influenced by various determinants (Degroote, Vogelaers & Vandijck, 2014). Degroote et al. (2014) believe that there is a consensus on the influence of socio-economic status, immunological status, and presence of symptoms, comorbidity, social support, and adherence to ART. Despite the growing body of knowledge regarding the determinants of HRQOL in PLWHI in developing countries (Bajunirwe et al., 2009; Poupard et al., 2007; Stangl et al., 2007), limited published information is available in Rwanda regarding HRQOL and HIV infection. A study conducted a decade ago to examine the relationship between body fat redistribution (BFR) and QOL in HAART-treated HIV+ subjects with BFR in Rwanda, has reported that body fat alterations negatively affect psychological and social domains of QOL (Mutimura, Stewart & Crowther, 2007). The study also revealed that HIV+ Rwandan women with BFR were significantly more affected by abdominal adiposity ($p < 0.001$) and facial and buttock atrophy ($p < 0.05$) in comparison to HIV+ men with BFR. Another study by Biraguma and Rhoda (2012) assessed the prevalence of peripheral neuropathy and QOL among adults living with HIV infection in Rwanda. The authors found that PLWHI with neuropathy had lower QOL scores in the physical and psychological domains than those without neuropathy symptoms. Evidence from

these studies highlights the need for specific strategies to prevent and manage comorbidities for HIV in Rwanda.

Following this, several studies have also been conducted investigating NCD risk factors in PLWHI (Kagaruki et al., 2014; Edward et al., 2013; Muronya et al., 2011). These studies provide evidence that risk factors for NCDs were more prevalent in PLWHI on ART. This is also complemented by other researchers who found that the prevalence of hypertension was significantly higher in PLWHI on ART compared to those who were not on treatment (Dimala, Atashili, Mbuagbaw, Wilfred & Monekosso, 2016; Nduka, Stranges, Sarki, Kimani & Uthman, 2016). However, despite the widespread availability of evidence of a huge burden of NCD risk factors in PLWHI, there is a dearth of research on the relationship between NCDs and the risk factors associated with them and the HRQOL in PLWHI. The few available studies conducted in this area have generally focused on single risk factors for NCDs and HRQOL, and have been carried out in developed countries (Korthuis et al., 2008; Turner et al., 2001). These studies highlight the fact that participants who were physically inactive and smokers reported a lower physical and mental HRQOL. The results support integration of physical activity and smoking cessation in the clinical management of PLWHI. This is also confirmed by Mutimura et al. (2008) who suggest that exercise training reduces central adiposity and improves metabolic indices in HAART-treated HIV+ subjects in Rwanda. Thus, further research will help in understanding the influence of various NCD risk factors on the HRQOL of PLWHI. In this regard, health care providers and policy-makers will achieve a deeper understanding of these comorbidities in the comprehensive care of PLWHI. Hence**,** understanding NCD risk predictors for lower HRQOL is crucial in maximising the HRQOL in long-term management

of PLWHI, especially in designing health education programmes and informing health policy. The present aspect of the study aimed to: (1) identify physical and mental health-related dimensions of QOL among PLWHI in Rwanda; and (2) determine the associations between behavioural and biological risk factors for NCDs with physical and mental health-related dimensions of QOL.

5.2 Results

5.2.1 Description of Study Sample

A total number of 806 of PLWHI were approached in four selected health centres, and 794 participants consented to participate, yielding a response rate of 98.5%. The mean age of the respondents was 38 years (SD=10.8), and the ages ranged from 18 years to 70 years. The majority of the participants were female (n=513; 64.6%), had primary or no formal education (n= 636; 80.1%), were currently married (n=507; 63.9%), lived in an urban area (n=535; 67.4%) and fell into the age range of 18-40 years (n=485; 61.1%). Table 5.1 and 5.2 summarises information regarding the sociodemographic characteristics of the study's participants.

Table 5.1: Distribution of sociodemographic characteristics for gender, education, marital status (N=794)

Characteristics	Total N=794	PLWHI on ART n=698	PLWHI not on ART n=96	p-value
Gender				< 0.001

Women	513 (64.6)	471 (67.5)	42 (43.8)	
Men	281 (35.4)	227 (32.5)	54 (56.3)	
Age group/ years				0.570
18-30	240 (30.2)	206 (29.5)	34 (35.4)	
31-40	245 (30.9)	218 (31.2)	27 (28.1)	
41-50	204 (25.7)	183 (26.2)	21 (21.9)	
> 50	105 (13.2)	91 (13.0)	14 (14.6)	
Marital status				0.076
Never married	145 (18.3)	121 (17.3)	24 (25.0)	
Currently married	507 (63.9)	457 (65.5)	50 (52.1)	
Separated/Divorced	52 (6.5)	43 (6.2)	9 (9.4)	
Widowed	90 (11.3)	77 (11.0)	13 (13.5)	
Educational level				0.378
No formal education	160 (20.2)	139 (19.9)	21 (21.9)	
Primary	476 (59.9)	415 (59.5)	61 (63.5)	
≥ Secondary	158 (19.9)	144 (20.6)	14 (14.6)	

Table 5.2: Distribution of sociodemographic characteristics for employment, monthly household income, and residence (N=794)

Characteristics	Total N=794	PLWHI on ART n=698	PLWHI not on ART n=96	p-value
Employment status				0.009
Public service	81 (10.2)	75 (10.7)	6 (6.3)	
Self-employed	264 (33.2)	225 (32.2)	39 (40.6)	
Peasant/Farmer	252 (31.7)	233 (33.4)	19 (19.8)	
Unemployed	197 (24.8)	165 (23.6)	32 (33.3)	
Monthly household income				0.067
≤ 20000 RWF	179 (22.5)	158 (22.6)	21 (21.9)	
20001-40000 RWF	311 (39.2)	276 (39.5)	35 (36.5)	
40001-60000 RWF	129 (16.2)	104 (14.9)	25 (26.0)	
60001-80000 RWF	65 (8.2)	59 (8.5)	6 (6.3)	
> 80000 RWF	110 (13.9)	101 (14.5)	9 (9.4)	
Residence location				< 0.001
Rural	259 (32.6)	248 (35.5)	11 (11.5)	
Urban	535 (67.4)	450 (64.5)	85 (88.5)	

Note: 1USD=785 Rwandan Franc

Table 5.3 illustrates the characteristics of the study's participants according to their HIV-related characteristics. The majority of the participants had known their HIV+ status for a

period of 1-6 years (n=603; 76.0%), were on ART (n=698; 87.9%), had their CD4+ count > 350mm^3 (n=545; 68.6%), and disclosed their HIV status (n=633; 79.7%).

Table 5.3: Distribution of HIV-related characteristics of the study participants

Characteristics	Total N=794	PLWHI on ART n=698	PLWHI not on ART n=96	p-value
Time since HIV diagnosis				0.001
≤ 3 years	338 (42.6)	280 (40.1)	58 (60.4)	
4-6 years	265 (33.4)	243 (34.8)	22 (22.9)	
≥ 7 years	191 (24.1)	175 (25.1)	16 (16.7)	
CD4 cell count				0.075
≤ 200 cells/µl	84 (10.6)	77 (11.0)	7 (7.3)	
201-350 cells/µl	165 (20.8)	148 (21.2)	17 (17.7)	
351-500 cells/µl	220 (27.7)	199 (28.5)	21 (21.9)	
> 500 cells/µl	325 (40.9)	274 (39.3)	51 (53.1)	
Disclosure of HIV+ serostatus				< 0.001
Yes	633 (79.7)	612 (87.7)	21 (21.9)	
No	161 (20.3)	86 (12.3)	75 (78.1)	

Table 5.4 indicates the comparison of behavioural and biological risk factors for NCDs for HIV+ participants on ART and HIV+ and ART-naïve study participants. All behavioural risk factors and BMIs were comparable, while WHR and BP were not. The proportion of the participants with increased WHR was significantly higher among PLWHI on ART than those not on ART (46.1% vs. 24.2%, p<0.001), while the proportion of the participants with hypertension was significantly lower among PLWHI on ART than those not on ART (20.3% vs. 54.2%, p<0.001).

Table 5.4: Distribution of behavioural and biological risk factors for NCDs

Characteristics	Total N=794	PLWHI on ART n=698	PLWHI not on ART n=96	p-value
Tobacco use				0.679
Non users	665 (83.8)	586 (84.0)	79 (82.3)	
Users	129 (16.2)	112 (16.0)	17 (17.7)	
Alcohol use				0.795
Non users	545 (68.6)	478 (68.5)	67 (69.8)	
Users	249 (31.4)	220 (31.5)	29 (30.2)	
Physical activity level [a]				0.276
Low	203 (26.3)	176 (25.9)	27 (29.0)	
Moderate	184 (23.8)	168 (24.7)	16 (17.2)	
High	385 (49.9)	335 (49.3)	50 (53.8)	
Fruits and vegetables intake				0.717
≥ 5 servings	28 (3.5)	24 (3.4)	4 (4.2)	
< 5 servings	766 (96.5)	674 (96.6)	92 (95.8)	
BMI/ kg/m^2 category [b]				0.056
Underweight	98 (12.3)	82 (11.7)	16 (16.7)	
Normal weight	550 (69.3)	493 (70.6)	57 (59.4)	
Overweight	115 (14.5)	100 (14.3)	15 (15.6)	
Obese	31 (3.9)	23 (3.3)	8 (8.3)	
Abdominal obesity [c]				< 0.001
No	437 (56.6)	365 (53.9)	72 (75.8)	
Yes	335 (43.4)	312 (46.1)	23 (24.2)	
Hypertension [d]				< 0.001
No	600 (75.6)	556 (79.7)	44 (45.8)	
Yes	194 (24.4)	142 (20.3)	52 (54.2)	

[a] Low: <600MET min/week; moderate: 600–2999 MET min/week; high: ≥1500 MET min/week vigorous physical activity or ≥ 3000 MET min/week moderate/vigorous physical activity.
[b] Underweight: <18.5; normal: 18.50–24.99; overweight: 25.00–29.99; obese: ≥ 30.0.
[c] Having WHR greater than 0.95 for men and 0.85 for women.
[d] A SBP of 140 mm Hg or more, or a DBP of 90 mm Hg or more.

5.2.2 Heath-related Quality of Life

The HRQOL was measured by the MOS-HIV Health Survey. The questionnaire consisted of 11 MOS-HIV sub-scales, including general health perception, bodily pain, physical

functioning, role function, social function, mental health, vitality, health distress, cognitive functioning, QOL, and health transition. Based on these sub-scales, the PHS and MHS scores were calculated. The mean PHS value was 63.96±11.68, with a range of 30-92, and the mean value of mental MHS was 53.43±10.89, ranging from 26.0-78.3. Table 5.5 shows the distribution of mean, SD, median and interquartile range (IQR) values of the MOS-HIV questionnaire domains.

Table 5.5: Distribution of MOS-HIV scores

Dimensions	Mean ± SD	Median [IQR]	Minimum	Maximum
A. PHS	63.96±11.68	64.00 [57.56-72.00]	30	92
- GH	41.35±10.28	40.00 [35.00-50.00]	15	70
- PF	67.28±12.25	58.33 [58.33-83.33]	58	92
- RF	76.65±36.74	100.00 [50.00-100.00]	0	100
- SF	77.34±23.35	80.00 [60.00-100.00]	0	100
- P	57.04±26.96	44.44 [44.44-77.78]	0	100
B. MHS	53.43±10.89	53.67 [46.00-61.17]	26	76
- CF	58.15±16.00	60.00 [45.00-70.00]	20	95
- MH	45.54±12.05	40.00 [36.00-60.00]	32	76
- EF	54.20±9.94	50.00 [50.00-60.00]	35	75
- HD	60.71±19.40	60.00 [50.00-75.00]	15	100
- QOL	50.40±31.74	50.00 [25.00-75.00]	0	100
- HT (changes in health status)	50.56±31.93	50.00 [25.00-75.00]	0	100

Abbreviations: *PHS* Physical health summary score, *GH* General Health Perception, *PF* Physical Functioning, *RF* Role function, *SF* Social function, *P* Pain, *MHS* Mental health summary score, *CF* Cognitive Functioning, *MH* Mental Health *EF* Energy/Fatigue, *HD* Health Distress, *QOL* Quality of life, *HT* Health transition

5.2.3 Sociodemographic and HIV-related Variables with the Physical and Mental Health Summary Scores

The PHS and MHS are presented with respect to the specific sociodemographic and HIV-related variables (Table 5.6). The specific sociodemographic and HIV-related variables include age, marital status, educational level, employment status, monthly household income, disclosure of HIV + serostatus, time since HIV diagnosis, CD4 cell counts, ART use, and ART duration.

Table 5.6: Mean values of PHS and MHS with respect to the specific sociodemographic and HIV-related variables

	PHS		MHS	
	Mean ± SD	**Significance Test**	**Mean ± SD**	**Significance Test**
Age		p=0.147		p=0.027
≤ 40 years	64.45± 11.29		54.22 ± 10.67	
> 40 years	63.19±12.34		52.44 ± 11.07	
Gender		p=0.094		p=0.599
Female	63.42 ± 11.51		53.35 ± 10.97	
Male	64.92± 12.11		53.79 ± 10.68	
Marital status		p <0.001		p <0.001
Married	65.21± 11.31		54.86 ± 10.54	
Not married	62.04± 12.12		51.47 ± 11.04	
Educational level		p=0.006		p=0.217
≤ primary schooling	63.36 ± 11.81		53.26± 10.98	
> primary schooling	66.29± 11.14		54.48± 10.37	
Employment status		p=0.028		p=.012
Employed	64.56± 11.70		54.15± 10.35	
Unemployed	62.53± 11.71		52.01 ± 11.85	
Monthly Income		p=0.130		p=0.557
> 40000RWF	64.75± 12.04		53.79 ± 10.79	
≤ 40000RWF	63.43± 11.52		53.32± 10.92	
Disclosure of HIV + serostatus		p=0.004		P<0.001
Yes	64.60 ± 11.26		54.38± 10.69	

No	61.67± 13.02		50.51± 10.93	
CD4 cell counts		P<0.001		p=0.010
≥ 350 cell counts	65.14 ± 11.42		54.20 ± 10.63	
< 350 cell counts	61.47± 12.02		52.05 ± 11.21	
Time since HIV diagnosis		p=0.004		p=0.476
> 5 years	65.74 ± 10.89		53.91 ± 11.10	
≤ 5 years	63.10± 12.03		53.31± 10.76	
ART use		p=0.252		p=0.927
Experienced	64.12 ± 11.59		53.51± 10.82	
Naïve	62.66 ± 12.65		53.40± 11.21	

An independent sample t-test was conducted to examine whether there were significant differences between PHS and MHS scores in the various categories of participants.

The following results were produced from the analyses in Table 5.6 above. The participants who were 40 years and below had higher MHS scores (Mean=54.22 ± 10.67) than those who were older than 40 years (Mean=52.44 ± 11.07, p= 0.027). Those who were married had higher scores in both PHS and MHS (Mean= 65.21±11.31; Mean=54.86 ± 10.54) than those who were not married, including never married, separated, divorced, and widowed (Mean=62.04±12.12, p <0.001; Mean=51.47 ± 11.04, p <0.001) respectively. The participants who had higher education than primary schooling had higher scores in PHS (Mean=66.29± 11.14) compared to those who had primary or less schooling (Mean= 63.36 ± 11.81, p= 0.006). Those who were employed had higher scores in PHS and MHS (Mean= 64.56± 11.70; Mean= 54.15± 10.35) than those who were unemployed (Mean=62.53± 11.71, p= 0.028; Mean=52.01 ± 11.85, p= 0.012) respectively. Participants who disclosed their HIV+ serostatus to somebody had higher scores in PHS and MHS (Mean=64.60 ±11.26; Mean=54.38± 10.69) than those who did not disclose their HIV+ serostatus (Mean= 61.67± 13.02, p= 0.004; Mean= 50.51± 10.93, p <.001) respectively. Participants who had CD4 cell counts of ≥ 350 had higher scores in PHS and

MHS (Mean= 65.14 ± 11.42; Mean=54.20 ± 10.63) than those who had CD4 cell counts of < 350 (Mean=61.47± 12.02, p <0.001; Mean=52.05 ± 11.21, p=0.010) respectively. The participants who were HIV+ for more than five years had higher scores (Mean= 65.74 ± 10.89) in PHS scores than those who were HIV+ for less than five years (Mean= 63.10± 12.03, p=0.004). There were no statistically significant differences in PHS and MHS scores regarding gender, monthly household income, and ART use status.

5.2.4 Behavioural and Biological Risk Factors for NCDs with the Physical and Mental Health Summary Scores

Table 5.7: illustrates the mean values of PHS and MHS scores for participants with and without risk factors for NCDs. NCD risk factors include tobacco use, alcohol use, low fruit and vegetable intake, physical inactivity, overweight, abdominal obesity, and hypertension.

Table 5.7: Mean values of PHS and MHS health summary scores for participants with and without NCD risk factors

	PHS		MHS	
	Mean ± SD	**Significance Test**	**Mean ± SD**	**Significance Test**
Tobacco use		p=0.046		p<0.001
No	64.19 ±11.86		54.53± 10.41	
Yes	61.58± 10.33		43.72± 10.27	
Alcohol use		p=0.367		p=0.035
No	63.68± 11.72		54.05± 10.60	
Yes	64.52± 11.78		52.24± 11.36	
Physical inactivity		p=0.002		p=0.619
No	64.21 ± 10.93		52.94± 10.76	
Yes	60.20± 14.35		52.44± 10.69	
Low fruit and vegetable intake		p=0.756		p=0.788

	No	63.95± 11.769		53.64± 10.28	
	Yes	63.67± 10.968		53.53± 10.91	
Overweight			p=0.287		p=0.341
	No	63.73± 11.66		53.67± 10.84	
	Yes	64.92 ± 10.09		52.69± 10.97	
Abdominal obesity			p=0.026		p=0.014
	No	64.89± 11.95		54.38± 10.48	
	Yes	62.93± 11.42		52.38± 11.28	
Hypertension			p=0.003		p=0.926
	No	64.69± 11.21		53.48± 10.58	
	Yes	61.41± 13.05		53.57± 11.79	

An independent t-test was conducted to determine if significant differences existed between physical and mental health-related QOL of respondents with and without behavioural and biological risk factors for NCDs. The results indicate that those who were tobacco users, those who were physically inactive, those with abdominal obesity, and those experiencing hypertension reported significantly lower PHS scores (p-value: 0.046, 0.002, 0.026 and 0.003 respectively). Participants who were tobacco users, alcohol users, and those who had abdominal obesity had lower MHS scores (p-value: < 0.001, 0.035 and 0.014 respectively). There were no significant differences in PHS and MHS scores in relation to physical inactivity, low fruit and vegetable intake, and being overweight.

5.2.5 Factors Associated with Health-related Quality of Life among PLWHI

A hierarchical multiple regression analysis was used to assess the ability of NCD risk factors to predict overall PHS and MHS, after controlling the influence of socio demographic and HIV-related factors. Included in the model were all the variables that showed statistically significant associations ($p<0.05$) in the bivariate analysis. Preliminary analyses were conducted to guarantee against violation of the assumptions of normality, linearity, multicollinearity, and

homoscedasticity. The overall of model fit reveal that socio demographics, HIV-related, and risk factors for NCDs were significantly associated with PHS and MHS.

Table 5.8 illustrates the association between behavioural and biological risk factors for NCDs and PHS. For PHS score dimensions the marital status, level of education, and employment status were entered into the model first, and were significantly related to PHS, explaining 8% of the variance (Table 5.8; R square=0.081, F(3, 644) = 5.977, p =0.001). Introducing CD4 cell counts, disclosure of HIV+ serostatus, and HIV duration variables added 7% of variation in the PHS, and this change in R square was significant (Table 5.8; R square=0.072, F(3, 641)=5.309, p =0.001). The total variance explained by the model as a whole, including NCD risk factors, was 23% and significant, F (10, 637) =5.168, p < .001 for PHS. NCD risk factors explained an additional 8% of the variance in PHS after controlling socio demographic and HIV-related factors, and this change in R square was significant, F change (4, 637)=4.195, p=0.002. This suggested that behavioural and biological risk factors for NCDs have the effect above and beyond the effects of sociodemographic and HIV-related factors. In the final model, five control measures were statistically significant for PHS. The PHS scores increased by 0.09 points for participants who were currently married (beta= .086, p = .039), and decreased by 0.09 points in participants who had CD4 counts less than 350 cells/µl (beta=-.085, p=.036), 0.09 points in participants who had abdominal obesity (beta=-.086, p=.026), 0.10 for participants who were physically inactive (beta=-.098, p =.012), and 0.11 points for participants who were hypertensive (beta= -.107, p =.008).

Table 5.8: Hierarchical multiple regression analysis for predicting PHS

Variables	PHS								
	Overall F-test	**Beta**	**t**	**df**	**p-value**	**R square**	**Adjusted R square**	**R square change**	**Sig. F change**
Model 1	5.977			3,644	.001	.081	.069	.081	.001
Marital status		.116	2.858		.004				
Education		.085	2.153		.032				
Employment		-.068	-1.641		.101				
Model 2	5.703			6,641	.000	.153	.126	.072	.001
Marital status		.104	2.525		.012				
Education		.071	1.822		.069				
Employment		-.052	-1.256		.210				
CD4 count		-.110	-2.731		.006				
Disclosure of HIV+ serostatus		-.027	-.639		.523				
HIV duration		-.063	-1.609		.108				
Model 3	5.168			10,637	.000	.225	.183	.072	.002
Marital status		.086	2.038		.039				
Education		.070	1.788		.074				
Employment		-.033	-.793		.428				
CD4 count		-.085	-2.015		.036				
Disclosure of HIV+ serostatus		.001	.012		.990				
HIV duration		-.065	-1.642		.101				
Tobacco use		-.053	-1.106		.269				
Physical inactivity		-.098	-2.374		.012				
Abdominal obesity		-.086	-2.225		.026				
Hypertension		-.107	-2.421		.008				

F-statistic and p-value < 0.05

Table 5.9 shows the association between behavioural and biological risk factors for NCDs and MHS. For MHS dimensions the age, marital status, and employment status were entered in the model first, and were significantly related to MHS, explaining 9% of the variance (Table 5.9; R square=0.090, F (3, 722) =7.418, p<.001). Introducing CD4 cells counts and disclosure of HIV+ serostatus variables explained an added 4% of variation in MHS, and this change in R

square was significant (Table 5.9; R square=0.042, F(2, 720)=5.377 p= 0.05). The addition of NCDs risk factors (alcohol use, tobacco use, and abdominal obesity) at Step 3 explained an additional of 23% in the variation of MHS after controlling the influence of socio demographic and HIV-related factors, and this change in R square was significant (Table 5.9; R square=0.228, F (3, 717) =20.532, p<.001). This suggested that the relationship between NCD risk factors (alcohol use, tobacco use, and abdominal obesity) and MHS is not mediated or explained by sociodemographic and HIV-related factors. The total variance explained by the model as a whole, including NCD risk factors, was 36%, F (8, 717) =12.198, p<.001 for MHS. The results indicate that four control measures, including marital status (beta=.111, p= .003), disclosure of HIV serostatus (beta=-.084, p=0.027), tobacco use (beta=-.272, p <.001), and abdominal obesity (beta=-.089, p=.011) explained significant variances in the MHS. The MHS scores increased by 0.11 points for participants who were currently married, and the MHS decreased by 0.08 points for participants who did not disclose their HIV+ serostatus, decreased 0.09 points for those who had abdominal obesity, and decreased 0.27 points for those who were tobacco users.

Table 5.9: Hierarchical multiple regression analysis for predicting MHS

Variables	MHS								
	Overall F-test	**Beta**	**T**	**Df**	**p-value**	**R square**	**Adjusted R square**	**R square change**	**Sig. F change**
Model 1	7.418			3,722	.000	.090	.078	.090	.000
Age		-.065	-1.767		.078				
Marital status		.135	3.470		.001				
Employment		-.051	-1.298		.195				
Model 2	6.656			5,720	.000	.132	.114	.042	.005
Age		.054	-1.445		.149				
Marital status		.114	2.925		.004				
Employment		-.029	-.744		.457				
CD4 count		-.052	-1.381		.168				

Disclosure of HIV+ serostatus		-.107	-2.755		.006				
Model 3	12.198			8,717	.000	.360	.330	.228	.000
Age		-.017	-.482		.630				
Marital status		.111	2.955		.003				
Employment		-.005	-.127		.899				
CD4 count		-.029	-.791		.429				
Disclosure of HIV+ serostatus		-.084	-2.223		.027				
Tobacco use		-.272	-7.230		.000				
Alcohol use		.008	-.225		.822				
Abdominal obesity		-.089	-2.540		.011				

F-statistic and p-value < 0.05

5.3 Discussion

The study examined the association between physical and mental health-related dimensions of QOL with behavioural and biological risk factors, after controlling sociodemographic and HIV-related factors in adults living with HIV infection in Rwanda. The findings revealed that the physical HRQOL dimension had higher scores than the mental HRQOL dimension in the current study. These findings are related to other studies that used a similar questionnaire (Briongos Figuero et al., 2011; Bachiller Luque et al., 2011; Perez et al., 2005). In addition, the findings highlight an improvement in the HRQOL, contrary to a previous study (Delate & Coons, 2001). In that study (Delate & Coons, 2001), the participants reported a low HRQOL, with the mean scores for the PHS and MHS being 42.8 ±10.9 and 46.6 ±6.2, respectively. This confirms that the success of cART is associated with better virology and immunological status. Thus, interventions to enhance ART adherence are urgently required to improve and maintain the HRQOL of PLWHI on ART. These interventions may include education, cognitive-behavioural interventions, directly observed therapy, treatment supporters, and active

adherence reminder devices (Chaiyachati et al., 2014). Hence, routine assessment of the HRQOL will help to better understand the impact of HIV infection itself, and ART on health and the QOL of those living with HIV may provide potential information to inform interventions that can improve the HRQOL in this population.

On the other hand, lower scores in the mental HRQOL may be explained by different factors, including psychosocial factors. Available evidence highlights the high prevalence of psychological morbidity, especially depression, in PLWHI (Mohammed, Mengistie, Dessie & Godana, 2015; Bhatia & Munjal, 2014), and it presents depression as an important predictor of a poor mental HRQOL (Briongos Figuero et al., 2011). In this vein, a study that aimed to assess the prevalence, socio-demographic determinants and phenomenology of depressive disorder among PLWHI was conducted in Nigeria (Aguocha et al., 2016), and authors concluded that there was a high rate of depression, especially among female PLWHI in South East Nigeria, and they recommended that mental health services should be an integral part of HIV care and treatment. This is also complemented by Bernard, Dabis and de Rekeneire (2017) who suggested that the pooled prevalence estimates of depression ranged between 9% and 32% in PLWHI on ART antiretroviral and in untreated or mixed (treated/untreated) ones, while reported factors of depression were low socio-economic conditions in PLHIV on ART, female sex and immunosuppression in mixed/untreated PLWHI. In this regard, early identification and proper treatment of psychological morbidity may enhance the mental HRQOL of PLWHI. Thus, routine screening and treating depression in PLWHI are highly recommended.

The results of this study reveal that behavioural and biological risk factors for NCDs were significantly associated with a lower HRQOL. In addition, NCD risk factors exclusively contributed to a lower HRQOL between PLWHI, after controlling sociodemographic variables and HIV-related factors (disclosure of HIV status, CD4 cell count, and the length of HIV infection). In addition, the study revealed an increase in the prevalence of risk factors for NCDs in PLWHI and a longer life expectancy for PLWHI. This means that prevention and control of NCDs and their risk factors is an important public health concern in HIV care and treatment. While tobacco use and abdominal obesity were associated with a poor mental HRQOL, physical inactivity and hypertension were associated with a poor physical HRQOL. Findings highlight the importance of lifestyle modification, including regular physical activity, healthy eating habits, and smoking cessation programmes in PLWHI. Adopting a healthy lifestyle is viewed as one of the best ways to address risk factors for NCDs, which in turn improves the HRQOL of PLWHI.

These results also confirm previously reported results. A negative association was found between tobacco use and the HRQOL, especially the mental HRQOL (Kowal et al., 2008; Turner et al., 2001). The relationship between tobacco use and a bad mental HRQOL is evident due to the growing body of evidence that shows that smokers are more likely to have psychiatric co-morbidity (Shuter, Bernstein & Moadel, 2012). A recent study on smoking shows that the life expectancy is lower among PLWHI on ART than HIV itself, and mortality related to smoking increases noticeably with age (Helleberg et al., 2015). Thus, a decline in the HRQOL and increases in smoking-related mortality can be expected in PLWHI of all ages. This implies that health promotion programmes that focus on smoking prevention and

cessation should be prioritised in this population. Interestingly, in this study, no association was found between tobacco use and the physical HRQOL. This is despite the availability of evidence on the detrimental effects of tobacco use on the immune system and ART (Shirley et al., 2013; Miguez-Burbano et al., 2003). Despite this, other researchers suggest that a lower HRQOL in PLWHI might be attributable to chronic obstructive pulmonary disease rather than tobacco use itself (Drummond et al., 2010). In light of this research, well-designed research is needed to clarify the relationship between tobacco use and a HRQOL.

Additionally, physical inactivity was associated with a poor physical HRQOL. These findings are consistent with previous studies (Kowal et al., 2008; Uphold, Holmes, Reid, Findley & Parada, 2007). There is also much evidence to show positive effects of physical activity in PLWHI, including physical and psychological benefits (Derman et al., 2010). In contrast to the current study, Uphold et al. (2007) found a relationship between healthy diet and a physical and mental HRQOL. Thus, interventions to increase physical activity in PLWHI are warranted. Physiotherapists are in a better position to design programmes to increase PLWHI participation in physical activity and to increase awareness of the benefits of physical activity among other health care services.

Furthermore, abdominal obesity and hypertension were associated with a reduced physical and mental HRQOL. A growing body of evidence indicates that abdominal obesity is prevalent among HIV+ adults on antiretroviral therapy (Hejazi, Lee, Lin & Choong, 2010). These suggest that targeting abdominal obesity in the care of PLWHI could provide a better overall QOL, especially for those living with HIV infection. Existing evidence has also shown that

hypertension is strongly associated with cardiovascular and kidney disease among PLWHI (Peck et al., 2014), which in turn may be associated with a lower QOL in PLWHI. Thus, screening and treatment of hypertension must be an integral part in following-up with PLWHI.

Findings also reveal the significance of sociodemographic and HIV-related factors to predict the HRQOL of PLWHI. Lack of disclosure of HIV serostatus to somebody was associated with a poor mental HRQOL. The same results were found in previous research (Bunjoungmanee, Chunloy, Tangsathapornpong, Khawcharoenporn & Apisarnthanarak, 2014). These findings provide an opportunity to improve the HRQOL for those living with HIV infection. Disclosure refers to giving out information either voluntarily, or to be in compliance with legal regulations. In HIV, it specifically relates to informing others of one's positive HIV status– primarily to the sexual partner(s), but broader definitions encompass disclosure to family members and other social networks. Disclosure may be done to request accommodation and association or simply as a way to alert others about one's vulnerabilities. Health care professionals are required to assist PLWHI in the process of making the decision as to whether or not to disclose their HIV serostatus.

The available evidence also indicates that there is an association between HIV status disclosure and social support. Social support may facilitate disclosure among family members (Go et al., 2016; Murphy, Moscicki, Vermund, Muenz & Adolescent Medicine HIV/AIDS Research Network., 2000) and in turn improve self-esteem, coping, and engaging in healthy lifestyle behaviours (Atuyambe et al., 2014). However, there is no common formula for disclosure counselling, it varies from context to context, and importantly from person to person.

Sometimes disclosure is a person's choice, whereas in other circumstances, PLWHI are forced or obliged to disclose their seropositive status due to varied HIV-related symptoms that they may be experiencing. In this regard, effective disclosure counselling should consider a person's psychosocial context, including their social support networks, the stigma, depression, or occupation-related health issues. In this regard, the training of health care providers on how to assist PLWHI with disclosure decisions and resources are central to good care. These are viewed as effective strategies on helping out PLWHI. Further research is needed to develop evidence-based, disclosure-focused screening questions to identify those who need special attention in HIV disclosure counselling.

Being unmarried was associated with a poor mental and physical HRQOL. These results are in accordance with previous studies that indicate that a stable relationship contributes to a physical HRQOL (Préau et al., 2007; Perez et al., 2005). These results re-affirm the importance of social support in enhancing the HRQOL of PLWHI. Apart from family members and friends of PLWHI, this research's findings support HIV support groups being integrated into social networks for PLWHI to assist, especially those who perceive a low level of social support. Once again, participants with a lower CD4 count also reported a poor physical HRQOL. These findings are consistent with other studies on the topic (Kowal et al., 2008; Liu et al., 2006). Armon and Lichtenstein (2012) found further evidence of association between CD4 cell count and mental HRQOL. This study's results suggest that the initiation of ART to all PLWHI, regardless of their CD4 cell count, can reduce morbidity and mortality, and improve the QOL of PLWHI. Thus, intervention strategies to improve ART adherence in PLWHI are warranted.

These results suggest that the assessment of associations between the behavioural and biological risk factors for NCDs and an HRQOL provides opportunities for targeted counselling and secondary prevention efforts, so that health care providers implement strategies that have a significant impact on the HRQOL. Modifiable and preventable factors associated with the HRQOL provide potential targets for intervention. These findings highlight the importance of a multidisciplinary care approach in the care of PLWHI, including dieticians and physiotherapists, to implement effective, healthy lifestyle interventions. The association of modifiable and preventable risk factors provides an opportunity to enhance the physical and mental HRQOL in PLWHI. In this regard, efforts to support inter-professional, collaborative practice and person-centred, integrated service delivery are the key to interventions, so as to promote lifestyle changes for NCD risk factor reduction in PLWHI. It is apparent that a comprehensive health care of PLWHI should offer a continuum of care with a multidisciplinary team to deal with the needs and various characteristics of PLWHI. The role of each team member should be defined in a more proactive way. Physiotherapists, as exercise experts, need to establish appropriate physical activity guidelines for PLWHI, and physical activity would be part of a routine health assessment in HIV clinics. In this regard, national programmes should be adopting programes to imrove physical activity and comprehensive multidisciplinary programmes in response to evidence from studies done previousely and this important study too.

Even though it is very hard to change one's behaviour, the current study indicates the importance of promoting counselling on the adverse outcomes of NCD risk factors and the benefits to engage in preventive health behaviours. Apart from that, a health promotion

approach will help to empower people and involve them in decisions about health behaviours to reduce their NCD risk. Addressing a single risk factor without considering multiple risk factors for NCDs and other modifiable NCD risk factors is an inefficient or unsustainable approach, hence, consideration of both behavioural and biological risk factors may help to reduce the burden of NCD risk factors, and result in optimal outcomes for PLWHI.

5.4 Conclusion

The results reveal the moderate physical and mental health-related dimensions of QOL among PLWHI in Rwanda. While the results indicate that tobacco users and those who had abdominal obesity reported a poor mental HRQOL, physical inactivity and hypertension have a negative impact on the physical HRQOL. In addition, certain sociodemographic and HIV-related variables–specifically being unmarried, lack of HIV disclosure, and low CD4 count (less 350 cell count/mm^3)–were associated with significantly lower mental and physical dimensions of QOL. The association of behavioural and biological risk factors for NCDs with a poor physical and mental HRQOL suggests that there is still impairment in the HRQOL of those living with HIV with access to ARV drugs in Rwanda. This provides a window of opportunity to improve HRQOL; thus, intervention strategies to prevent and control NCD risk factors should be viewed as central to PLWHI. Given that behavioural and biological risk factors are preventable and modifiable, risk factor modification should be ensured with appropriate education programmes for PLWHI, with the emphasis on reducing and controlling NCD risk factors in order to improve the HRQOL of those living with HIV infection, and should be accompanied by regular monitoring of these risk factors. Regular monitoring would identify PLWHI who are at increased risk of NCD so that timely and effective interventions can be initiated to reduce

prevantable risk factors, which in turn reduce NCDs-related morbidity and mortality. NCDs have a detectable preclinical period, before they become clinically apparent and Treatment is more effective and cheap if given earlier (at the time of screen detection) than later (at the time the disease becomes clinically apparent). In addition, Health care providers should be provided with the necessary information to help PLWHI who are more vulnerable to NCDs due to the HIV infection itself, drugs' side effects, and an unhealthy lifestyle. With improved knowledge about NCD risk factors PLWHI are more likely to perceive their risk for NCDs and to present for early screening and treatment, and achieve better outcomes. Assessing the epidemiology of preventable risk factors for NCDs in PLWHI is the basis of prevention of NCDs in this population. It may help HIV healthcare providers and policy-makers to design and target intervention programmes for preventing and controlling NCDs.

The following chapter will focus on the profile and predictors of preventable risk factors for NCDs in PLWHI in Rwanda.

Chapter Six

Profile and Predictors of Behavioural and Biological Risk Factors for Non-communicable Diseases in HIV+ adults in Rwanda

6.1 Introduction

The second phase of the PRECEDE model addressed objective 2. This chapter presents a description of the behavioural and biological risk factors for NCDs among PLWHI in Rwanda. The risk factors for NCDs' analysis were assessed based on the WHO stepwise approach for the investigation of NCDs risk factors (Appendix G) (WHO, 2001).

Following recent advances in the treatment of HIV, which include a cART that are more available to PLWHI (Napravnik et al. 2013), the management of HIV infection has improved, especially in Africa. As a result, life expectancy and the QOL for PLWHI have improved (Basavaraj et al., 2010; Clayson et al. 2006). These findings are confirmed in the current study where the participants reported a moderate HRQOL, where the mean PHS was 63.96±11.68 and the mean MHS was 53.43±10.89, in contrast to the previous study (Delate & Coons, 2001). Studies reveal that PLWHI on HIV treatment and adhering to medication, have a higher risk of several NCDs such as CVDs, kidney diseases, liver diseases, malignancies, and some neurological diseases (Deeks et al., 2013). Most NCDs share modifiable behavioural risk factors such as tobacco use, unhealthy diet, physical inactivity, and harmful alcohol use. Behavioural or lifestyle risk factors are causes of overweight and obesity, high BP, raised

blood glucose, and dyslipidemia, all of which are biological risk factors for NCDs. NCDs and their risk factors are significantly more prevalent in PLWHI than HIV- patients (Figueroa-Cosme et al., 2010; Crothers et al., 2009; Triant et al., 2007; Gazzaruso et al. 2003). These results concur with the findings from Chapter 3 of this study, where the findings of review revealed that PLWHI are more likely to be current smokers and physically inactive than HIV-individuals. Thus, in addition to traditional risk factors shared by the general population, there are HIV-related factors that could increase the risk for NCDs in PLWHI. PLWHI are at an increased risk for NCDs due to the HIV disease and their reduced immunity, use of some antiretroviral therapy and contextual and sociodemographic factors (Haregu et al., 2012).

Studies conducted in SSA countries highlight an increase and prevalence in NCD risk factors in PLWHI (Kagaruki et al., 2014; Edward et al., 2013; Muronya et al., 2011). These findings concur with prior research conducted in Rwanda indicating a 70% increase in physical inactivity among PLWHI who were on ART (Frantz & Murenzi, 2013). Additionally, the findings of the current study, discussed in the previous chapter, reveal that NCD risk factors exert negative effects on the HRQOL of PLWHI. These findings are related to other studies conducted on this subject (Degroote et al., 2014; Crothers et al., 2005). Other serious health threats and NCD behavioural risk factors include behavioural and physiological pathways that impact on the acquisition, transmission, and progression of HIV. Harmful alcohol use undermines the immune system, thus raising the susceptibility to contracting and then countering HIV and other infections, as well as poor adherence to the medication (Schneider et al., 2014). PLWHI who smoke are more likely to get serious illness including chronic obstructive pulmonary disease (COPD), heart diseases, stroke, and varied types of cancers such

as lung, head, neck, cervical and anal cancers (Shirley et al., 2013). However, no focused strategy is available to address NCDs and their risk factors in PLWHI (Sogarwal & Mehra, 2015).

Rwanda, like other SSA countries, bears the brunt of an increasing burden of NCDs associated with lifestyle risk behaviours such as tobacco use, harmful alcohol use, unhealthy diet, and physical inactivity that contribute to adverse cardio-metabolic risk trends (Dalal et al., 2011). This evidence suggests the need for further and well-designed epidemiologic studies to inform policy and practice to prevent the oncoming NCD epidemic in PLWHI. Thus, this study describes the associations and distribution patterns of behavioural and biological risk factors on NCDs among PLWHI in Rwanda. This study has three aims namely: 1) to determine the prevalence and distribution patterns of behavioural and biological risk factors for NCDs among PLWHI; 2) to estimate the association of behavioural risk factors with sociodemographic and HIV-specific factors: biological risk factors and behavioural risk factors among PLWHI, and 3) to identify factors that predict behavioural and biological risk factors for NCDs.

6.2 Results

This section presents a description of the behavioural and biological risk factors for NCDs among PLWHI in Rwanda. To identify these factors, the WHO-STEPS were administered to assess the prevalence and predictors of these factors.

6.2.1 Prevalence of Risk Factors for Non-communicable Diseases

Risk factors for the NCDs studied include behavioural risk factors such as tobacco use, alcohol consumption, fruit and vegetable intake, physical activity, and biological risk factors such as BMI, WHR, and BP. The prevalence of current daily smokers, i.e. participants who smoked on a daily basis any tobacco products such as cigarettes or pipes was 16.2%, and the prevalence of current drinkers, i.e. participants who consumed at least one drink of any alcoholic beverage during the past 30 days, was 31.4%. More than 95% consumed insufficient vegetables and fruit (having less than five fruit and/or vegetable servings per day), and 26.1% had low physical activity (< 600 MET minutes per week). In addition, the prevalence of being overweight or obese (having a BMI $\geq$ 25kg/m²) was 18.4%, while the prevalence of abdominal obesity (having a WHR greater than 0.95 for men and 0.85 for women) was 43.4%. Around 24.4% of the participants had raised BP defined as a SBP of 140mm Hg or more, or a DBP (DBP) of 90mm Hg or more, or taking antihypertensive medication. Regarding combined NCD risk factors, a small proportion of the participants (2%) had no risk factors, whilst the majority of the participants (33.9%) had two risk factors, followed by those who had one risk factor (30.5%).

6.2.2 Association of Behavioural Risk Factors with Sociodemographic and HIV-specific Factors

Behavioural risk factors include tobacco use, alcohol consumption, fruit and vegetable intake, and physical activity. The overall prevalence of tobacco use was 16.2%. It was higher among participants who were in the age group older than 50 years (33.3%) compared to those who were in the age group of 31-40 years (10.6%), and higher among those who were separated or

divorced (28.8%) compared to those who were never married (12.4%). Participants who did not disclose their HIV+ serostatus smoked more than those who disclosed their HIV+ serostatus (21.7% vs. 14.8% respectively), and males smoked more than females (20.3% vs.14.0%). The prevalence of tobacco use was also high in participants who had known their HIV+ status for a period of ≥ seven years (20.4%), in those who were ART-experienced for more than six years (22.6%) and urban residents (18%). However, there was a decline in the proportion of tobacco use in public service workers (11.1%).

The prevalence of alcohol consumption was 31.4%, with the highest prevalence observed among participants who were males (42.0%). The prevalence of alcohol use was also higher for those who had secondary school education or higher (38.0%), those who were widowed (40.9%), who lived in an urban area (34.0%) and those who had been diagnosed with HIV for longer than seven years (36.6%). Overall, 96.5% of the participants consumed insufficient fruit and vegetables. A slightly lower prevalence of insufficient fruit and vegetable intake was observed among participants who had a monthly household income of RWF 40000 or more (94.7%), in those who were never married (94.5%), and those who were females (95.7%).

The prevalence of physical inactivity was 26.1% across the sample. The prevalence of physical inactivity was higher in participants who were currently married (33.3%) compared to other groups of marital status, and in those who had secondary school or higher (36.2%) compared to those who had no formal education (21.3%). Physical inactivity was also more prevalent in public service employees (35.1%) compared to those who were self-employed (21.2%) and in

females (28.7%) compared to males (21.6%). In participants who had CD4 counts of less than 350 cells/µl, and those who did not disclose their HIV+ serostatus, the prevalence of physical inactivity was 28.2% and 32.9%, respectively. Table 6.1 indicates the distribution of behavioural risk factors with respect to sociodemographic and HIV-related characteristics.

Table 6.1: Distribution of behavioural risk factors of study participants (N=794)

Socio demographic and HIV-related variables	Behavioural risk factors							
	Current tobacco use		Current alcohol use		< 5 servings of fruits and vegetables		Physical inactivity	
	No n (%)	Yes n (%)	No n (%)	Yes n (%)	No n (%)	Yes n (%)	No n (%)	Yes n (%)
All	**665 (83.8)**	**129 (16.2)**	**545 (68.6)**	**249 (31.4)**	**28 (3.5)**	**766 (96.5)**	**571 (73.9)**	**202 (26.1)**
Gender	p=0.029		p <0.001		p=0.170		p=0.038	
Female	441 (86.0)	72 (14.0)	382 (74.5)	131 (25.5)	22 (4.3)	491 (95.7)	353 (71.3)	142 (28.7)
Male	224 (79.7)	57 (20.3)	163 (58.0)	118 (42.0)	6 (2.1)	275 (97.9)	218 (78.4)	60 (21.6)
Age	p <0.001		p=0.477		p=0.427		p=0.794	
18-30 years	206 (85.8)	34 (14.2)	170 (70.8)	70 (29.2)	10 (4.2)	230 (95.8)	172 (73.5)	62 (26.5)
31-40 years	219 (89.4)	26 (10.6)	161 (65.7)	84 (34.3)	11 (4.5)	234 (95.5)	179 (76.2)	56 (23.8)
41-50 years	170 (83.3)	34 (16.7)	145 (71.1)	59 (28.9)	4 (2.0)	200 (98.0)	145 (72.1)	56 (27.9)
> 50 years	70 (66.7)	35 (33.3)	69 (65.7)	36 (34.3)	3 (2.9)	102 (97.1)	75 (72.8)	28 (27.2)
Marital status	p=0.022		p=0.005		p=0.479		p=0.423	
Never married	127 (87.6)	18 (12.4)	100 (71.4)	40 (28.6)	106 (73.1)	137 (94.5)	106 (73.1)	39 (26.9)
Currently married	430 (84.8)	77 (15.2)	380 (76.9)	114 (23.1)	338 (66.7)	490 (96.6)	338 (66.7)	169 (33.3)
Separated/Divorced	37 (71.2)	15 (28.8)	39 (76.5)	12 (23.8)	36 (69.2)	51 (98.1)	36 (69.2)	16 (30.8)
Widowed	71 (78.9)	19 (21.1)	52 (59.1)	36 (40.9)	65 (72.2)	88 (97.8)	65 (72.2)	25 (27.8)
Educational level	p=0.091		p=0.046		p=0.715		p=0.005	
No formal education	125 (78.1)	35 (21.9)	105 (65.6)	55 (34.4)	4 (2.5)	156 (97.5)	122 (78.7)	33 (21.3)
Primary	404 (84.9)	72 (15.1)	342 (71.8)	134 (28.2)	18 (3.8)	458 (96.2)	352 (75.5)	114 (24.5)
≥ Secondary	136 (86.1)	22 (13.9)	98 (62.0)	60 (38.0)	6 (3.8)	152 (96.2)	97 (63.8)	55 (36.2)
Employment status	p=0.539		p=0.267		p=0.396		p=0.071	
Public service	72 (88.9)	9 (11.1)	50 (61.7)	31 (38.3)	3 (3.7)	78 (96.3)	50 (64.9)	27 (35.1)
Self-employed	221 (83.7)	43 (16.3)	177 (67.0)	87 (33.0)	11 (4.2)	253 (95.8)	205 (78.8)	55 (21.2)
Peasant/Farmer	211 (83.7)	41 (16.3)	174 (69.0)	78 (31.0)	5 (2.0)	247 (98.0)	177 (72.0)	69 (28.0)
Unemployed	161 (81.7)	36 (18.3)	144 (73.1)	53 (26.9)	9 (4.6)	188 (95.4)	139 (73.2)	51 (26.8)
Monthly income	p=0.567		p=0.199		p=0.037		p=0.304	
> 40000RWF	258 (84.9)	46 (15.1)	200 (65.8)	104 (34.2)	16 (5.3)	288 (94.7)	226 (76.1)	71 (23.9)
≤ 40000RWF	407 (83.1)	83 (16.9)	345 (70.4)	145 (29.6)	12 (2.4)	478 (97.6)	345 (72.5)	131 (27.5)
Residence location	p=0.030		p=0.025		p=1.000		p=0.611	
Rural	228 (88.0)	31 (12.0)	192 (74.1)	67 (25.9)	9 (3.5)	250 (96.5)	182 (72.5)	69 (27.5)
Urban	437 (81.7)	98 (18.3)	353 (66.0)	182 (34.0)	19 (3.6)	516 (96.4)	389 (74.5)	133 (25.5)
Time since HIV diagnosis	p=0.069		p=0.175		p=0.588		p=0.946	
1-3 years	281 (83.1)	57 (16.9)	235 (69.5)	103 (30.5)	11 (3.3)	327 (96.7)	242 (73.6)	87 (26.4)

4-6 years	232 (87.5)	33 (12.5)	189 (71.3)	76 (28.7)	8 (3.0)	257 (97.0)	191 (74.6)	65 (25.4)
≥ 7 years	152 (79.6)	39 (20.4)	121 (63.4)	70 (36.6)	9 (4.7)	182 (95.3)	138 (73.4)	50 (26.6)
CD4 cell count	p=0.528		p=0.574		p=0.595		p=0.424	
≥ *350* cells/µl	378 (69.4)	85 (15.6)	460 (84.4)	167 (30.6)	21 (3.9)	524 (96.1)	398 (74.8)	134 (25.2)
< *350* cells/µl	167 (67.1)	44 (17.7)	205 (82.3)	82 (32.9)	7 (2.8)	242 (97.2)	173 (71.8)	68 (28.2)
Disclosure of HIV+	p=0.046		p=0.216		p=0.694		p=0.038	
Yes	539 (85.2)	94 (14.8)	441 (69.7)	192 (30.3)	21 (3.3)	612 (96.7)	465 (75.6)	150 (24.4)
No	126 (78.3)	35 (21.7)	104 (64.6)	57 (35.4)	7 (4.3)	154 (95.7)	106 (67.1)	52 (32.9)
ART use	p=790		p=0.887		p=0.723		p=0.324	
ART-naive	79 (82.3)	17 (17.7)	67 (69.8)	29 (30.2)	4 (4.2)	92 (95.8)	65 (69.1)	29 (30.9)
ART-experienced	586 (84.0)	112 (16.0)	478 (68.5)	220 (31.5)	24 (3.4)	674 (96.6)	506 (74.5)	173 (25.5)
Duration of ART	p=0.129		p=0.058		p=0.896		p=0.968	
< 12 months	97 (84.3)	18 (15.7)	92 (80.0)	23 (20.0)	3 (2.6)	112 (97.4)	83 (72.8)	31 (27.2)
12-36 months	241 (87.0)	36 (13.0)	187 (67.5)	90 (32.5)	10 (3.6)	267 (96.4)	202 (75.1)	67 (24.9)
37-72 months	159 (83.2)	32 (16.8)	126 (66.0)	65 (34.0)	6 (3.1)	185 (96.9)	138 (75.0)	46 (25.0)
≥ 73 months	89 (77.4)	26 (22.6)	73 (63.5)	42 (36.5)	5 (4.3)	110 (95.7)	83 (74.1)	29 (25.9)

Note: 1USD=745 Rwandan Francs

6.2.3 Association of Biological Risk Factors with sociodemographic, HIV-related and Behavioural Risk Factors

The biological risk factors studied included BMI, WHR, and BP. The prevalence of being overweight was 18.4% across the sample. A higher prevalence of being overweight was observed in those who had a monthly household income of RWF40 000 or more (22.0%), those who had been HIV infected for seven years or more (23.6%) compared to those who had HIV infection for four to six years (16.6%), those who were widowed (25.6%) compared to those who were currently married (15.8%), those who were self-employed (23.1%) compared to peasants/farmers (11.9%), those who had CD4 counts higher than 350 cells/µl (21.3%), those who were urban residents (22.6%), those who were ART-naïve (24.0%) compared to those who were ART-experienced (17.6%), those who were male (19.6%), and those who were tobacco users (23.3%).

The prevalence of abdominal obesity was observed in 43.4% of participants. Higher prevalence was observed in females (58.8%), in residents from rural areas (50.8%), in participants who had been HIV infected for four to six years (49.6%) compared to those who had been HIV infected for ≥ seven years (38.3%), in those who were peasants/farmers (49.8%) compared to public services employees (36.7%), in those who never married (48.2%) compared to those who were divorced/separated (26.9%), among aged 18-30 year olds (49.1%) compared to those aged > 50 years (37.5%), as well as in participants who were tobacco users (46.8%). Around 46.1% of those participants who were ART-experienced had abdominal obesity compared to those who were ART-naïve (24.2%).

The overall prevalence of hypertension was 24.4%. The highest prevalence of raised BP was observed in participants, who were HIV+ and ART naïve (54.2%) compared to those who were HIV+ on ART (20.3%). A higher prevalence was also observed among those aged 50 years and above (38.6%), those who did not disclose their HIV+ serostatus (34.8%), those who were widowed (28.9%), those who were self-employed (28.4%), those who had ≤ 200 cells⁄µl (29.8%), and those who were urban residents (26.9%). The prevalence of raised BP in participants who were tobacco users and those who were physically inactive was 34.9% and 31.2%, respectively. Table 6.2 illustrates the distribution of the biological risk factors with respect to sociodemographic and HIV-related characteristics.

Table 6.2: Distribution of biological risk factors of the sample (N=794)

Sociodemographic and HIV-related Variables	Biological Risk Factors					
	Overweight		Abdominal Obesity		Hypertension	
	No n (%)	Yes n (%)	No n (%)	Yes n (%)	No n (%)	Yes n (%)
All	**648(81.6)**	**146(18.4)**	**411(56.6)**	**315(43.4)**	**610(75.6)**	**164(24.4)**
Gender	p=0.588		p <0.001		p=0.004	
Female	422 (82.3)	91 (17.7)	205 (41.2)	292 (58.8)	405 (78.9)	108 (21.1)
Male	226 (80.4)	55 (19.6)	232 (84.4)	43 (15.6)	195 (69.4)	86 (30.6)
Age	p=0.415		p=0.147		p=0.005	
18-30 years	197 (82.1)	43 (17.9)	117 (50.9)	113 (49.1)	190 (79.2)	50 (20.8)
31-40 years	192 (78.4)	53 (21.6)	141 (59.5)	96 (40.5)	186 (75.9)	59 (24.1)
41-50 years	172 (84.3)	32 (15.7)	114 (56.7)	87 (43.3)	159 (77.9)	45 (22.1)
> 50 years	87 (82.9)	18 (17.1)	65 (62.5)	39 (37.5)	65 (61.9)	40 (38.1)
Marital status	p=0.048		p=0.070		p=0.124	
Never married	111 (76.6)	34 (23.4)	71 (51.8)	66 (48.2)	120 (82.8)	25 (17.2)
Currently married	427 (84.2)	80 (15.8)	277 (56.2)	216 (43.8)	379 (74.8)	128 (25.2)
Separated/Divorced	43 (82.7)	9 (17.3)	38 (73.1)	14 (26.9)	37 (71.2)	15 (28.8)
Widowed	67 (74.4)	23 (25.6)	51 (56.7)	39 (43.3)	64 (71.1)	26 (28.9)
Educational level	p=0.939		p=0.077		p=0.076	
No formal education	132 (82.5)	28 (17.5)	102 (64.6)	56 (35.4)	121 (75.6)	39 (24.4)
Primary	388 (81.5)	88 (18.5)	249 (54.4)	209 (45.6)	349 (73.3)	127 (26.7)
≥ Secondary	128 (81.0)	30 (19.0)	86 (55.1)	70 (44.9)	130 (82.3)	28 (17.7)
Employment status	p=0.006		p=0.017		p=0.046	
Public service	68 (84.0)	13 (16.0)	50 (63.3)	29 (36.7)	70 (86.4)	11 (13.6)
Self-employed	203 (76.9)	61 (23.1)	162 (62.8)	96 (37.2)	189 (71.6)	75 (28.4)
Peasant/Farmer	222 (88.1)	30 (11.9)	122 (50.2)	121 (49.8)	188 (74.6)	64 (25.4)
Unemployed	155 (78.7)	42 (21.3)	103 (53.6)	89 (46.4)	153 (77.7)	44 (22.3)
Monthly income	p=0.029		p=0.168		p=0.473	
> 40000RWF	236 (77.6)	68 (22.4)	179 (59.9)	120 (40.1)	225 (74.0)	79 (26.0)
≤ 40000RWF	412 (84.1)	78 (15.9)	258 (54.5)	215 (45.5)	375 (76.5)	115 (23.5)
Residence location	p<0.001		p=0.006		p=0.024	
Rural	234 (90.3)	25 (9.7)	121 (49.2)	125 (50.8)	209 (80.7)	50 (19.3)
Urban	414 (77.4)	121 (22.6)	316 (60.1)	210 (39.9)	391(73.1)	144 (26.9)
Time since HIV diagnosis	p=0.106		p=0.036		p=0.812; x^2 =0.418	
1-3 years	281 (83.1)	57 (16.9)	190 (58.6)	134 (41.4)	257 (76.0)	81 (24.0)
4-6 years	221 (83.4)	44 (16.6)	131 (50.4)	129 (49.6)	202 (76.2)	63 (23.8)
≥ 7 years	146 (76.4)	45 (23.6)	116 (61.7)	72 (38.3)	141 (73.8)	50 (26.2)
CD4 cell count	p=0.003		p=0.944		p=0.636	

≥ *350* cells/µl	429 (78.7)	116 (21.3)	299 (56.5)	230 (43.5)	415 (76.1)	130 (23.9)
< *350* cells/µl	219 (88.0)	30 (12.0)	138 (56.8)	105 (43.2)	185 (74.3)	64 (25.7)
Disclosure of HIV+ status	p=0.219		p=0.030		p=0.001	
Yes	522 (82.5)	111 (17.5)	335 (54.6)	279 (45.4)	495 (78.2)	138 (21.8)
No	126 (78.3)	35 (21.7)	102 (64.6)	56 (35.4)	105(65.2)	56 (34.8)
ART use	p=0.173		p <0.001		p =0.005	
ART-naive	73 (76.0)	23 (24.0)	72 (75.8)	23 (24.2)	81 (84.4)	15 (15.6)
ART-experienced	575 (82.4)	123 (17.6)	365 (53.9)	312 (46.1)	519 (74.4)	179(25.6)
Duration of ART	p=0.312		p=0.178		p=0.318	
< 12 months	98 (85.2)	17 (14.8)	64 (59.3)	44 (40.7)	97 (84.3)	18 (15.7)
12-36 months	231 (83.4)	46 (16.6)	134 (49.8)	135 (50.2)	223 (80.5)	54 (19.5)
37-72 months	158 (82.7)	33 (17.3)	99 (52.9)	88 (47.1)	150 (78.5)	41 (21.5)
≥ 73 months	88 (76.5)	27 (23.5)	68 (60.2)	45 (39.8)	86 (74.8)	29 (25.2)
Tobacco use	p=0.151		p =0.452		p=0.004	
Nonusers	549 (82.6)	116 (17.4)	370 (57.3)	276 (42.7)	516 (77.6)	149 (22.4)
Users	99 (76.7)	30 (23.3)	67 (53.2)	59 (46.8)	84 (65.1)	45 (34.9)
Alcohol use	p=0.397		p=0.259		p=0.812	
Nonusers	440 (80.7)	105 (19.3)	290 (55.1)	236 (44.9)	410 (75.2)	135 (24.8)
Users	208 (83.5)	41 (16.5)	147 (59.8)	99 (40.2)	190 (76.3)	59 (23.7)
Fruit and vegetable intake	p=0.747		p=0.631		p=0.294	
≥ 5 servings	24 (85.7)	4 (14.3)	17 (63.0)	10 (37.0)	24 (85.7)	4 (14.3)
< 5 servings	624 (81.5)	142 (18.5)	420 (56.4)	325 (43.6)	576 (75.2)	190 (24.8)
Physical activity	p=0.890		p=0.469		p=0.026	
Physically active	468 (82.0)	103 (18.0)	322 (57.9)	234 (42.1)	440 (77.1)	131 (22.9)
Physically inactive	164 (81.2)	38 (18.8)	107 (54.6)	89 (45.4)	139 (68.8)	63 (31.2)

Note: 1USD=745 Rwandan Francs

A Chi-square test for independence was conducted to examine whether or not there was an association between behavioural and biological risk factors for NCDs with sociodemographic characteristics. P-values (p) are provided in Table 6.1 and Table 6.2 above. The results revealed that there was a statistically significant association between age group and tobacco use ($p < 0.001$) and hypertension ($p=0.005$). The prevalence of tobacco use and hypertension was significantly higher in older participants. A significant association was found between gender and tobacco use ($p=0.029$), alcohol use ($p < 0.001$), physical activity ($p=0.038$), WHR (WHR) ($p<0.001$) and BP ($p=0.004$). Tobacco use, alcohol use, and hypertension were more prevalent in males, while physical inactivity and abdominal obesity were more prevalent in females. A significant association was found between marital status and tobacco use ($p=0.022$), alcohol use ($p=0.005$) and BMI ($p=0.048$). Tobacco use was more prevalent in participants who were separated or divorced; alcohol use was more prevalent in participants who were not married, while widowed participants were more likely to be overweight or obese. There was a statistically significant association between educational level and alcohol use ($p=0.046$) and physical activity ($p=0.005$). Alcohol use and physical inactivity were more prevalent in those who had secondary school or more. A significant association was found between residence location and tobacco use ($p=0.030$), alcohol use ($p=0.025$), BMI ($p<0.001$), WHR ($p=0.006$), and BP ($p=0.024$). Abdominal obesity was more prevalent in residents from rural areas, whereas tobacco use, alcohol use, being overweight, and hypertension were more prevalent in urban residents.

There was also a statistically significant association between employment status and BMI ($p=0.006$), WHR ($p=0.017$) and BP ($p=0.046$). Being overweight and hypertension were more prevalent in self-employed individuals, while abdominal obesity was prevalent in

peasants/farmers. The results indicated a significant association between household income and fruit and vegetable intake (p=0.011), and BMI (p=0.017). There was an increase in fruit and vegetable consumption and being overweight in participants with monthly household incomes of > RWF40 000.

Additionally, association between HIV-related characteristics and NCD risk factors was measured. The results revealed that there was a significant association between the disclosure of HIV+ serostatus and tobacco use (p=0.046), physical activity (p=0.038), WHR (p=0.030), and BP (p=0.001). Tobacco use, physical inactivity, and hypertension were more prevalent in participants who did not disclose their HIV+ serostatus, whereas abdominal obesity was prevalent in those who disclosed their HIV+ serostatus. A significant association was found between the duration of the HIV infection and WHR (p=0.036). Abdominal obesity was more common in participants who had been HIV infected for four to six years. Participants who had CD4 counts higher than 350 cells/µl were more likely to be overweight (p=0.003). There was a statistically significant association between ART use and WHR (p<0.001) and BP (p=0.005). Hypertension and abdominal obesity were more prevalent in HIV+ subjects who were ART-experienced. Finally, a chi-square test for independence (with Yates Continuity Correction) indicated a significant association between BP and tobacco use (p=0.004) and physical activity (p=0.026). The prevalence of hypertension was more frequent in those who were tobacco users and those who were physically inactive.

6.2.4 Predictors of Behavioural and Biological Risk Factors of NCDs

A binary logistic regression analysis, using a forced-entry approach, was used to assess how well those variables identified as being associated with behavioural and biological risk factors for NCDs in the bivariate analysis, predicts or explains behavioural and biological risk factors for NCDs. It provides an indication of the relative magnitude of each predictor variable. Included in the model were all the variables that showed significant level $p<0.05$ from the chi-square test in order to yield reliable models. Table 6.3 presents the variables in the equation that provide information about the contribution or importance of each predictor variable for behavioural risk factors for NCDs.

Table 6.3: Predictors of behavioural risk factors for NCDs (N=794)

NCDs risk factors	Baseline Model	Beta (SE)	Wald's x^2	df	p-value	OR (95% CI)
Tobacco use	**Gender (ref: male vs. female)**	-.309 (.237)	1.703	1	.192	.734 (.462-1.168
	Age group (ref:18-30 age group)		18.142	3	.000	
	31-40 age group	.050 (.358)	.020	1	.888	1.052 (.512-2.123)
	41-50 age group	.506 (.359)	1.980	1	.159	1.658 (.820-3.352)
	> 50 age group	1.366 (.393)	12.049	1	.001	3.053 (1.564-5.962)
	Marital status (ref: Never married)		4.518	3	.211	
	Married/cohabiting	.429 (.375)	1.306	1	.253	1.535 (.736-3.201)
	Separated/divorced	1.086 (.515)	4.441	1	.028	2.575 (1.109-5.978)
	Widowed	.489 (.489)	1.001	1	.317	1.631 (.625-4.254)
	Place of residence (ref: urban vs. rural)	-.402 (.244)	2.699	1	.106	1.453 (.924-2.284)
	Disclosure of HIV (ref: yes vs. no)	1.055 (.341)	9.605	1	.024	1.739 (1.077-2.809)

	Constant	-2.504 (.332)	56.799	1	.000	.082
Alcohol use	**Gender (ref: male vs. female)**	-.876 (.177)	24.579	1	.000	2.056 (1.506-2.808)
	Educational status (ref: no formal education)		1.682	2	.431	
	Primary	-.169 (.217)	.609	1	.435	.844 (.552-1.291
	≥ Secondary	.091 (.256)	.126	1	.722	1.095 (.663-1.809)
	Marital status (ref: Never married)		12.357	3	.006	
	Married/cohabiting	-.154 (.222)	.480	1	.015	.535 (.303-.945)
	Separated/divorced	.000 (.391)	.000	1	1.000	1.000 (.465-2.151)
	Widowed	.723 (.297)	5.933	1	.488	1.061 (.985-3.688)
	Place of residence (ref: urban vs. rural)	-.351 (.183)	3.667	1	.055	.704 (.491-1.008)
	Constant	-.149 (.216)	.475	1	.491	.862
	Constant	2.664 (.280)	90.773	1	.000	14.349
Physical inactivity	**Gender (ref: male vs. female)**	.374 (.180)	4.315	1	.038	.688 (.484-.979)
	Marital status (ref: Never married)		12.357	3	.006	
	Married/cohabiting	-.154 (.222)	.480	1	.488	.857 (.555-1.325)
	Separated/divorced	.000 (.391)	.000	1	1.000	1.000 (.465-2.151)
	Widowed	.723 (.297)	5.933	1	.015	2.061 (1.152-3.688)
	Educational status (ref: no formal education)		10.632	2	.005	
	Primary	.273 (.233)	1.372	1	.241	1.313 (.832-2.073)
	≥ Secondary	.818 (.269)	9.250	1	.002	2.266 (1.337-3.838)
	Disclosure of HIV (ref: yes vs. no)	.464 (.200)	5.374	1	.020	1.590 (1.074-2.353)
	Constant	-1.728 (.307)	31.612	1	.000	.178

For tobacco use, the model contained five covariate variables (gender, age, marital status, place of residence, and disclosure of HIV+ status). The full model containing all predictors was

statistically significant, x^2 (9, N=794) = 42.510, p<0.001, indicating that the model was able to distinguish between the participants who smoked and those who did not. The model as a whole explained between 8.1% (Cox and Snell R square) and 13.8% (Nagelkerke R square) the variance explained by the predictors and correctly classified 84.1% of cases. When all five covariates were entered into the equation, the three variables (age group, marital status, and disclosure of HIV+ serostatus) remained statistically significant (p <0.001, p=0.028 and p=0.024, respectively). The analysis indicated that age is significant for predicting the use of tobacco. The participants aged 50 years and older (old people) were three times more likely to smoke compared to those aged 18 to 30 (young people) (OR=3.053, 95% CI=1.564-5.962, p=0.001). The results also revealed that the participants who were separated or divorced (OR: 2.575, 95% CI=1.109-5.978) and those who did not disclose their HIV+ serostatus (OR: 1.739; 95% CI: 1.077- 2.809) were two and half times more likely to smoke, compared to those who were single and two times more likely to smoke compared to those who disclosed their HIV+, controlling for all other factors in the model.

For alcohol use, the model contained four independent variables (gender, educational level, marital status, and place of residence). The full model containing all predictors was statistically significant, x^2 (7, N=794) = 34.881, p<.001, indicating that the model was able to distinguish between the participants who drank and those who did not. The model as a whole explained between 6.2% (Cox and Snell R square) and 8.7% (Nagelkerke R square) the variance explained by the predictors and correctly classified 69.1% of cases. Two covariates (gender and marital status) (OR=2.056, 95% CI= 1.506-2.808, p<0.001; OR=.535, 95% CI= .303- .945, p=0.015 respectively) made a unique statistically significant contribution to the model. This indicated that

the participants who were males were twice as likely to drink as females, controlling for all other factors in the model. The odds ratio of .535 for marital status indicates that alcohol use was significantly lower in participants who were married compared to participants who were single.

For physical inactivity, the model contained four independent variables (gender, marital status, educational level, and disclosure to HIV+ status). The full model containing all predictors was statistically significant, x^2 (7, N=773) = 31.726, p<0.001, indicating that the model was able to distinguish between the participants who were physically inactive and those who were physically active. The model as a whole explained between 4.0% (Cox and Snell R square) and 5.9% (Nagelkerke R square) the variance explained by the predictors and correctly classified 74.3% of cases. All four covariates (gender, marital status, educational level, and disclosure to HIV+ status) made a unique statistically significant contribution to the model (p=0.038; p=0.015; p=0.002; p=0.020, respectively). An odds ratio of 2.061 for marital status and odds ratio of 2.266 for educational status indicated that widowed participants and those who had secondary schooling or higher were twice as likely as participants with no formal education and currently married to be physically inactive, controlling for all other factors in the model. Whereas the odds ratio of .688 for gender and odds ratio of 1.590 for disclosure of HIV+ serostatus indicated that males and those who disclosed their HIV+ serostatus were less likely to be physically inactive than females and those who did not disclose their HIV+ serostatus.

Additionally, Table 6.4 presents the variables in the equation that provides information about the contributions or importance of each predictor variable for being overweight, abdominal obesity, and hypertension.

Table 6.4: Predictors of biological risk factors for NCDs (N=794)

NCDs risk factors	Baseline Model	Beta (SE)	Wald's x^2	df	p-value	OR (95% CI)
Overweight	**Marital status (ref: Never married)**		5.201	3	.158	
	Married/cohabiting	-.446 (.242)	3.385	1	.066	.640 (.398-1.030)
	Separated/divorced	-.429 (.425)	1.022	1	.312	.651 (.283-1.497)
	Widowed	.030 (.321)	.009	1	.926	1.030 (.550-1.931)
	Employment status (ref: public service)		2.154	3	.541	
	Self-employed	.437 (.342)	1.636	1	.201	1.549(.792-3.027)
	Peasant/Farmer	.162 (.393)	.170	1	.680	1.176 (.544-2.543)
	Unemployed	.270 (.365)	.547	1	.460	1.310 (.640-2.682)
	Income (ref: ≤ 40000RWF vs. > 40000RWF)	-.168 (.211)	.635	1	.425	.845 (.559-1.278)
	Place of residence (ref: urban vs. rural)	.722 (.286)	6.360	1	.012	2.060 (1.175-3.611)
	CD4 cell counts (ref: ≥ 350 cells/µl vs. < 350 cells/µl)	-.507 (.229)	4.906	1	.027	.602 (.384-.943)
	Constant	-1.777 (.453)	15.386	1	.000	.169
Abdominal obesity	**Gender (ref: male vs. female)**	-2.052 (.195)	110.767	1	.000	.128 (.088-.188)
	Place of residence (ref: urban vs. rural)	-.295 (.183)	2.606	1	.106	.745 (.521-1.065)
	HIV diagnosis duration (ref:1-3 years)		3.449	2	.178	
	4-6 years	.276 (.189)	2.150	1	.143	1.318 (.911-1.908)
	>=7 years	-.099 (.217)	.208	1	.649	.906 (.592-1.386)

	ART use (ref: ART-naïve vs. ART-experienced)	.390 (.320)	1.489	1	.222	1.478 (.789-2.766)
	Disclosure of HIV (ref: yes vs. no)	-.339 (.232)	2.123	1	.145	.713 (.452-1.124)
	Tobacco use (ref: Non-users vs. users	.543 (.227)	5.720	1	.017	1.722 (1.103-2.687)
	Constant	.116 (.367)	.101	1	.751	1.123
Hypertension	**Gender (ref: male vs. female)**	.249 (.187)	1.785	1	.181	1.283 (.890-1.850)
	Age group (ref:18-30 age group)		7.917	3	.048	
	31-40 age group	.191 (.244)	.611	1	.435	1.210 (.750-1.951)
	41-50 age group	-.045 (.258)	.031	1	.860	.956 (.577-1.584)
	> 50 age group	.686 (.287)	5.707	1	.017	1.985 (1.131-3.483)
	Employment status (ref: public service)		10.421	3	.015	
	Self-employed	.827 (.368)	5.039	1	.025	2.287 (1.111-4.708)
	Peasant/Farmer	1.068 (.395)	7.309	1	.057	1.909 (.980-4.309)
	Unemployed	.434 (.386)	1.259	1	.262	1.543 (.723-3.290)
	Disclosure of HIV (ref: yes vs. no)	-.188 (.282)	.442	1	.506	.829 (.477-1.441)
	ART use (ref: ART-naïve vs. ART-experienced)	-1.581 (.308)	26.395	1	.003	3.22 (1.11-3.76)
	Tobacco use (ref: Non-users vs. users	.485 (.227)	4.572	1	.033	1.625 (1.041-2.535)
	Physical activity (ref: physically active vs. physically inactive)	.494 (.197)	6.294	1	.012	1.638 (1.114-2.410)
	Disclosure of HIV (ref: yes vs. no)	-.188 (.282)	.442	1	.506	.829 (.477-1.441)
	Constant	-.548 (.495)	1.229	1	.026	.289

For being overweight, the model contained five independent variables (marital status, employment status, monthly income, place of residence, and CD4 cell count). The full model containing all predictors was statistically significant, x^2 (9, N=794) = 35.029, p<0.001, indicating

that the model was able to distinguish between the participants who were overweight and those who were normal weight. The model as whole explained between 5.5% (Cox and Snell R square) and 8.9% (Nagelkerke R square) the variance explained by the predictors and correctly classified 81.6% of cases. Only place of residence and CD4 cell counts made a unique, statistically significant contribution to the model (OR=2.060, 95% CI= .1.175- 3.611, p=0.012; OR= .602, 95% CI= .384-.943, p= 0.027, respectively). This indicates that the participants who were urban residents were twice as likely as rural residents to be overweight, while the low CD4+ cell count category $\leq 350mm^3$ was predictive of being overweight.

For abdominal obesity, the model contained six independent variables (gender, residence location, time since HIV diagnosis, disclosure of HIV+ status, ART use, and tobacco use). The full model containing all predictors was statistically significant, x^2 (7, N=772) = 164.929, p<0.001, indicating that the model was able to distinguish between the participants who had abdominal obesity and those who had normal WHR. The model as a whole explained between 20.5% (Cox and Snell R square) and 27.4% (Nagelkerke R square) the variance explained by the predictors and correctly classified 68.5% of cases. Only gender and tobacco use made a unique statistically significant contribution to the model. The results revealed that tobacco users were 1.7 times more likely to have abdominal obesity than non-tobacco users (OR=1.722, 95% CI=1.103-2.687, p=0.017). While males were less likely to have abdominal obesity than females (OR=.128, 95% CI=.088-.188, p<0.001).

For hypertension, the model contained eight independent variables (age, gender, and employment status, residence location, and disclosure to HIV+, ART use, tobacco use, and physical inactivity). The full model containing all predictors was statistically significant, x^2 (12, N=773) = 81.268, p<0.001, indicating that the model was able to distinguish between the participants who were hypertensive and those who were normotensive. The model as a whole explained between 10.0% (Cox and Snell R square) and 14.8% (Nagelkerke R square) the variance explained by the predictors and correctly classified 76.3% of cases. Five covariates (age group, employment status, ART use, tobacco use and physical inactivity) made a unique, statistically significant contribution to the model (p=0.017, p=0.025, p=0.003, p=0.033 and p=0.012, respectively). The strongest predictor of having hypertension was being on ART, recording an odds ratio of 3.22 (95% CI=1.11-3.76). This indicated that the participants who were on ART were over three times more likely to be hypertensive than those who were ART-naïve, controlling for all other factors in the model. Regarding employment status and hypertension, the self-employed subjects were twice (OR=2.287, 95% CI=1.111-4.708, p=0.025) as likely to have hypertension compared to public services employees. The odds of those in the over 50 age group were twice more than the youngest group of 18 to 30 years. The final statistically significant measure showed that tobacco users and physically inactive participants were 1.6 times more likely to have hypertension (OR=1.625, 95% CI=1.041-2.535, p=0.033; OR=1.638, 95% CI=1.114-2.410, p=0.025, respectively) than their comparison group counterparts.

6.3 Discussion

This study has assessed distribution patterns and behavioural and biological predictors for cardiovascular and metabolic diseases among HIV+ adults in Rwanda. Findings from this study demonstrate a high prevalence of behavioural and biological risk factors in both HIV+ subjects on ART and HIV+ subjects who are ART naïve, specifically those with low fruit and vegetable intake, abdominal obesity, and who are regular alcohol users.

In the current study, the prevalence of insufficient fruit and vegetable intake was 96.5%, an estimate that is higher than the findings from previous studies among HIV+ populations in other countries (Kaguruki et al., 2014; Muronya et al., 2011). The role of fruit and vegetable intake in promoting healthy wellbeing has been well established (Oguntibeju, Esterhuyse & Truter, 2013). Various studies from both HICs as well as LMICs, specifically in Africa, have highlighted that insufficient fruit and vegetable intake constitutes a risk for various NCDs, including cancer, coronary heart diseases, stroke, and cataract formation (Oguntibeju et al., 2013; Van Duyn & Pivonka, 2000). Other studies show that increasing an individual's fruit and vegetable consumption to up to 600g per day could reduce the total worldwide burden of disease by 1.8%, and reduce the burden of ischaemic heart disease and ischaemic stroke by 31% and 19% respectively (Lock, Pomerleau, Causer, Altmann & McKee, 2005). These observations are similar to findings in the recent STEPS survey conducted in Rwanda (Ministry of Health [2015], 2015). Thus, despite the health benefits of fruit and vegetable intake, it seems that five or more servings per day as recommended by WHO is difficult to accomplish with limited dietary values in many SSA countries, including Rwanda. This finding suggests that development and follow-up is needed to support public health and community outreach programmes and interventions.

Nutrition literacy regarding the benefits of daily consumption of fruit and vegetables is considered an important health education programme for both HIV+ and uninfected individuals. Complementary socio-economical programmes that assist and advise PLWHI on how to improve their socio-economic status by creating income generation activities, is important.

In this current study, the observed prevalence of low physical activity of (26.1%) was more than double the prevalence reported in the general population of Rwanda (12.0%) (MOH, 2015). But, this prevalence was low compared to an earlier study conducted in PLWHI in Rwanda that found a prevalence of 70% (Frantz & Murenzi, 2013). The contradictory prevalence rates are due to methodological differences across these studies. The previous study conducted in an urban area among HIV+ on ART only, with a small sample size different to the present study that was carried out with both HIV+ subjects on ART and ART-naïve subjects and self-identified rural and urban residents with a large sample size. Further research with objective measures of physical activity such as heart rate monitoring, accelerometers, and pedometers is required to confirm these results in a countrywide targeting of PLWHI. The prevalence rates of physical inactivity fall within the range of 19-73% reported in literature among PLWHI (Schuelter-Trevisol et al., 2012). Low physical inactivity increases the risk of many adverse health conditions, including major NCDs such as coronary heart disease, T2D, and breast and colon cancers, and shortens life expectancy (Lee et al., 2012). This implies that by decreasing this unhealthy behaviour, one could improve the health in the general population and in PLWHI who are more prone to numerous risks for NCDs. This emphasises the need to promote the health benefits of physical activities in PLWHI and to discourage sedentary lifestyle in this population.

About one-third (30.5%) of HIV+ Rwandans were alcohol users, a finding that concurs with other studies conducted among HIV+ adults in African countries such as Uganda (33%) (Wandera et al., 2015), Tanzania (32.9%) (Kaguruki et al., 2014), and South Africa (29.2%) (Mashinya et al., 2014).However, there is a high proportion of alcohol users in the general Rwandan population (41.2%) and several reports have highlighted the negative effects of alcohol use in HIV+ and uninfected persons. These include, but are not limited to, increased medical complications, poorer outcomes, disease progression due to immunosuppression, and poor adherence to ART regimens (Goar et al., 2011; Lucas, Gebo, Chaisson & Moore, 2002). This finding proposes early screening for high levels of harmful alcohol use in PLWHI on ART and those who are ART naïve in African and Rwandan health facilities, in order to provide appropriate support and advice. Education and raising awareness interventions on harmful alcohol use is an important step towards improving health and wellbeing.

Some participants reported low levels of daily smoking or use of tobacco products, approximately 16.2%, but this proportion of HIV+ and uninfected Rwandans who smoked daily is significant enough to predispose them to various CVDs and metabolic diseases in future decades. Tobacco use is associated with many health risks, including decline in lung structure and physiology, leading to reduced respiratory and immune systems mainly for HIV+ individuals who are already affected with HIV inflammation (Rossouw et al., 2015; Zyambo et al., 2015). Compared to previous studies such as the STEP-wise survey conducted in Rwanda in 2012-2013 (MOH, 2015), in Nigeria (Edouard et al., 2013), and in Malawi (Muronya et al., 2011), these findings imply that there is a need for an effective health education through individual counselling and/or community campaign programmes as methods for knowledge utilisation for

behavioural change among HIV+ (regardless of ART use) and uninfected individuals with regard to tobacco use as an important adverse lifestyle risk behaviour. This finding suggests that interventions promoting smoking cessation and community education campaigns against harmful alcohol use are necessary strategies to improve the wellbeing of Rwandans, specifically those with HIV-infection who are at increased risk for CVDs and metabolic diseases.

The prevalence of 18.4% of the study population being overweight is higher than that reported in Malawi (Muronya et al., 2011) and is lower compared to reports from other SSA countries such as Nigeria, Rwanda, and Tanzania, which ranges from 26.2% to 43.0% (Peck et al., 2014; Edward et al., 2013; Frantz & Murenzi, 2013). A recent study in the United States among PLWHI found that increasingly, overweight and obesity are associated with adverse medical consequences, including hypertension and dyslipidemia, compared to the HIV- population, and all of these factors are important contributors to the development of NCDs (Crum-Cianflone et al., 2010). Screening for obesity and weight management strategies should thus be integrated into routine healthcare programmes to promote the wellbeing of individuals with HIV infection. The 43.4% prevalence of abdominal obesity in this current is consistent with results from other studies conducted in Tanzania, South Africa and Malawi among HIV+ people (Kaguruki et al., 2014; Mashinya et al., 2014; Muronya et al., 2011) as well as those in Brazil (Jaime, Florindo, Latorre & Segurado, 2006). These estimates have a higher prevalence (36.5%) than a study conducted in Malaysia on factors associated with abdominal obesity among HIV+ adults on ART (Hejazi et al., 2010). These findings suggest that the care of PLWHI must include interventions to address specific biological risk factors that place this population at increased risk for CVD due to abdominal obesity, to provide better QOL for PLWHI.

The 24.4% prevalence of raised BP observed in this study has also been observed in other studies, and this is consistent with the 26.2% prevalence estimates in studies conducted in Tanzania on the magnitude of risk factors of NCDs among PLWHI (Kaguruki et al., 2014). In this study, the prevalence of high BP is much less than the high BP reported among PLWHI in South Africa and Malawi, where 42.7% and 45.9% of HIV+ adults respectively had raised BP (Mashinya et al., 2014; Muronya et al., 2011). Again, in this study, hypertension prevalence was lower among HIV + ART-naïve patients than HIV+ patients on ART. These findings are consistent with recent findings (Dimala et al., 2016; Nduka et al., 2016). This supports the association between ART and hypertension. Further research with longitudinal designs will help in understanding the association between hypertension and HIV and ART. Besides, a previous study has shown that high BP, and ultimately hypertension, was strongly associated with end-organ damage, such kidney disease (Peck et al., 2014). This perhaps suggests that regular screening and monitoring of patients with hypertension should be an integral part of follow-up for PLWHI enrolling into care and initiating ART. In addition, tobacco use and physical inactivity were significantly associated with hypertension in this study. This implies that traditional NCD control measures, such as lifestyle and diet change should be suggested to PLWHI, by focusing on vulnerable groups, especially those in the over 50 age group.

A low level of education was associated with being physically active, whereas low income was associated with insufficient fruit and vegetable intake, and residing in urban places was associated with being overweight, possibly because of other mediating factors, such as the type of diet in cities that comprise a higher fat content, and high levels of physical activity due to farm work by most rural dwellers who are subsistence farmers and are consequently less obese due to

the high habitual farm work and thus high physical activity. These sociodemographic factors are consistent with findings from other diverse studies in HIV+ individuals (Mashinya et al., 2014; Malaza et al., 2012; Goar et al., 2011) as well as the general non-HIV population (Aryal et al., 2015). Lack of disclosure of HIV+ serostatus was associated with tobacco use. HIV+ people who do not disclose their HIV+ serostatus have no 'buddy' or a close relative to always provide psychosocial counselling, and HIV+ persons may often feel depressed and isolated (Smith, Rossetto & Peterson, 2008). This may lead and/or contribute to adapting to risky lifestyle behaviours associated with depression. This finding is similar to what Duval et al. (2008) reported in their French study, suggesting that tobacco smoking is associated with a HIV+ serostatus, and that HIV+ adults appear to be highly obsessed with or accustomed tobacco smoking. A low CD4+ cell count category <350mm^3 was predictive of being overweight. This appears to be obvious as a high weight gain is associated with a higher CD4+ cell count and improvement to health, since a higher BMI in HIV+ individuals is related to improved immune-suppression and improved health (Semu et al., 2016. Previous studies have highlighted that a higher CD4 count was associated with a higher BMI (Semu et al., 2016; Crum-Cianflone et al., 2010). Preventive behavioural education measures to curtail cardiovascular and metabolic diseases should encompass sociodemographic factors as important predictors of various NCDs.

6.4 Conclusion

A high burden of NCD risk factors was observed in PLWHI in Rwanda. The findings from this study support the emergence of a future NCD epidemic among PLWHI in Rwanda due to the existence of various risk factors for NCDs in this population. This highlights the need to screen and treat these risk factors. This study has also shown that predictors of behavioural and

biological risk factors among PLWHI included old age that was associated with tobacco use and harmful alcohol use. Men were more likely to be associated with higher rates of alcohol use, but also more likely to be physically active, and fewer men than women had abdominal obesity. Conjugal marriage support protected married individuals from heavy harmful drinking compared to their unmarried counterparts. The current study may point to the need for advocacy and the formulation of prevention strategies for NCDs and their risk factors in PLWHI. In addition, NCD prevention programmes should consider gender-specific interventions regarding physical activity and alcohol consumption, since the related risk factors are not the same in men and women. Policies and strategies are needed in Rwanda to package and monitor modifiable lifestyle risk factors for NCDs, both in HIV+ subjects receiving ART and HIV+ ART-naive subjects. Modalities for sustainable prevention efforts need be aligned with evidence-based, identified risk factors. Failure to do so may result in emerging NCD comorbidities in PLWHI that increase the future morbidity and mortality in this population. The presence of another disease would definitely extert a negative effect on life expectancy and QOL of PLWHI. As an example, tobacco use risks that result in higher prevalence and severity of pulmonary tuberculosis, cardiovascular diseases and AIDS-related cancers, and adversely affecting the immunologic response to ART as discussed in the previous chapters. However, the current findings are contrary to the findings of numerous other studies, and therefore understanding the influence of psychosocial factors will complement the STEPS data and will help researchers to reach a better understanding. The next chapter focuses on the assessment of knowledge and risk perceptions of chronic disease lifestyle risk factors in PLWHI.

Chapter Seven

Knowledge of Chronic Diseases of Lifestyle Risk Factors and their Associated Factors among Adults Living with HIV Infection in Rwanda

7.1 Introduction

Chapter five described HRQOL and associated factors among PLWHI in Rwanda, whilst Chapter six presented a description of the behavioural and biological risk factors for NCDs in this population. Findings that arose from these chapters indicated that there is an increase in the prevalence of behavioural and biological risk factors for NCDs. The findings also indicated that these risk factors for NCDs were significantly associated with a lower HRQOL. Thus, an analysis of determinants of risk factors for NCDs to complement these findings is needed to develop and implement necessary strategies against future NCDs in PLWHI. The third phase of the PRECEDE model, namely an educational and public health assessment to guide a context-specific dissemination plan, addressed objectives 3 and 4. This chapter will specifically address objective 3, which is pertinent to predisposing factors such as knowledge, risk perception, and self-efficacy, whilst Chapter 8 will address objective 4, which is pertinent to reinforcing and enabling factors, such as the motivators and barriers to a healthy lifestyle. Knowledge about risk factors for NCDs was measured with an adapted validated and reliable knowledge assessment questionnaire about risk factors for chronic diseases of lifestyle (Appendix I) (Frantz, 2008).

The burden of NCDs and their associated risk factors continue to increase in African countries due to the process of ageing, rapid unplanned urbanisation, and the globalisation of unhealthy lifestyles (Forouzanfar et al., 2015; Murray et al., 2015). Simultaneously, life expectancy of those infected with HIV has increased dramatically as a result of cART (Nakagawa et al., 2013). Findings also reveal a moderate HRQOL among PLWHI in this study. Thus, PLWHI may live longer, but with increasing rates of non-HIV chronic diseases. The excess risk of NCDs in PLWHI is attributable to chronic inflammation, immune activation associated with HIV infection, opportunistic infections, certain ART drug side-effects, and traditional risk factors being tobacco use, hypertension, diabetes, and hyperlipidaemia (Bloomfield et al., 2014). Additionally, most previous studies have revealed that NCDs, especially CMDs, are more prevalent in HIV+ than uninfected individuals (Triant, 2013; Galli et al., 2010). These studies indicate the need for more research to understand the determinants for CMDs in this population. Current findings also indicate that about 16.2% individuals reported daily smoking, 31.4% reported harmful alcohol use, and 95% reported insufficient consumption of vegetables and fruit, while 26.1% reported being physically inactive. Being overweight affected 18.4% of individuals, and abdominal obesity affected 43.4%, whilst hypertension affected 24.4% of the subjects. Hence, the identification of these determinants may help in developing targeted CMD interventions and policies in PLWHI. Additionally, adoption of a healthy lifestyle such as avoiding smoking and alcohol, maintaining a healthy diet, and participating in physical activities are viewed as essential in the prevention and control of CMDs.

Various studies have identified numerous predictors for NCD risk factors in non-HIV+ subjects, including knowledge about risk factors (Aryal et al., 2015; Bodhare et al., 2013; Kulkayeva,

Harun-Or-Rashid, Yoshida, Tulebayev & Sakamoto, 2012). This is also complemented by the current study that was conducted among PLWHI in Rwanda. Certain sociodemographic and HIV-related variables were predictors for NCD risk factors in this population. Moreover, as demonstrated by various researchers, there is a relationship between knowledge of NCD risk factors and risk perceptions in non-HIV+ subjects (Choi, Rankin, Stewart & Oka, 2008; Wilcox & Stefanick, 1999). Along with HBM, people may adopt preventive health behaviours if they perceive themselves at risk for NCDs and perceive serious consequences of NCDs on their health (Orji, Vassileva & Mandryk, 2012). In this vein, a study that aimed to explore the level of knowledge and perceptions of T2D mellitus was conducted in Rwanda (Mukeshimana & Nkosi, 2014), and the authors concluded that knowledge and perceptions of T2D mellitus of respondents were poor and inadequate, and they recommended that improving knowledge and risk perceptions of type T2D mellitus are very important. However, a few studies are available to confirm this association in PLWHI. Cioe, Crawford, and Stein (2014) have conducted a study to describe CVD risk factor knowledge and risk perception in HIV+ adults. The results indicate that CVD risk factor knowledge was adequate, but risk perception was inaccurate. These findings have been confirmed in other study conducted in Kenya (Temu et al., 2015). Temu et al. (2015) are of the view that behaviour change interventions may improve the QOL of those infected with HIV. The role that predisposing factors, specifically knowledge, plays in predicting or explaining behavioural and biological risk factors for NCDs in PLWHI remains unknown in other SSA countries, including Rwanda. Thus, it is evident that researchers in developing countries cannot base their interventions entirely on information from developed countries, since interventions need to be context-specific. In this regard, this apect of the study aimed to assess knowledge of

chronic disease lifestyle risk factors and their associated factors amongst adults living with HIV infection in Rwanda.

7.2 Results

7.2.1 Knowledge of NCD Risk Factors

The current study assessed knowledge about chronic disease lifestyle risk factors in terms of lifestyle changes, risk factors, and signs and symptoms in respect of hypertension, diabetes, and stroke. Table 7.1 presents the frequencies and percentages for individual items for general knowledge regarding the risk factors for chronic lifestyle diseases. The majority of the participants (90.4%) had heard of diabetes, and 75.7% of the participants perceived that NCDs can be prevented, whereas more than 65% reported that they had never heard of a stroke. The perception that obesity can result in contracting an NCD was the most frequently reported risk (71.2%), followed by unbalanced diet (56.9%), while factors least considered to contribute to NCDs were alcohol consumption and physical inactivity (15.2% and 17.1%, respectively). On the other hand, participants were asked to agree or disagree with various statements relating to their perceptions of NCDs. More than 65% of the participants were worried about having NCDs, while some participants (35.6%) felt that they had a low risk of contracting NCDs. Less than half (46.5%) of the subjects reported that they were confident of controlling the risk of contracting NCDs. Only 21.7% of the participants reported that they had no information on how to prevent NCDs.

Table 7.1: Frequency and percentage of participants who answered 'yes' on general knowledge about NCDs (N=794)

Items	n (%)
Ever heard of NCDs?	521(65.6)
Ever heard of stroke?	270 (34.0)
Ever heard of hypertension?	685 (86.3)
Ever heard of diabetes?	718 (90.4)
Can an NCD be prevented?	601 (75.7)
Have you been taught in a health centre about NCDs?	694 (87.4)
Factors that contribute to NCDs	
Smoking	424 (53.4)
Physical inactivity	136 (17.1)
Obesity	565 (71.2)
Unbalanced diet	452 (56.9)
Alcohol	121 (15.2)
Stress	361 (45.5)
Perception of NCDs	
Compared to others my age and sex, I am at lower risk of NCD	283 (35.6)
I worry about having NCD	518 (65.2)
I think my personal effort will help control my risk of having NCD	369 (46.5)
I have information on how to prevent NCD	172 (21.7)

Table 7.2 indicates frequencies and percentages of participants who gave correct answers to each statement related to hypertension, diabetes, and stroke. All statements related to the stroke section were answered correctly by less than 30% of the participants. The statements related to the diabetes section that the normal blood glucose level is 3.8-7.7, that the usual cause of diabetes is lack of effective insulin in the body, and that diabetes can be cured, were answered correctly by 29.8%, 39.0%, and 39.7% respectively. Remaining statements on diabetes were answered correctly by more than 40% of the participants. All statements in the hypertension section were answered correctly by more than 65% of the participants, except the statement that a BP of 130/80mmHg is considered high, which was answered correctly by 63.0%.

Table 7.2: Frequency and percentage of participants who answered correctly to each statement about NCDs (N=794)

Sections	Knowledge Statement	n (%)
Hypertension	Hypertension is another name for BP	648 (81.6)
	The following BP is considered to be high: 130/80	500 (63.0)
	Hypertension can be treated with medication, exercise and weight loss	606 (76.3)
	Lifestyle changes, such as stopping smoking and weight loss can decrease BP	583 (73.4)
	Damage to the kidneys is a sign of high BP	529 (66.6)
Diabetes	Diabetes is commonly known as " sugar" sickness	608 (76.6)
	The following is normal blood glucose level 3.8-7-7	237 (29.8)
	Eating too much sugar and other sweet food can cause diabetes	433 (54.5)
	Diabetes can be cured	315 (39.7)
	Shaking and sweating are signs of high sugar levels	363 (45.7)
	Kidneys produce insulin	321 (40.4)
	The usual cause of diabetes is lack of effective insulin in the body	310 (39.0)
	Diabetes causes poor circulation	361 (45.5)
	Medication is more important than diet and exercise to control diabetes	366 (46.1)
	There are two types of diabetes namely Type 1 and Type 2	361 (45.5)
	Diabetes can damage my kidneys	337 (42.4)
Stroke	The most common type of stroke is when the blood supply to the brain is blocked	212 (26.7)
	Another name for stroke is a cerebrovascular accident	191 (24.1)
	Signs of a stroke include blurred vision, paralysis on one side of the body and, a severe headache	166 (20.9)
	You are at risk of getting a stroke if you are obese	134 (16.9)
	The most common known risk factor for stroke is high BP	119 (15.0)
	If you drink alcohol you are less likely to have a stroke	94 (11.8)
	To reduce the risk of stroke you need to eat well and exercise regularly	102 (12.8)
	Right arm paralysis could be a physical disability from a stroke	102 (12.8)
	If you stop smoking, you can decrease the risk of having a stroke	102 (12.8)
	Diabetes and strokes are closely linked	122 (15.4)

Table 7.3 presents the classification of the knowledge for each individual section and overall knowledge score. Regarding the individual sections of the questionnaire, a mean score of 3.68 ± 1.492 was found for the hypertension section, 5.24 ± 3.475 for the diabetes section, and 2.76 ± 1.659 for the stroke section. With reference to the overall score for the knowledge questionnaire, the mean score was found to be 10.91 ± 5.572 (42%) with a range of 1-26 of possible value. The majority of respondents, i.e. 518 (65.2%) had poor knowledge, 223 (28.1%) had average knowledge, while only a few 53 (6.7%) had good knowledge.

Table 7.3: Distribution of the classification of the knowledge for each individual section and overall knowledge score (N=794)

Knowledge Level	n (%)
Hypertension	
Poor knowledge <50% (0-2.4/5)	173 (21.8)
Average knowledge 51-70% (2.5-3.5/5)	137 (17.3)
Good knowledge > 70% (3.6-5/5)	484 (61.0)
Diabetes	
Poor knowledge <50% (0-5.4/11)	425 (53.5)
Average knowledge 51-70% (5.5-7.7/11)	118 (14.9)
Good knowledge > 70% (7.8-11/11)	251 (31.6)
Stroke	
Poor knowledge <50% (0-4.9/10)	644 (81.1)
Average knowledge 51-70% (5-7/10)	150 (18.9)
Good knowledge > 70% (7.1-10/10)	0 (0.0)
Overall knowledge	
Poor knowledge <50% (0-12/26)	518 (65.2)
Average knowledge 51-70% (13-18/26)	223 (28.1)
Good knowledge > 70% (19-26/26)	53 (6.7)

7.2.2 Association between NCD Risk Factors' knowledge and Other Variables

The three categories of overall knowledge were then classified into 'poor' or 'good' levels. The 'poor' level included participants classified as being in the poor knowledge category and 'good' comprised participants being in the average and good knowledge categories. The researcher found that 34.8% (276 of the 794 participants) had a good level of knowledge about risk factors for NCDs. Table 7.4 indicates the association between NCD risk factors' knowledge and sociodemographic and HIV-related characteristics.

Table 7.4: Levels of knowledge of NCD risk factors by sociodemographic and HIV-related characteristics (N=794)

		Knowledge about NCD Risk Factors		
Characteristics	**Total N=794**	**Poor n (%)**	**Good n (%)**	**p-value**
All		518 (65.2)	276 (34.8)	
Gender				0.040
Female	513 (64.6)	323 (63.0)	190 (37.0)	
Male	281 (35.4)	195 (69.4)	86 (30.6)	
Age group/ years				0.120
18-30	240 (30.2)	159 (66.3)	81 (33.8)	
31-40	245 (30.9)	157 (64.1)	88 (35.9)	
41-50	204 (25.7)	124 (60.8)	80 (39.2)	
> 50	105 (13.2)	78 (74.3)	27 (25.7)	
Marital status				0.128
Never married	145 (18.3)	86 (59.3)	59 (40.7)	
Currently married	507 (63.9)	335 (66.1)	172 (33.9)	
Separated/Divorced	52 (6.5)	40 (76.9)	12 (23.1)	
Widowed	90 (11.3)	57 (63.3)	33 (36.7)	
Educational level				0.005
No formal education	160 (20.2)	118 (73.8)	42 (26.3)	
Primary	476 (59.9)	311 (65.3)	165 (34.7)	
≥ Secondary	158 (19.9)	89 (56.3)	69 (43.7)	
Employment status				0.014

Public service	81 (10.2)	42 (51.9)	39 (48.1)	
Self-employed	264 (33.2)	184 (69.7)	80 (30.3)	
Peasant/Farmer	252 (31.7)	157 (62.3)	95 (37.7)	
Unemployed	197 (24.8)	135 (68.5)	62 (31.5)	
Monthly household income				0.459
≤ 20000 RWF	179 (22.5)	120 (67.0)	59 (33.0)	
20001-40000 RWF	311 (39.2)	204 (65.6)	107 (34.4)	
40001-60000 RWF	129 (16.2)	89 (69.0)	40 (31.0)	
60001-80000 RWF	65 (8.2)	41 (63.1)	24 (36.9)	
> 80000 RWF	110 (13.9)	64 (58.2)	46 (41.8)	
Residence location				0.002
Rural	259 (32.6	149 (57.5)	110 (42.5)	
Urban	535 (67.4)	369 (69.0)	166 (31.0)	
Time since HIV diagnosis				0.630
1-3 years	338 (42.6)	223 (66.0)	115 (34.0)	
4-6 years	265 (33.4)	167 (63.0)	98 (37.0)	
≥ 7 years	191 (24.1)	128 (67.0)	63 (33.0)	
Most recent CD4 cell count				0.002
≥ 350 cells/µl	545 (68.6)	375 (68.8)	170 (31.2)	
< 350 cells/µl	249 (31.4)	143 (57.4)	106 (42.6)	
Disclosure of HIV+ serostatus				1.000
Yes	633 (79.7)	413 (65.2)	220 (34.8)	
No	161 (20.3)	105 (65.2)	56 (34.8))	
ART use status				0.376
ART-naïve	96 (12.1)	67 (69.8)	29 (30.2)	
ART use	698 (87.9)	451 (64.6)	247 (35.4)	

A chi-square test for independence was conducted to examine whether or not there was a relationship between knowledge and various other variables. The results revealed that females were more knowledgeable about NCD risk factors than males (p=0.040) were. In terms of educational level, 43.7% of participants with secondary schooling or more had significantly better knowledge compared to those who only had primary or less schooling (p=0.005). Rural residents, participants who had CD4 counts less than 350 cells/µl, and public service employees were likely to be more knowledgeable than urban residents, those who had ≥350 cell counts, and other employee counterparts (p=0.002; p=0.002; p=0.014 respectively). Additionally, participants who were normotensive, i.e. 228 subjects (38.0%), showed good knowledge

compared to those who were hypertensive, i.e. 48 subjects (24.7%) (p=0.001) (Table7.5). Other variables studied did not reveal any significant association.

Table 7.5: Levels of knowledge of NCD risk factors by behavioural and biological risk factors for NCDs

Characteristics	Total N=794	PLWHI on ART n=698	PLWHI not on ART n=96	p-value
Tobacco use				0.144
Daily smoker	93 (11.7)	69 (74.2)	24 (25.8)	
Non-daily smoker	36 (4.5)	22 (61.1)	14 (38.9)	
Non-smoker	665 (83.8)	427 (64.2)	238 (35.8)	
Alcohol consumption				0.803
Non-drinkers	506 (63.7)	328 (64.8)	178 (35.2)	
Drinkers	288 (36.3)	190 (66.0)	98 (34.0)	
Physical activity level [a]				0.049
Low	203 (26.3)	123 (60.6)	80 (39.4)	
Moderate	184 (23.8)	133 (72.3)	51 (27.7)	
High	385 (49.9)	249 (64.7)	136 (35.3)	
Fruit and vegetable intake				0.925
≥ 5 servings	28 (3.5)	19 (67.9)	9 (32.1)	
< 5 servings	766 (96.5)	499 (65.1)	267 (34.9)	
BMI/ kg/m^2 category [b]				0.326
Underweight	98 (12.3)	64 (65.3)	34 (34.7)	
Normal weight	550 (69.3)	361 (65.6)	189 (34.4)	
Overweight	115 (14.5)	69 (60.0)	46 (40.0)	
Obese	31 (3.9)	24 (77.4)	7 (22.6)	
Abdominal obesity [c]				0.386
No	427 (56.2)	291 (68.1)	136 (31.9)	
Yes	333 (43.8)	217 (65.2)	116 (34.8)	
Hypertension [d]				0.001
No	600 (75.6)	372 (62.0)	228 (38.0)	
Yes	194 (24.4)	146 (75.3)	48 (24.7)	

[a] Low: <600MET min/week; moderate: 600–2999 MET min/week; high: ≥1500 MET min/week vigorous physical activity or ≥ 3000 MET min/week moderate/vigorous physical activity
[b] Underweight: <18.5; normal:18.50–24.99; overweight:25.00–29.99; obese: ≥ 30.0
[c] Having WHR greater than 0.95 for men and 0.85 for women
[d] A SBP of 140mm Hg or more, or a DBP of 90mm Hg or more

7.2.3 Factors Associated with Knowledge about Risk Factors for Non-communicable Diseases

The relationships between the knowledge of risk factors for NCDs with NCD risk factors and other variables were assessed. A binary logistic regression included the variables that showed statistically significant associations ($p< 0.05$) in bivariate analysis. Table 7.6 indicates a binary logistic regression analysis of predictors of good knowledge of NCD risk factors.

Table 7.6: Predictors of behavioural risk factors for NCDs (N=794)

Baseline Model	Beta (SE)	Wald's x^2	df	p-value	OR (95% CI)
Gender (ref: male vs. female)	-.277 (.170)	2.655	1	.103	.758 (.543-1.058)
Educational status (ref: no formal education)		2.305	2	.043	
Primary	.392 (.215)	3.317	1	.069	1.479 (.971-2.255)
≥ Secondary	.682 (.274)	6.192	1	.013	1.978 (1.156-3.385)
Employment status (ref: Public service)		3.681	3	.298	
Self-employed	-.542 (.284)	3.628	1	.057	.582 (.333- 1.016)
Peasant/Farmer	-.410 (.324)	1.602	1	.206	.664 (.352-1.252)
Unemployed	-.379 (.308)	1.515	1	.218	.685 (.375-1.251)
Place of residence (ref: urban vs. rural)	-.399 (.205)	3.806	1	.051	.671 (.449-1.002)
CD4 cell counts (ref: ≥ 350 cells/µl vs. < 350 cells/µl)	.501 (.171)	8.586	1	.003	1.651 (1.181-2.308)
Physical activity level (ref: high)		5.727	2	.057	
Moderate	-.417 (.205)	4.130	1	.042	.659 (.441-.985)
Low	.115 (.190)	.367	1	.544	1.122 (.774-1.627)

BP (ref: Normotension vs. hypertension)	-.561 (.196)	8.197	1	.004	.571 (.389-.838)

The analysis revealed that the model contained seven independent variables (gender, educational status, employment status, residence location, CD4 cell counts, physical activity, and BP). The full model containing all predictors was statistically significant, x^2 (11, N=772) = 51.317, p<.001, indicating that the model was able to distinguish between the participants who had good knowledge and those who had poor knowledge. The model as a whole explained the variation in the dependant variable explained by the predictors between 6.4% (Cox and Snell R square) and 8.9% (Nagelkerke R squared) and correctly classified 69.2% of cases. Three independent variables made a unique, statistically significant contribution to the model. The strongest predictor of having good knowledge was having secondary schooling or more, recording an odds ratio of 1.978. This indicates that the participants who had secondary schooling or more were twice as likely to have good knowledge compared to those who had no formal education, controlling for all other factors in the model. The odds ratio of 1.651 for CD4 cell counts shows that the participants who had < 350 CD4 cell counts were more knowledgeable about NCD risk factors compared to those who had ≥ 350 CD4 cell counts. The results also show that hypertensive participants were less likely to have good knowledge about NCD risk factors than normotensive participants (OR=.571, 95% CI=.389-.838, p<0.004).

7.3 Discussion

The study assessed knowledge of chronic disease lifestyle risk factors and their associated factors among adults living with HIV infection in Rwanda. The results indicated that the

majority of the participants (65.0%) had low levels of knowledge about NCD risk factors. In contrast to the current study, Cioe et al., (2014) found fairly high knowledge about CVD risk factors among HIV+ adults. However, a previous study was conducted in a developed country and used the Heart Disease Fact Questionnaire (HDFQ) (Wagner et al., 2005) that assesses major risk factors associated with development of CVDs, which is not similar to the knowledge assessment questionnaire relating to risk factors for chronic lifestyle diseases that measure risk factors for the development of hypertension, diabetes, and stroke (Frantz, 2008). These findings are not really comparable. This suggests that interventions to improve knowledge of NCD risk factors needs to be context-specific. Besides, the low mean knowledge of 11.80 ± 5.40 (45.4%) reported in the current study, was similar (11.59 ± 4.49) to that reported in an earlier study on prevalence and knowledge of chronic lifestyle diseases risk factors amongst high school learners in a study conducted in the Northern Cape province in South Africa, which used a similar questionnaire (Sauls & Frantz, 2012).

Available evidence indicates that good knowledge of NCD risk factors is associated with an increased risk perception of NCDs (Choi et al., 2008). This is confirmed in the current study, where the majority of the participants had limited knowledge about NCD risk factors and a low perceived risk of NCDs. Thus, the provision of general and specific information about NCD risk factors in terms of lifestyle changes, risk factors, and signs and symptoms, may improve knowledge and increased perceived risk about NCDs in PLWHI.

Knowledge about risk factors for NCDs is an essential step to modify behavioural lifestyle for NCDs. Interestingly, in this study; few participants reported that they have no information to

prevent NCDs. This is despite the majority of the participants who showed that they had been taught about NCDs in health centres. This implies that health care providers in HIV clinics may not be discussing in sufficient detail NCD risk factors with PLWHI. A possible explanation is that health care professional in some HIV clinics are still relying on an "infectious disease" model of care. This suggests that the adoption of the chronic care model should be the most important part in improving HIV care and in raising awareness about comorbidities in the context of the HIV care continuum. These findings also highlight the need for NCD risk factor screening and comprehensive prevention strategies in HIV care of PLWHI. An effective way to prevent NCDs is based on early identification and treatment of those who are at high risk of NCDs. In case where risk factors for NCDs are known, PLWHI are more likely to perceive their risk for NCDs and to present for early screening and treatment, and achieve better outcomes. Additionally, more than half of the respondents in the present study reported that they were confident in controlling the risk of having NCDs. This indicates that PLWHI have relative motivation to take action against NCDs. In this regards, behavioural goal setting may improve motivation.

Additionally, the participants' levels of knowledge were associated with their education level, CD4 cell counts, and BP hypertension. Highly educated participants had good knowledge of NCD risk factors compared to their counterparts. This information is not surprising, due to the fact that a higher level of education is usually associated with health literacy. The participants who were normotensive showed better knowledge than those who were hypertensive. A good level of knowledge among those who had a low CD4 count reflects the benefits of regular clinical attendance among this population. These results highlight the need for NCD educational

programmes among PLWH both on ART and those who are ART-naïve. The promotion of health and well-being relies on health literacy. For people with chronic diseases, high levels of health literacy are useful to be involved in self-management, to use health services, and to improve health outcomes. Poor knowledge was associated with hypertension, and was predictive of being physically inactive. These results concur with a prior study, which found that people with poor knowledge were significantly more likely to be drinkers, and poor knowledge was predictive of the likelihood of becoming overweight (Kulkayeva et al., 2012). These findings highlight the importance of comprehensive health education and health promotion programmes in PLWHI. The programmes should be focused on areas identified by the current study, such as lifestyle changes, and the risk factors, signs, and symptoms of hypertension, diabetes, and stroke. Lifestyle diseases are preventable. Adequate and appropriate knowledge of lifestyle diseases and lifestyle modification are the main components in their prevention and management of NCDs. Thus, the preventive measures for the maximum benefits are to raise awareness for NCD risks among PLWHI and encourage them to perform the desired health behaviours.

7.4 Conclusion

This study indicated that knowledge about NCDs risk factors was poor. The disproportion of poor knowledge across a range of sociodemographic and HIV-related groups, coupled with the existence of NCD risk factors identified in previous chapters would put PLWHI at greater risk of NCDs. In addition, these factors have a negative impact on the HRQOL of PLWHI. Based on the serious implications for PLWHI exposed to risk factors for NCDs, it is critical to recognise methods of intervention that are suitable for this population. The provision of information about

NCD prevention and health promotion is the first step to tackle NCDs in PLWHI. In addition, self-management-known as preventive strategies-undertaken to promote or maintain health might be a critical component in improving the HRQOL in long-term treatment and care for PLWHI. Existing literature supports the importance of a healthy lifestyle in the prevention of NCDs in different population groups, including PLWHI. Despite this, many people are unable to initiate and maintain healthy lifestyle behaviours. This highlights the need to identify factors that influence initiation and maintenance of healthy lifestyle behaviours. In the next chapter, personal and environmental factors that influence physical activity participation and health diets and a healthy lifestyle among PLWHI in Rwanda will be presented.

Chapter Eight

Motivators and Barriers to Physical Activity Participation and Health Diets among People Living with HIV infection in Rwanda

8.1 Introduction

This chapter addresses objective 4, which is related to phase 3 of the PRECEDE model. As was evident in Chapter Seven, the majority of the participants had poor knowledge about NCD risk factors. Thus, provision of information about NCD risk factors will improve knowledge about these risk factors. However, a change in knowledge alone is not enough to change behaviour. According to Green and Kreuter (2005), identification of predisposing, reinforcing, and enabling factors may help to design programmes to achieve positive changes in health behaviour among PLWHI. Thus, it is necessary to understand why PLWHI engage in health risk behaviours and what might motivate them to change. This chapter focuses on both reinforcing and enabling factors for health behaviours to complement predisposing factors identified in the previous chapter. Motivators and barriers to physical activity participation and healthy diet were measured with the Motivators and Barriers of Healthy Lifestyle Scale (MABS) (Appendix J) (Downes, 2010).

In a positive vein, chronic lifestyle diseases have been demonstrated to be preventable by addressing the modifiable risk factors (Chen et al., 2015; De Waure et al., 2013). Adopting a healthy lifestyle, including avoiding smoking and alcohol, maintaining a healthy diet, and participating in physical activities, may help different populations, including PLWHI to live

longer with an improved QOL (Uphold et al., 2007). A growing body of scientific evidence indicates that healthy lifestyle interventions have beneficial effects on health outcomes in HIV+ and non-HIV+ populations (Santos-Parker et al., 2014; Botros et al., 2012; Chudyk & Petrella, 2011; Somarriba et al., 2010; Mutimura et al., 2008).

PLWHI, in comparison to the uninfected population, are expected to have a higher life expectancy if they adopt a healthy lifestyle (Nakagawa et al., 2013). Factors such as physical activity, dietary modification, and weight management are essential in HIV management (Derman et al., 2010). Physical activity and dietary interventions are useful in improving NCD risk factors among PLWHI (Hand et al., 2009; Roos et al., 2014; Stradling et al., 2012). Regardless of the proven benefits of healthy lifestyle interventions, PLWHI are likely to stray from adhering to physical activity and diet recommendations (Petróczi et al., 2010). Thus individual and environmental factors to practice healthy lifestyles should be an explicit part of health education and evidence-based guidelines (McGuire, Anderson & Fulbrook, 2014). A few studies have attempted to identify factors that influence practicing healthy lifestyles among PLWHI in general (Capili, Anastasi, Chang & Ogedegbe, 2014; Petróczi et al., 2010), and only one study conducted in South Africa focused primarily on physical activity (Roos et al., 2015).

These studies highlight that the factors that influence a healthy lifestyle can be classified into personal, social, and environmental factors. The studies confirm that identification of these factors might provide the basis for healthy lifestyle counselling that motivates behaviour changes in PLWHI. However, the authors emphasise that adherence to healthy lifestyle habits in PLWHI

is not well-documented, and suggest that more research is required to inform NCDs prevention strategies in PLWHI.

Knowledge transmission from health professionals to individuals with chronic disease, including PLWHA, is a vital tool in preventing and reducing the burden of diseases. Patients need basic knowledge about disease management before they will follow medical advice. However, there are barriers that can hinder behaviour changes, including inadequate accessibility to information, difficulties in interpreting information, the belief regarding the education's reliability and usefulness, and social support, all of which are well-known to influence adoption and maintenance of a healthy lifestyle (Murray et al., 2013). Thus, the behaviour changes and empowerment approaches are likely to increase the accessibility and actual practice of positive behaviour and the adoption of a healthy lifestyle by high risk groups (Tengland, 2012). Available evidence reveals that there are few studies that focus on personal and environmental factors that motivate or hamper healthy lifestyle behaviours among PLWHI. It is against this background that this study was carried out to identify motivators and barriers to physical activity participation and healthy diets and their association with sociodemographic factors, HIV-related factors, physical activity, fruit and vegetable intake, BMI, and WHR among PLWHI in Rwanda.

8.2 Results

8.2.1 Motivators and Barriers to a Healthy Lifestyle

The participants' motivators and barriers to a healthy lifestyle were assessed. In assessing the scores for the motivators and barriers, the overall mean scores for the motivators and barriers'

sub-scales were 28.29 ± 6.3 and 22.59 ± 3.96, with a range of 23 to 34, and 13 to 32 respectively. In addition, data from a four-point Likert scale were reduced to create nominal data by combining the categories: "strongly disagree" and "disagree" into "disagree or No" and "agree" and "strongly agree" into "agree or Yes". The most prevalent motivators reported by the participants were "want to be healthy" (94.7%) and "want to be more energetic (94.2%). The important barriers identified by the participants were "am not motivated" (50.7%), "am unable to afford it" (45.0%) and "have not been told by my healthcare provider to change my lifestyle" (44.9%). The motivators least identified were "can easily get to a place to exercise" (68.9%) and "will reduce my chances of getting sick" (78.5%), while the barrier least reported was "I feel stressed" (26.2%). Table 8.1 depicts the frequencies and percentage responses to items on the Motivators and Barriers of a Healthy Lifestyle Survey.

Table 8.1: Motivator and barrier items for each domain, and percentage of participants who agreed to the statements

Item	n (%)
Motivators:	
I motivated to practice a healthy lifestyle because I…	
May live longer	675 (89.1)
Want to be healthy	718 (94.7)
Believe that God wants me to take care of my body	690 (91.0)
Want to be more energetic	714 (94.2)
Want to manage my weight	694 (91.6)
Have someone to encourage or help me	672 (88.7)
Have seen others get sick from unhealthy behaviours	661 (87.2)
Will reduce my chances of getting sick	595 (78.5)
Can easily get to a place to exercise (sidewalk, park, or exercise facility)	522 (68.9)
Barriers:	
I am not able to practice a healthy lifestyle because I…	
Am not motivated	384 (50.7)
Do not have someone to encourage or help me	208 (27.4)
Live in an unsafe neighborhood	172 (22.7)

Have too many things to do	331 (43.7)
Have health problems	223 (29.4)
Do not know what to do	307 (40.5)
Am unable to afford it	341 (45.0)
Am not able to easily get to a place to exercise (sidewalk, park, or exercise facility)	199 (26.3)
Have not been told by my healthcare provider (doctor, nurse, practitioner, etc.) to change my lifestyle	340 (44.9)
I feel stressed	199 (25.7)

8.2.2 Factors Associated with Motivators and Barriers to a Healthy Lifestyle among Participants

Table 8.2 shows means and standard deviations for the motivators and barriers according to sociodemographic factors, HIV-related factors, physical activity, fruit and vegetable intake, BMI, and WHR.

Table 8.2: Relationship between motivators and barriers scores and various factors

Variables	Motivator Dimension		Barrier Dimension	
	Mean ±SD	p-value	Mean ±SD	p-value
Gender		0.950		0.316
Male	28.32± 2.51		22.36± 3.85	
Female	28.34± 2.52		22.67 ± 4.46	
Age		0.849		0.226
≤ 40 years	28.35 ± 2.55		22.40± 3.67	
> 40 years	28.31 ± 2.47		22.76 ± 4.30	
Marital status		0.481		<0.001
Not married	28.24 ± 0.60		23.35 ± 4.23	
Married	28.38 ± 2.47		22.07± 3.68	
Educational level		0.011		0.941
≤ Primary schooling	28.12 ± 2.41		22.55 ± 3.95	
≥ Secondary schooling	28.73± 2.82		22.58 ± 3.96	
Employment status		0.922		0.014
Employed	28.34± 2.54		22.30 ± 3.75	
Unemployed	28.32 ± 2.46		23.12 ± 4.31	
Monthly income (RWF)		0.004		0.603
> 40000	28.67 ± 2.51		22.65 ± 4.01	

≤ 40000	28.11 ± 2.50		22.50 ± 3.92	
Residence		0.125		<0.001
Urban	28.43 ± 2.47		22.96 ± 3.99	
Rural	28.11 ± 2.61		21.63 ± 3.71	
CD4 cell counts		0.568		0.906
≥ 350 cell counts	28.37 ± 2.537		22.57 ± 3.900	
< 350 cell counts	28.25 ± 2.468		22.53 ± 4.080	
Time since HIV diagnosis		0.607		0.193
> 5 years	28.30 ± 2.544		22.42 ± 3.943	
≤ 5 years	28.40 ± 2.459		22.83 ±3.961	
Disclosure of HIV+ serostatus		0.245		0.261
Yes	28.39 ± 2.500		22.47 ±4.000	
No	28.11 ± 2.571		22.88 ± 3.750	
Physical activity		0.166		<0.001
Physically active	28.34 ± 2.529		22.14 ± 3.848	
Physically inactive	28.01 ± 2.537		23.67 ± 4.460	
Fruit and vegetable intake		0.987		0.383
≥ 5 servings	28.33± 2.600		22.08 ± 3.546	
< 5 servings	28.33 ± 2.511		22.59 ± 3.979	
BMI/ kg/m^2		0.089		<0.001
≤ 24.9	28.41 ± 2.493		22.31± 3.839	
≥ 25	27.99 ± 2.591		23.60± 4.244	
WHR/cm		0.261		0.093
< 0.95 (men) and < 0.85 (women)	28.41±2.490		22.35±3.760	
≥ 0.95 (men) and ≥ 0.85 (women)	28.19±2.542		22.86 ±4.262	

An independent-samples t-test was conducted to compare the motivator and barrier scores for different variables. There were statistically significant differences in the motivators' scores for participants who had secondary schooling or more (28.73± 2.82) and those who had primary schooling or less (28.12 ± 2.41, p= 0.011). Similarly, in those who had a monthly household income of > RFW 40 000 (28.67 ± 2.51) and those who had a monthly household income of ≤ RFW 40 000 (28.11 ± 2.50, p= 0.004), there were significant differences. This implies that participants who had secondary schooling or more, and those who had a monthly household income of > RFW 40000 believe that there are more motivators to engage in a healthy lifestyle. There were also statistically significant differences in the barrier scores for participants who were married (22.07± 3.68) compared to those who were unmarried (23.35 ± 4.23, p< 0.001), in

urban residents (22.96 ± 3.99) as opposed to rural residents (21.63 ± 3.71, p< 0.001), and in those who were employed (22.30 ± 3.75) compared to those who were unemployed (23.13 ± 4.31, p=0.014). These results indicate that participants who were urban residents, those not married, and those unemployed had more barriers to overcome while they were willing to engage in physical activity and healthy diet.

Independent-samples t-test results also showed that there were statistically significant differences in barrier scores reported by participants who were physically active (22.14 ± 3.85) in comparison to those who were physically inactive (23.67 ± 4.46, p< 0.001), as well as participants who had a BMI of 25 or more (23.60± 4.24) compared to those who had BMI of 24.9 or less (22.31± 3.84, p < 001). These results indicate that participants who were physically inactive and those who had high BMIs had significantly more barriers to engage in a healthy lifestyle than their comparison group counterparts. There were no significant differences in motivator and barrier scores with respect to HIV-related factors revealed by the study.

Table 8.3 illustrates results of the multivariate analysis. A standard multiple regression analysis was used to evaluate the relationships between motivator and barrier dimensions and variables. Included in the model were all the variables that showed significant level p <0.05 from the independent-samples t-test. The model contained two independent variables (educational level and monthly household income) for the motivator dimension, whereas the model contained five independent variables (marital status, employment status, residence location, physical activity, and BMI) for the barrier dimension.

Table 8.3: Standard multiple regression results of the participants according to motivator and barrier dimensions (N=794)

Dimensions	Predictor (s)	Beta	p-value (Predictor)	R^2 (model)	p-value (Model)
Motivators	Monthly household income	-.109	0.004	0.051	0.005
	Educational level	-0.094	0.017		
Barriers	Marital status	-0.119	0.003	0.091	<0.001
	Residence location	-.140	<0.001		
	Physical activity	0.131	0.001		
	BMI	0.103	0.008		

Monthly household income ($\beta = -0.109$, $p = 0.004$) and educational level ($\beta = -0.094$, $p = 0.017$) emerged as significant predictors of the motivators dimension. They explained 5% of the variation in the motivators' dimension score. Higher monthly household income and being highly educated exerted a positive effect on the motivators' dimension. For the barriers dimension, marital status ($\beta = -0.119$, $p < 0.05$), residence location ($\beta = 0.140$, $p < 0.01$), physical activity status ($\beta = 0.131$, $p = 0.001$), and BMI ($\beta = 0.103$, $p < 0.05$) were selected as significant predictors. They explained 9% of the variation in the barriers' dimension. BMI and being urban residents exerted positive effects on the barriers' dimension scores, whereas being physically active and married exhibited negative effects on the barriers' dimension scores.

8.3 Discussion

This study examined the personal and environmental factors that influence a healthy lifestyle for PLWHI in Rwanda. A high score on the motivator dimensions indicates that PLWHI revealed that there are more personal and environmental factors that facilitate healthy lifestyle behaviours than inhibitors, while a moderate score on the barrier dimension indicates that PLWHI

experience relative barriers to performing the desired health behaviours. It is interesting to note that mean motivator scores are higher than the mean barrier score in the present study. In accordance with Motivators and Barriers of Health Behaviours (MBHB) Model, in case the motivating factors are greater than the barriers, a person will be more likely to practice healthy behaviours (Downes, 2008). In the current study, PLWHI have a positive attitude towards participation in physical activity and healthy diets, and this implies that PLWHI are more likely to engage in physical activity and healthy dietary habits.

In situations where personal and environmental factors influence healthy lifestyle, health care providers are required to develop behavioural counselling programmes with aim of initiating and maintaining lifestyle modification in PLWHI in order to prevent and control NCDs in this population. The content and methods of developed programmes should underline healthy lifestyle motivators, while providing solutions to overcoming the barriers. In order to achieve this, health care providers must be informed about behavioural change theories that help them to explain why behaviours change. The findings of this study also revealed that the most frequent barriers to physical activity participation and healthy diet included lack of motivation, affordability, lack of information from healthcare providers, time, and just lack of understanding what needs to be done. These findings highlight that there are gaps in the content of counselling and health education for PLWHI. Health care providers are in a better position to develop strategies that help PLWHI to engage in healthy lifestyles. Improved knowledge enhances success and healthy lifestyle adherence. This highlights the significant need for continuous patient education counselling, and develops individualised strategies to improve lifestyles, even for those suffering from HIV. However, it is unfortunate that one of the barriers, as mentioned

above, is the lack of information from healthcare providers. These results may have implications for clinical practice and health service provision, given that all of the participants were recruited from health centres providing HIV care. This indicates a lack of motivation in health care providers in terms of providing care to PLWHI in health centre facilities. There is a great need to encourage health care providers, as they play a crucial role in motivating their clients to adopt healthier lifestyles. On the other hand, goal-setting and action-planning could be one way to help PLWHI.

Additionally comments such as "want to be healthy", "want to manage my weight", "have someone to encourage" or "help me", and "believe that God wants me to take care of my body" were commonly reported motivators to participate in physical activity and follow a healthy diet in the current study. These results are consistent with results in other studies of PLWHI that explored factors affecting practice of healthy lifestyle behaviours using the qualitative approach. Capili et al. (2014) found that socioeconomic or financial circumstances were acknowledged as the primary barriers to a healthy lifestyle, while social support was considered as the primary motivator. Roos et al. (2015) found that in South Africa, support and encouragement came from friends and family, religious practices during worship, and the community environment. Social support from family and friends is vital to engage in a healthy lifestyle. Participation in physical activity with other people can help in developing positive social norms for physical activity in the individual's social network (Berkman, 2000). Observing the physical activity behaviour of others can also help individuals to learn about physical activity, in addition to receiving the positive feedback about the benefits of physical activity (Stahl et al., 2001). In addition, stress was reported as one of the pressing issues. Thus, the available evidence indicates that stress may

impair healthy lifestyle practices (Hamer, 2012). In this case, the following health strategies are recommended to manage stress, and they include taking a break from the stressors, exercising, receiving social support, and meditation.

Marital status, residence location, physical activity, and BMI have been associated with barriers, while monthly household income and educational level have been associated with motivators. The findings of this study are consistent with those of an earlier study that assessed physical activity barriers related to body weight status and sociodemographic factors among Malaysian men in the Klang Valley (Ibrahim, Karim, Oon & Ngah, 2013). Marriage status has been associated with physical activity. King, Kiernan, Ahn, and Wilcox (1998) found that the transition from being single to married had a positive effect on physical activity, compared to individuals who stayed single. A change in marital status might influence and motivate the individual to engage in physical activity. Furthermore, the motivation factor was proved to have a relationship with level of physical activity (Trost, Owen, Bauman, Sallis & Brown, 2002). Thus, interventions in health-promotion programmes using cognitive approaches seem the most suitable for overcoming these barriers. For example, strategies to increase confidence and motivation may help individuals to increase their physical activity participation and improve their weight management.

In addition, educational level was also found to contribute significantly towards physical activity participation and as healthy diet motivators. Participants with higher educational levels were more likely to perceive more motivators than participants with lower educational levels. These individuals who are usually at the highest levels of income and job classification are also more

likely to engage in healthy behaviours such as physical activity engagement and proper diet than those of lower job status and income (Giles-Corti & Donovan, 2002). Individuals with a higher education also tend to adopt more health-promoting behaviours and reduce riskier behaviours at a faster rate. This might be due to their high awareness of the benefits of living a healthy lifestyle and their ability to obtain social and material resources (such as gym memberships) that maintains levels of physical activity, even in adverse weather conditions (McNeill, Kreuter & Subramanian, 2006).

Different factors to consider for effective healthy lifestyle interventions were classified based on the PRECEDE model (Green & Kreuter, 2005). These include predisposing factors such as knowledge, attitude, belief, exiting skills, and self-efficacy; enabling factors such as the availability, accessibility, and affordability of health care and community resources, laws and policies; and reinforcing factors such as social support and peer influence. In line with previous study conducted among non-HIV+ subjects in Karaj, Iran (Sabzmakan et al., 2014), environmental factors were barriers to a healthy lifestyle. To design healthy lifestyle interventions, policy-makers should consider environmental factors, including policies and local legislation that promote healthy lifestyles or discourage NCD risk factors, in addition to educational measures (patients' education). Thus, to promote physical activity participation and a healthy diet in PLWHI, policy-makers should consider motivators and barriers to a healthy lifestyle in an attempt to develop comprehensive interventions. In addition, health education and counselling of PLWHI should be designed in consideration of specific groups, including those who are overweight, physically inactive, urban residents, and those who are not married, all of whom are more likely to report more barriers.

8.4 Conclusion

While healthy lifestyle interventions have the potential to combat NCDs, especially CMD in PLWHI, identifying barriers and motivators to engaging in these interventions is now significantly important in the long-term care of PLWHI. This study provides valuable personal and environmental factors to consider in designing healthy lifestyle programmes that aim to promote physical activity and healthy eating in PLWHI. Addressing barriers and motivators to physical activity participation and health diets in the design and implementation of NCD prevention programme for PLWHI can inform the delivery of customised, evidence-based strategies towards better lifestyle for PLWHI. Following this, health care providers may provide individualised counselling to PLWHI to initiate and maintain physical activity and a healthy diet in their daily lives; which in turn reduces PLWHI's vulnerability to NCD by preventing or delaying these diseases. In this case, prevention of NCDs is cost effective. Again, in addition to educational strategies deal with changing health-related behaviours in PLWHI; considering policy decisions as important and integral part to behavioural change is crucial in tackling issues around access such as affordability and availability; as an example, by addressing financial issues and time constraints among PLWHI. Future research is sorely needed to identify factors influencing the motivation of HIV care providers to implement health promotion and disease prevention activities in clinical practice, in addition to comprehensive management of PLWHI provided by a multidisciplinary team that gives a continuum of care. The findings from phases 1 and 2 of the PRECEDE model indicate an impaired HRQOL and the existence of risk factors for NCDs in PLWHI in Rwanda, whereas reasons for health behaviours in this population were identified in phase 3 of this model, and these include predisposing factors (knowledge, risk perception, and self-efficacy about NCD risk factors), reinforcing factors (motivators to physical

activity participation and healthy diets), and enabling factors (barriers to physical activity participation and healthy diets). Several behavioural change strategies were identified for all the factors mentioned above. Additionally, the availability of reliable and comparable data is well known as one of the approaches to address NCDs among PLWHI via evidence-building for proper planning of NCD prevention and control strategies (Petersen, Yiannoutsos, Justice & Egger, 2014). However, integration of research evidence into healthcare decision-making is a multifaceted and challenging process influenced by numerous factors, including policy-makers' experience, available resources, the policy context, etc. (Harvey & Kitson, 2015; Davies, 2005). This implies the need for a communication approach that takes account of various competing factors. In this regard, the next chapter will focus on developing a health policy brief based on this PhD research's findings.

Chapter Nine

Development of the health policy brief

9.1 Introduction

The researcher has chosen the manuscript-based style to write and organise this PhD research due to the fact that this format encourages more concrete publications. This PhD research has ten chapters such as introduction, literature review, review paper, methodology, four research papers, development of a health policy brief, and summary discussion, conclusions and recommendations. However, it merges summary discussion, conclusions and recommendations into health policy brief chapter to avoid duplication. The ultimate goal of Chapter Nine is to present the health policy brief on strategies addressing the behavioural and biological risk factors for NCDs among PLWHI in Rwanda. Policy briefs are documents reserved for policy-makers to facilitate policy decision-making, with policy guidelines that are informed by research generated evidences. A researcher has chosen a policy brief among several other research dissemination tools due to the fact that it makes research findings digestible by increasing the likelihood of the research being read and acted upon. The designed health policy brief appears in the following section.

9.2 Health Policy Brief

Health Policy Brief

Preventable Risk Factors for Non-Communicable Diseases among People Living with HIV Infection in Rwanda

From: **Juvenal Biraguma**

To: **Minister of Health, Rwanda**

Executive Summary

Non-communicable disease is an international public health concern and Rwanda has not been excluded. Of more concern are the people living with HIV infection who have increased risk of developing non-communicable diseases. This study conducted in Rwanda aimed to address the problem, highlight the concerns and present some solutions.

Introduction

Like other Sub-Saharan Africa (SSA) countries, Rwanda bears an increasing burden of NCDs, and a high proportion of NCDs are associated with lifestyle risk behaviours that contribute to higher incidents of cancers, CVDs, and type 2 diabetes (T2D) (Forouzanfar et al., 2015; Murray et al., 2015). Simultaneously, life expectancy of those infected with HIV has increased dramatically as a result of cART (Nakagawa et al., 2013). Thus, PLWHI may live longer, but with increasing rates of non-HIV chronic diseases. The excess risk of NCDs in PLWHI is attributable to chronic inflammation, immune activation associated with HIV infection, opportunistic infections, certain ART drug side-effects, and traditional risk factors being tobacco use, hypertension, diabetes, and hyperlipidaemia (Bloomfield et al., 2014).

Additionally, most previous studies have revealed that NCDs, especially CMDs, are more prevalent in HIV+ than uninfected individuals (Triant, 2013; Galli et al., 2010; Meigs & Grinspoon, 2009). These studies indicate the need for more research to understand the determinants for CMDs in this population. Again, NCDs have appeared as the leading cause of morbidity and mortality in PLWHI in developed countries (Triant, 2007). Risk stratification for targeting individuals at high risk of developing NCDs such as PLWHI is necessary. Such risk stratification approaches are important, as people with HIV infection live longer due to effective cART, but are often at increased risk of developing various types of NCDs, specifically CMDs. Additionally, preventive strategies, including lifestyle interventions, are not significantly integrated in primary care settings and in the

HIV care continuum.

Furthermore, NCD policy in Rwanda provides strategies for the prevention of NCDs in the general population but no focused strategy is available to address them in PLWHI, despite the fact they are at increased risk for NCDs. As HIV infection is evolving to become less deadly in Rwanda, as in other Sub-Saharan Africa countries, it is important that the associated NCDs that are emerging in PLWHI established on ART are tracked. Therefore, the purpose of this health policy brief is to propose to the government of Rwanda in general, and the Ministry of Health in particular, the possible and sustainable strategies to address risk factors for NCDs among PLWHI in Rwanda.

Approaches and Results

This PhD research was conducted in randomly selected public health centres from three purposively selected provinces, namely Kigali City and the Southern and Eastern provinces of Rwanda. The study was carried out in outpatient HIV clinics that provide HIV services. Permission was sought from the relevant authorities at the University of the Western Cape and from the relevant Rwandan committees. Four validated and reliable questionnaires were used to collect data for PLWHI. The questionnaires were administered by research assistants who engaged in face-to-face interviews to receive information from participants. Physical examinations were made to obtain additional variables required.

Data derived from the WHO-STEPS indicate that about 16.2% individuals reported daily smoking, 31.4% reported harmful alcohol use, and 95% reported insufficient consumption of vegetables and fruit, while 26.1% reported being physically inactive. Being overweight affected 18.4% of individuals, and abdominal obesity affected 43.4%, whilst hypertension affected 24.4% of the subjects. The proportion of HIV+ adults Rwandans who smoked daily and were current drinkers is significant enough to predispose them to various NCDs in future decades. These findings confirm existing evidence that PLWHI have increased risk of NCDs especially CMDs (Lang, Boccara, Mary-Krause & Cohen, 2015; Kaplan et al., 2007). In addition, a recent narrative review confirmed that there are important drug interactions between alcohol and ART, or therapies for opportunistic infections and other co-morbidities (Schneider et al., 2014). These findings suggest that interventions promoting smoking cessation and community education campaigns against harmful alcohol use are necessary strategies to improve the wellbeing of Rwandans, specifically those with HIV-infection who are at increased risk for CMDs.

The prevalence of insufficient fruit and vegetable intake was 96.5% in this research, an

estimate that is higher than the findings from previous studies among HIV+ population in other countries (Kaguruki et al., 2014; Muronya et al., 2011). On the other hand, the observed prevalence of low physical activity of (26.1%) was more than double the prevalence reported in the general population of Rwanda (12.0%) (MOH, 2015). This finding is in agreement with other research findings that showed that the prevalence rates of physical inactivity fall within the range of 19-73% among PLWHI (Schuelter-Trevisol et al., 2012). This is viewed as a significant public health concern, thus highlighting the need for behaviour changes in PLWHI. These findings suggest that development and follow-up is needed to support public health and community outreach programmes and interventions. These findings also suggest that the care of PLWHI must include interventions to address specific biological risk factors, such as being overweight/obesity, abdominal obesity, and hypertension that place this population at increased risk for CMDs, to provide better QOL for PLWHI. This study has also shown that predictors of behavioural and biological risk factors among PLWHI included old age that was associated with tobacco use and harmful alcohol use. Men were more likely to be associated with higher rates of alcohol use, but also more likely to be physically active, and fewer men than women had abdominal obesity. Hence, the identification of these determinants may help in developing targeted CMD interventions and policies in PLWHI. In addition, NCD prevention programmes should consider gender-specific interventions regarding physical activity and alcohol consumption, since the related risk factors are not the same in men and women. Failure to do so may result in emerging NCD comorbidities in PLWHI that increase the future morbidity and mortality in this population.

Moreover, as demonstrated by various researchers, there is a relationship between knowledge of NCD risk factors and risk perceptions in non-HIV+ subjects (Choi, Rankin, Stewart & Oka, 2008; Wilcox & Stefanick, 1999). Along with HBM, people may adopt preventive health behaviours if they perceive themselves at risk for NCDs and perceive serious consequences of NCDs on their health (Orji, Vassileva & Mandryk, 2012). In this vein, this study explored the level of knowledge and perceptions of chronic lifestyle risk factors, the results revealed that knowledge and perceptions of chronic lifestyle diseases risk factors were poor and inadequate. This research study leads the researcher to believe that PLWHI in Rwanda may not modify their behavioural risk factors to prevent NCDs. In contrast to the current study, Cioe et al., (2014) found fairly high knowledge about CVD risk factors among HIV+ adults in the USA. Thus, it is evident that researchers in developing countries cannot base their interventions entirely on information from developed countries, since interventions need to be context-specific. Interestingly, in this study, few participants reported that they had no information to prevent NCDs, in spite of the majority of the participants claiming that they had been taught about NCDs in health centres. This implies that health care providers in HIV clinics may not be discussing NCD risk factors in sufficient detail with PLWHI. A possible explanation is that health

care professionals in some HIV clinics are still relying on an "infectious disease" model of care.

Findings also reveal a moderate HRQOL among PLWHI in this study. While the results indicate that tobacco users and those who had abdominal obesity reported a poor mental HRQOL, physical inactivity and hypertension have a negative impact on the physical HRQOL. The association of behavioural and biological risk factors for NCDs with a poor physical and mental HRQOL suggests that there is still impairment in the HRQOL of those living with HIV with access to ARV drugs in Rwanda. This provides a window of opportunity to improve HRQOL; thus, intervention strategies to prevent and control NCD risk factors should be viewed as central to PLWHI. In a positive vein, chronic lifestyle diseases have been demonstrated to be preventable by addressing the modifiable risk factors (Chen et al., 2015; De Waure et al., 2013). Adopting a healthy lifestyle, including avoiding smoking and alcohol, maintaining a healthy diet, and participating in physical activities, may help different populations, including PLWHI to live longer with an improved QOL (Uphold et al., 2007). A growing body of scientific evidence indicates that healthy lifestyle interventions have beneficial effects on health outcomes in HIV+ and non-HIV+ populations (Santos-Parker et al., 2014; Botros et al., 2012; Chudyk & Petrella, 2011; Somarriba et al., 2010; Mutimura et al., 2008). Thus, adopting a healthy lifestyle is viewed as one of the best ways to address risk factors for NCDs, which in turn improves the HRQOL of PLWHI.

Physical activity and dietary interventions are useful in improving NCD risk factors among PLWHI (Hand et al., 2009; Roos et al., 2014; Stradling et al., 2012). Regardless of the proven benefits of healthy lifestyle interventions, PLWHI are likely to stray from adhering to physical activity and diet recommendations (Petróczi et al., 2010). In this regard, participants in this research were questioned about why some people practice healthy lifestyle behaviours, i.e. exercise regularly and eat a healthy diet, and others do not. The findings of this study revealed that the most frequent barriers to physical activity participation and adopting a healthy diet included lack of motivation, affordability, lack of information from healthcare provider, time, and just a lack of understanding of what needs to be done. This study demonstrates that there are gaps in the content of counselling and health education of PLWHI. It is important that health care providers who treat and care PWLHI provide continuous patient education and counselling and develop individualised strategies to improve lifestyles for PLWHI in each health centre that provide HIV services. In this case, personal and environmental factors to practice healthy lifestyles should be an explicit part of health education and evidence-based guidelines. It is apparent that a comprehensive health care of PLWHI should offer a continuum of care with a multidisciplinary team to deal with the needs and various characteristics of PLWHI, including dieticians and physiotherapists, to implement

effective healthy lifestyle interventions.

Conclusion

Overall, adults living with HIV infection in Rwanda are at increased risk for non-communicable diseases due to the existence of non-communicable disease risk factors coupled with poor knowledge to identify these risk factors. People living with HIV infection also face numerous personal and environmental barriers in adopting a healthy lifestyle. In addition, these risk factors have a negative impact on health-related quality of life. These findings highlight the need for measures to prevent future epidemic of non-communicable diseases, especially cardiometabolic diseases in people living with HIV infection in Rwanda.

Implications and Recommendations

The existence of preventable risk factors for NCDs would surely expose PLWHI to a greater risk of NCDs if measures are not taken. The following options are proposed to help resolve the issue.

- As the NCD policy in Rwanda provides strategies for NCD prevention in the general population, the findings of this study should be used by the Rwandan Ministry of Health to review and improve the existing policy for NCDs and chronic care, by integrating focused strategies to address unrecognised NCDs in PLWHI.
- A comprehensive health education programme needs to be developed for PLWHI in order to raise their awareness about the adverse effects of risk factors for NCDs and on how they can change behavioural risk factors. In this regard, the Rwandan Ministry of Health needs to restructure the provision of HIV-related care into the chronic care model in order to integrate primary, secondary, and tertiary prevention for NCDs in HIV care and treatment.
- Health facilities that provide HIV services need to be more actively involved in a routine monitoring and screening for PLWHI attending health centres for early detection of NCDs and NCD risk factors, to prevent HIV-NCD co-morbidities and premature death.
- Available evidence indicates that physical activity is useful in improving NCD risk factors in HIV+ and non-HIV+ populations. This study recommends national programmes for adoption programmes to improve physical activity and comprehensive multidisciplinary programmes in response to evidence from this

study and studies done previously.

- The Ministry of Health should increase the number of rehabilitation professional in health centres and hospitals to ensure a comprehensive health care of PLWHI with a multidisciplinary team to deal with the needs and various characteristics of PLWHI, including dieticians and physiotherapists, to implement effective healthy lifestyle interventions.

9.3 Summary, Conclusions and Recommendations

9.3.1 Summary

In Rwanda, as in other SSA countries, life expectancy of PLWHI has increased dramatically as a result of cART. People living with HIV infection can now live longer but with increasing rates of NCDs. Thus, prevention of NCD comorbidities in PWLHI is crucial to maintain and gain health-related benefits and to maximise the HRQOL in the long-term management of PLWHI. The foremost modifiable risk factors for NCDs include the behavioural and biological risk factors, namely tobacco use, harmful alcohol use, unhealthy diet, physical inactivity, being overweight and obesity, high blood pressure, elevated blood glucose, and abnormal blood lipid levels (WHO, 2002). Thus, to prevent the emergence and progression of comorbid problems, such as CMDs, it is essential to intervene actively on modifiable risk factors in order to help PLWHI to adopt health-promoting behaviours. The overall aim of this study is to provide evidence that informs the development of a health policy brief on strategies addressing behavioural and biological risk factors for NCDs among PLWHI in Rwanda. Specifically, this PhD research aimed to (1) describe the associations and distribution patterns of behavioural and biological risk factors of NCDs among PLWHI in Rwanda; (2) assess knowledge of chronic lifestyle disease risk factors and their associated factors; (3) determine the associations between behavioural and biological risk factors for NCDs with physical and mental health-related dimensions of QOL; (4)

identify motivators and barriers to physical activity participation and healthy diets; and (5) develop a health policy brief on strategies addressing behavioural and biological risk factors for NCDs among PLWHI.

This study was guided by the PRECEDE model component (Green & Kreuter, 2005) with a focus on the first three phases including social assessment, epidemiological and behavioural assessment, educational and public health assessment to guide context-specific dissemination plan.

Measuring the HRQOL in the context of HIV infection is crucial to get a deep understanding of the effects of HIV infection itself and the ART drugs on people's lives. In this study, the HRQOL was assessed with the MOS-HIV questionnaire. The results revealed that the mean PHS and MHS scores value were 63.96±11.68 and 53.43±10.89, respectively, indicating a moderate physical and mental HRQOL. Higher scores in the physical HRQOL dimension than the mental HRQOL dimension confirms that the success of cART is associated with a better virology and immunological status. The results also reveal that behavioural and biological risk factors for NCDs were significantly associated with lower HRQOL. In addition, NCD risk factors exclusively contributed to a lower HRQOL between PLWHI after controlling sociodemographic variables and HIV-related factors (disclosure to HIV status, CD4 cell count, and the length of HIV infection). This research study showed a negative impact of tobacco use and abdominal obesity on the mental HRQOL and a negative impact of physical inactivity and hypertension on the physical HRQOL. In addition, certain sociodemographic and HIV-related variables,

specifically being unmarried, a lack of HIV disclosure, and low CD4 count (less 350 cell counts /mm^3) were associated with significantly lower mental and physical dimensions of QOL. The results of this study reveal that behavioural and biological risk factors for NCDs were significantly associated with a lower HRQOL. In addition, NCD risk factors exclusively contributed to lower HRQOL between PLWHI after controlling sociodemographic variables and HIV-related factors (disclosure of HIV status, CD4 cell count, and the length of HIV infection). This means that prevention and control of NCDs and their risk factors is an important public health concern in HIV care and treatment. Thus, assessing the epidemiology of preventable risk factors for NCDs in PLWHI is the basis of prevention of NCDs in this population. It may help HIV healthcare providers and policy-makers to design and target intervention programmes for preventing and controlling NCDs.

This section presents a description of the behavioural and biological risk factors for NCDs among PLWHI in Rwanda. To identify these factors, the WHO-STEPS were administered to assess the prevalence and predictors of these factors. The results of this study revealed that 16.2% of the participants smoked, 31.4% used alcohol, and 26.1% had low physical activity, while more than 95% consumed less than five servings of fruit and vegetables combined per day. The prevalence rates of hypertension, being overweight and obesity and abdominal obesity were 24.4%, 18.4%, and 43.4% respectively. In addition, tobacco use was associated significantly with older age, and separated and divorced participants, and in people who had not disclosed their HIV serostatus. Alcohol consumption was associated with males and never with married people. Physical inactivity was associated with females, high educational status, and lack of disclosure of HIV serostatus. People who were older than 50 years, self-employed, physically

inactive, smokers, and those who were on ART were more likely to be hypertensive. Urban residents were 2.3 times more likely to be overweight or obese than were rural residents, while a lower prevalence of being overweight or obese was observed in participants who had a CD4 count lower than 350 cells /mm^3. Abdominal obesity was significantly less prevalent in males than females.

With improved knowledge about NCD risk factors PLWHI are more likely to perceive their risk for NCDs and to present for early screening and treatment, and achieve better outcomes. However, when the participants were assessed regarding their knowledge regarding chronic lifestyle disease risk factors in terms of lifestyle changes, risk factors, and signs and symptoms in respect of hypertension, diabetes, and stroke, the results revealed that that the majority of the participants (65.0%) had low levels of knowledge. Only 21.7% of the participants reported that they had information on how to prevent NCDs. Less than half of the participants (46.5%) reported that they were confident in controlling their risk of contracting NCDs, while more than a third of the participants (35.6%) felt that they had a low risk of developing NCDs. Poor knowledge about risk factors for NCDs was associated with low educational status and having ≥ 350 CD4 cell counts. Hypertensive participants were less likely than normotensive participants to have good knowledge about NCD risk factors.

While healthy lifestyle interventions have the potential to combat NCDs, especially CMD in PLWHI, identifying barriers and motivators to engaging in these interventions is now significantly important in the long-term care of PLWHI. Motivators and barriers to physical

activity participation and healthy diet were measured with the Motivators and Barriers of Healthy Lifestyle Scale (MABS). This research study's results showed that the mean overall motivators and barrier scores were 28.29±6.3 and 22.59±3.96, respectively. The most frequently barriers to physical activity participation and healthy diet included lack of motivation, affordability, lack of information from healthcare providers, time, and the lack of understanding of what needs to be done. Participants who were urban residents, unmarried, unemployed, physically inactive, and who had high body mass indices had significantly more barriers to engaging in physical activity and healthy diet than their comparison group counterparts.

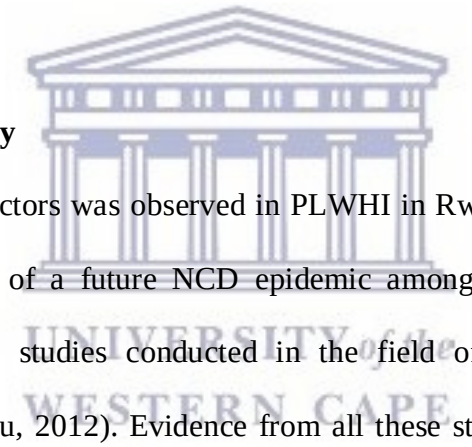
The findings from phases 1 and 2 of the PRECEDE model indicate an impaired HRQOL and the existence of risk factors for NCDs in PLWHI in Rwanda, whereas reasons for health behaviours in this population were identified in phase 3 of this model. The majority of the participants had poor knowledge about NCD risk factors. In addition, numerous barriers and motivators to physical activity participation and healthy diet were identified among PLWHI in Rwanda. Therefore, measures to prevent and control of NCDs and their risk factors is an important public health concern in the long-term treatment and care for PLWHI in Rwanda. Additionally, the availability of reliable and comparable data is well known as one of the approaches to address NCDs among PLWHI via evidence-building for proper planning of NCD prevention and control strategies (Petersen, Yiannoutsos, Justice & Egger, 2014). However, integration of research evidence into healthcare decision-making is a multifaceted and challenging process influenced by numerous factors, including policy-makers' experience, available resources, the policy context, etc. (Harvey & Kitson, 2015; Davies, 2005). This implies the need for a communication approach that takes account of various competing factors. Chapter nine dedicated to the

development of health policy brief is particularly novel and insightful strategy for bringing the major findings of the research study to the door step of non-scientist and technocrats to policy decision making that will improve the quality of life of people living with HIV infection in Rwanda. In this regard, the greatest impact can be achieved by creating healthy public policies that promoting healthy lifestyles to discourage NCD risk factors, and by controlling and reorienting health systems to address the needs of people living with HIV infection in Rwanda.

9.3.2 Limitations of the study

This study has a number of possible limitations. A cause and effect conclusion cannot be drawn from this cross-sectional descriptive study because there was no intervention. Therefore, it is not a true experimental design and the findings from this study should be applied with a dose of caution. But potentially confounding factors were taken into account in the analysis, accompanied by the big sample size. This study only focused on PLWHI adults (individuals over 21 years old), the participants were not randomly selected from the population, and the recruitment of the participants occurred in health centres only; therefore, the sample may not adequately represent the population of PLWHI in Rwanda. However, the results are still valid to all government-funded health centres in Rwanda. The participants of this study are similar to other PLWHI in other health centres in respect of HIV-related factors, as they share medical care protocols. The reliability and validity of the different questionnaire adapted were not ascertained in this study. Although their psychometric properties were established in previous studies and were cited appropriately in the Methodology section, the different questionnaires used may not be reliable or valid in Rwanda or a different culture. In addition, the self-reporting of behavioural risk factors for NCDs may be subject to social desirability biases insofar as this was a hospital-

based study where participants expect that health care providers will disprove those behavioural risk factors; thus the findings may be under-reported. However, these findings were collected using the WHO's STEPS questionnaire, which is deemed to be a reliable instrument. Another limitation is related to the lack of biochemical risk factor information. The current study has only utilised the first two steps, as advised by the WHO for resource-scarce settings such as Rwanda. Again, the majority of the participants in this study, viral loads, and critical indicators of disease progression were not available from the medical records. Finally, this study did not include HIV-controls; however, the findings were discussed in reference to Rwanda STEPS NCD risk factors survey, which used a similar questionnaire (MOH, 2015).



9.3.3 Implications of the study

A high burden of NCD risk factors was observed in PLWHI in Rwanda. The findings from this study support the emergence of a future NCD epidemic among PLWHI in Rwanda. These findings are related to other studies conducted in the field of HIV infection and NCDs (Magodoro et al., 2016; Nigatu, 2012). Evidence from all these studies highlights the need for specific strategies to prevent and control NCDs in the long-term care of PLWHI. Considering that there is the existence of behavioural and biological risk factors for NCDs among PLWHI in Rwanda, health centres that provide HIV services need to be more actively involved in a routine monitoring and screening for PLWHI attending health centres for early detection of NCDs and NCD risk factors. Routine screening of PLWHI for NCD is viewed as one of the best approaches to address NCD among PLWHI (Sogarwal & Mehra, 2015); whilst other researchers recommended improvement in the current screening approaches for NCDs among PLWHI (Peters et al., 2013). Thus, routinely assessing for NCDs and associated risk factors has the

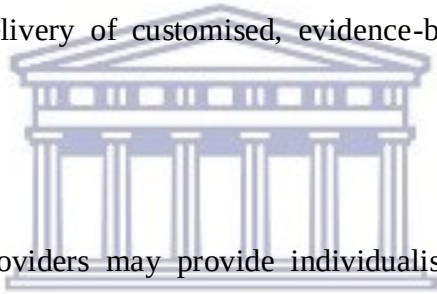
potential to prevent and control NCDs and minimise their impact on HRQOL. Risk factors for an NCD assessment tool needs to be harmonised in all HIV clinics in Rwanda in order to have a common understanding of these risk factors. In addition, the assessment and management of risk factors for NCDs need to be a central in the follow-up with PLWHI enrolling into care and initiating ART, by considering PLWHI in groups who are at high risk. Thus, in this regard, programme managers and policy-makers will gain a deep understanding of these comorbidities in the comprehensive care of PLWHI to inform policy decision-making.

Based on shared similarities between HIV and NCDs as chronic diseases, integrating prevention and management of NCDs and their risk factors into HIV clinical care and treatment services is a priority for policy and practice. Available evidence from Kenya confirms the feasibility to integrate NCD care for PLWHI along with HIV- patients (Edwards et al., 2015). Thus, the Rwandan Ministry of Health needs to restructure the provision of HIV-related care into the chronic care model in order to integrate primary, secondary, and tertiary prevention for NCDs in HIV care and treatment. Hence, HIV clinics should be able to provide comprehensive preventive measures and treatment for NCDs. The adoption of the chronic care model should be the most important part to improving HIV care, to educate PLWHI about NCDs and associated risk factors, and to raise awareness about comorbidities in the context of the HIV care continuum. Available evidence from Canada highlights the benefits of adopting the chronic care model in HIV care and treatment including improved disease screening, immunization, ART uptake, and virologic suppression rates (Tu, Belda, Littlejohn, Pedersen, Valle-Rivera & Tyndall, 2013).

Additionally, due to the fact that there is poor knowledge about risk factors for NCDs, these findings can contribute considerably to the development of a comprehensive health education for PLWHI in order to raise their awareness about the adverse effects of risk factors for NCDs and on how they can change behavioural risk factors. Available evidence indicates that good knowledge of NCD risk factors is associated with increased risk perception of NCDs (Choi et al., 2008). This is confirmed in the current study, where the majority of the participants had limited knowledge about NCD risk factors and a low perceived risk of NCDs. Thus, the provision of general and specific information about NCD risk factors in terms of lifestyle changes, risk factors, and signs and symptoms may improve knowledge, increased perceived risk about NCDs in PLWHI, and encourage them to perform the desired health behaviours. Educational strategies should include but not limited to verbal exchange of information, demonstration, videotapes, tailored printed materials etc. However, health education programmes for the prevention of NCD risk factors should be culturally and health literacy appropriate for PLWHI.

As was evident in Chapter Seven, the majority of the participants had poor knowledge about NCD risk factors. Thus, provision of information about NCD risk factors will improve knowledge about these risk factors. However, a change in knowledge alone is not enough to change behaviour. According to Green and Kreuter (2005), identification of predisposing, reinforcing, and enabling factors may help to design programmes to achieve positive changes in health behaviour among PLWHI. Thus, it is necessary to understand why PLWHI engage in health risk behaviours and what might motivate them to change. This study provides valuable personal and environmental factors to consider in designing healthy lifestyle programmes that aim to promote physical activity and healthy eating in PLWHI. These results are consistent with

results in other studies of PLWHI that explored factors affecting the practice of healthy lifestyle behaviours using a qualitative approach. Capili et al. (2014) found that an individual's socioeconomic or financial circumstances were acknowledged as primary barriers to a healthy lifestyle, while social support was considered as the primary motivator. Roos et al. (2015) found that in South Africa, support and encouragement came from friends and family, religious practices during worship, and the community environment. In addition, stress was reported as one of the pressing issues. Thus, available evidence indicates that stress may impair healthy lifestyle practices (Hamer, 2012). Addressing barriers and motivators to physical activity participation and health diets in the design and implementation of NCD prevention programme for PLWHI can inform the delivery of customised, evidence-based strategies towards better lifestyle for PLWHI.



Following this, health care providers may provide individualised counselling to PLWHI to initiate and maintain physical activity and a healthy diet in their daily lives; which in turn reduces PLWHI's vulnerability to NCD by preventing or delaying these diseases. In this case, prevention of NCDs is cost effective. Again, in addition to educational strategies deal with changing health-related behaviours in PLWHI; considering policy decisions as important and integral part to behavioural change is crucial in tackling issues around access such as affordability and availability; as an example, by addressing financial issues and time constraints among PLWHI.

These research findings also suggest that the assessment of the association between behavioural and biological risk factors for NCDs and a HRQOL provides opportunities for targeted

counselling and secondary prevention efforts, so that health care providers implement strategies that have a significant impact on the HRQOL. The results are broadly consistent with previous studies (Kowal et al., 2008; Uphold et al., 2007). This study reinforces the recommendation for integrating health promotion counselling and self-management programs in long-term treatment and care for PLWHI. Health care providers are in a better position to develop strategies that help PLWHI to engage in healthy lifestyles. Hence, health care providers in HIV care need education, training and assessment guidelines for identifying those who are exposed to behavioural and biological risk factors, so that they can provide guidance, counselling, and screening with confidence. For example, it is critical to develop simple and clear messages to educate patients and HIV care providers about the significance of NCD prevention in PLWHI, and the importance of identifying and treating NCD risk factors in subjects who are at a moderately high or high risk of contracting an NCD, and advising them how tobacco use, an unhealthy diet, harmful alcohol abuse, and low physical activity increases NCD risk and how NCDs can be prevented or delayed by healthy lifestyle behaviours. Thus, with better training, health care providers will gain a deep understanding of NCDs prevention and control, which in turn make them to adopt a multidisciplinary teamwork approach. Again, there is a need to integrate the prevention of risk factors for NCDs in PLWHI into the relevant legislation and policies, and use inter-sectorial co-operation to promote healthy behaviour and create an environment conducive to healthy living for Rwandans, especially those with HIV infection and who are at increased risk for cardiometabolic diseases.

9.3.4 Recommendations

The study was conducted in adults visiting the HIV outpatient clinics in Rwanda. Further risk factors for NCD surveillance studies focusing on in-patients living with HIV admitted to various hospitals or a national community-based study, considering biochemical measures and using objectives measures of behavioural risk factors, would be of interest to provide a comprehensive profile of risk factors for NCDs among PLWHI. In addition, future studies, especially longitudinal studies, should investigate the long-term impact of NCD risk factors on health and the QOL of PLWHI and should consider mixed method strategies, including more qualitative studies. Moreover, a comparative study in the non-HIV+ population to justify whether or not these risk factors for NCDs occur HIV+ people only, is also needed. Currently, there is limited data on healthy lifestyle interventions to combat NCDs in PLWHI, and future research on the feasibility and efficacy of these interventions is needed. Furthermore, future research is sorely needed to identify factors influencing the motivation of HIV care providers to implement health promotion and disease prevention activities in clinical practice, in addition to comprehensive management of PLWHI provided by a multidisciplinary team that gives a continuum of care. This study was guided by the PRECEDE model component (Green & Kreuter, 2005) with a focus on the first three phases, including social assessment, epidemiological and behavioural assessment, and an educational and public health assessment to guide context-specific dissemination plan. Further research needs to progress to intervention alignment, administrative and policy assessment, and implementation.

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Appendices

11.1 Appendix A: Ethical clearance from the Senate Research Grants and Study Leave Committee of the University of the Western Cape

UNIVERSITY of the WESTERN CAPE

OFFICE OF THE DEAN
DEPARTMENT OF RESEARCH DEVELOPMENT

13 August 2013

To Whom It May Concern

I hereby certify that the Senate Research Committee of the University of the Western Cape approved the methodology and ethics of the following research project by Mr J Biraguma (Physiotherapy)

Research Project:	Health Policy Brief: Towards prevention of risk factors for non-communicable diseases among people living with HIV/AIDS in Rwanda
Registration no:	13/6/34

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

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T: +27 21 959 2988/2948 . F: +27 21 959 3170
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11.2 Appendix B: Approval of research from the National Health Research Committee

Republic of Rwanda

RWANDA BIOMEDICAL CENTER

A Healthy People, A Wealthy Nation

Ministry of Health
P.Box 84 KIGALI

Medical Research Center

National Heath Research Committee
Ref: NHRC/2014/PROT/0133

Principal Investigator
Dr. Juvenal BIRAGUMA,

Scientific Review (Approval Notice)

Dear **Juvenal BIRAGUMA,**

Your research project entitled **"Health Policy Brief towards prevention of risk factors for non communicable diseases among people living with HIV/AIDS in Kigali City of Rwanda"** Has been reviewed by National Health Research Committee on 15th /January/2014, and based on the response on the comments provided by the reviewers on 25th October 2013 we are hereby providing approval for the above mentioned protocol.

Please note that approval of the protocol is valid for only lifetime stated in protocol and You are responsible for fulfilling the following requirements:

1. Changes amendments on approach and methodology must be submitted to the NHRC for review and approval to validate the changes.
2. Approval by the Rwanda National Ethics Committee will be needed prior to implementation of your research protocol
3. A submission of quarterly progress report is mandatory
4. Submission to NHRC of final results before publication is mandatory
5. Failure to fulfill the above requirements will result in termination of study

Approval reference number is **NHRC/2014/PROT/013**

Yours Sincerely,

Dr. Jean de Dieu NGIRABEGA
Vice Chairperson of NHRC
Signature:.....
Date:.....

Dr. Parfait UWALIRAYE
Chairperson of NHRC
Signature:.....
Date:.....

11.3 Appendix C: Ethics approval of research from the Rwanda National Ethics Committee

REPUBLIC OF RWANDA/REPUBLIQUE DU RWANDA

NATIONAL ETHICS COMMITTEE / COMITE NATIONAL D'ETHIQUE

Telephone: (250) 2 55 10 78 84
E-mail: info@rnecrwanda.org
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Ministry of Health
P.O. Box. 84
Kigali, Rwanda.

FWA Assurance No. 00001973
IRB 00001497 of IORG0001100

August 21, 2014
No. 248/RNEC/2014

Juvenal BIRAGUMA
Principal Investigator
(A student)

Your Project title **"Health Policy Brief: Towards prevention of risk factors for non-communicable diseases among people living with HIV infection in Rwanda"** has been evaluated by the Rwanda National Ethics committee.

		Involved in the decision		
			No (Reason)	
Name	**Institute**	**Yes**	**Absent**	**Withdrawn from the proceeding**
Dr.Jean-Baptiste MAZARATI	Biomedical Services (BIOS)	X		
Prof. Eugène RUTEMBESA	University of Rwanda	X		
Dr.Laetitia NYIRAZINYOYE	University of Rwanda(school of public Health)	X		
Prof.Alexandre LYAMBABAJE	University of Rwanda	X		
Mrs.Françoise UWINGABIYE	Lawyer at Musanze	X		
Dr. Egide KAYITARE	University of Rwanda	X		
Sr.Domitilla MUKANTABANA	Kabgayi Nursing and Midwife school	X		

Mr. David K. TUMUSIIME	Kigali Health institute	X		
Dr. Lisine TUYISENGE	Kigali Teaching Hospital		X	
Dr. Claude MUVUNYI	Biomedical Services (BIOS)	X		

After reviewing your protocol, during the RNEC meeting of July 12, 2014 where quorum was met, and revisions made on the advice of the RNEC submitted on 14 August 2014, **Approval has been granted to your study.**

Please note that approval of the protocol and consent form is valid for **12 months**.
You are responsible for fulfilling the following requirements:

1. Changes, amendments, and addenda to the protocol or consent form must be submitted to the committee for review and approval, prior to activation of the changes.
2. Only approved consent forms are to be used in the enrollment of participants
3. All consent forms signed by subjects should be retained on file. The RNEC may conduct audits of all study records, and consent documentation may be part of such audits.
4. A continuing review application must be submitted to the RNEC in a timely fashion and before expiry of this approval.
5. Failure to submit a continuing review application will result in termination of the study.
6. Notify the Rwanda National Ethics committee once the study is finished.

Sincerely,

R.N.E.C

Prof. Eugene RUTEMBESA
Vice-Chairperson, Rwanda National Ethics Committee.

Date of Approval: August 21, 2014
Expiration date: August 20, 2015

C.C.
- Hon. Minister of Health.
- The Permanent Secretary, Ministry of Health.

11.4 Appendix D: Research Clearance Certificate from Directorate General of Science, Technology and Research in Ministry of Education

REPUBLIC OF RWANDA

Kigali, 06/10/2014
N°...2546.../12.00/2014

MINISTRY OF EDUCATION
P.O.BOX 622 KIGALI

Re: Permission to carry out research in Rwanda - No: MINEDUC/S&T/263/2014

The Permission is hereby granted to **Mr. Juvenal Biraguma**, Ph.D student at the University of the western Cape, South Africa, to carry out research on: **"Health Policy Brief: Towards Prevention of Risk Factors for non- Communicable Diseases among People living with HIV infection in Rwanda".**

The research will be carried out in district Hospitals and Selected Health Centres located in Nyarugenge and Gasabo districts of Kigali City; Muhanga and Kamonyi districts of Southern province; Karongi and Rubavu districts of the Western province. The researcher will need access to Medical records of people living with HIV/AIDS in selected Health Centers. He will need to interview the district hospital laboratory personnel.

The period of research is from **23rd September, 2014 to 22nd September, 2015** It may be renewed if necessary, in which case a new permission will be sought by the researcher.

Please allow the **above mentioned researcher**, any help and support he might require to conduct this research.

Yours sincerely,

Remy TWIRINGIYIMANA
Ag. Director General,
Science, Technology and Research
Ministry of Education

11.5 Appendix E: Participant' information sheet

UNIVERSITY OF THE WESTERN CAPE

Private Bag X 17, Bellville 7535, South Africa

Tel: +27(0) 21-959 2542, Fax: 27(0) 21-959 1217

E-mail: mwarner@uwc.ac.za

INFORMATION SHEET

Project Title: Health Policy Brief: Towards prevention of risk factors for non-communicable diseases among people living with HIV infection in Rwanda.

What is this study about?

This is a research project being conducted by Mr. Juvenal Biraguma at the University of the Western Cape. We are inviting you to participate in this research project because you are a person living with HIV infection, and at risks of developing non-communicable diseases, which are prevented by addressing modifiable risk factors. The purpose of this research project is to develop a health policy brief that provides strategies for addressing risk factors of non-communicable diseases among people living with HIV infection based on the PRECEDE model.

What will I be asked to do if I agree to participate?

You will be asked to provide a signed consent letter to participate in this study. You will have to answer all questions of the questionnaire. You will be approached at your Health facility to

complete the questionnaire while waiting to be attended to by health professionals and giving it back to the researcher. You will deserve the right to withdraw from this study at any time and the right to ask for more clarification on the study. In addition, anthropometric and other measurements will be taken by the research team. Participation in this study will take approximately 30 to 40 minutes. The information you provide will be kept confidentially and the feedback will be made available to you after the completion of this study.

Would my participation in this study be kept confidential?

We will do our best to keep your personal information confidential. To help protect your confidentiality, do not indicate your names and/or other identifiable details. Only the codes will be used on the data forms. Through the use of an identification key, the researcher will be able to link your survey to your identity and only the researcher will have access to the identification key. Females and males will be accommodated in separate section of the health centre. If we write a report or article about this research project, your identity will be protected to the maximum extent possible.

What are the risks of this research?

There are no predicted risks associated with participating in this research study.

What are the benefits of this research?

This research is not designed to help you personally, but the results will help the people living with HIV infection in general, the ministry of health to develop research-based non-communicable disease prevention policies and to develop strategies for promoting the health of people living with HIV infection through control and management of non-communicable diseases and researcher to learn more about risk factors for non-communicable diseases and quality of life of people living with HIV infection. We hope that, in the future, other people

might benefit from this study through developing an appropriate intervention programme in people living with HIV infection regarding non-communicable diseases.

Do I have to be in this research and may I stop participating at any time?

Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalised or lose any benefits to which you otherwise qualify.

What if I have questions?

This research is being conducted by *Mr. Juvenal BIRAGUMA, a registered student in Physiotherapy Department a*t University of the Western Cape. If you have any questions about the research study itself, please contact Mr. *Juvenal BIRAGUMA* on telephone number 0785308659, email: juvenalbi@gmail.com

Should you have any questions regarding this study and your rights as a research participant or if you wish to report any problems you have experienced related to the study, please contact:

Chairperson of Rwanda National Ethics Committee: Dr Jean-Baptiste MAZARATI at 0788309807 or Dr. Laetitia NYIRAZINYOYE, secretary of the Rwanda National Ethics Committee at 0738683209

This research has been approved by the University of the Western Cape's Senate Research Committee and Ethics Committee.

11.6 Appendix F: Participant' consent form

UNIVERSITY OF THE WESTERN CAPE

Private Bag X 17, Bellville 7535, South Africa

Tel: +27(0) 21-959 2542, Fax: 27(0) 21-959 1217

E-mail: mwarner@uwc.ac.za

CONSENT FORM

Title of Research Project: Health Policy Brief: Towards prevention of risk factors for non-communicable diseases among people living with HIV infection in Rwanda.

The study has been described to me in language that I understand and I freely and voluntarily agree to participate. My questions about the study have been answered. I understand that my identity will not be disclosed and that I may withdraw from the study without giving a reason at any time and this will not negatively affect me in any way.

Participant's name……..

Participant's signature…… Date……

Witness' name……

Witness' signature…….. ….. Date……..

Should you have any questions regarding this study or wish to report any problems you have experienced related to the study, please contact Chairperson of Rwanda National Ethics

Committee: Dr Jean-Baptiste MAZARATI at 0788309807 or Dr. Laetitia NYIRAZINYOYE, secretary of the Rwanda National Ethics Committee at 0738683209

Study Coordinator's Name: Mr. Juvenal BIRAGUMA

University of the Western Cape

Private Bag X17, Belville 7535

Telephone: +27 (0) 21-959 2542

Cell: +27(0)787733421 in South Africa or +250(0)785308659 in Rwanda

Fax: +27 (0) 21-959 1217

Email: juvenalbi@gmail.com

11.7 Appendix G: WHO STEPS instrument

Section A: Sociodemographic and HIV-related factors

Instruction: Tick the option matching to the answer given by participant or as indicated in participants' medical records

C1. Sex (Record Male or Female as observed): 1Male □ 2 Female □

C2. How old are you now? Age in years: _____

C3. What is your current marital status?

1 Never married □

2 Currently married □

3 Cohabiting □

4 Separated □

5 Widowed □

6 Divorced □

C4. What is the highest level of education you have completed?

1 No formal education □

2 Primary □

3 Vocational training □

4 Secondary □

5 University □

C5. What is your current occupation?

1 Public (government) service □

2 Peasant (farmer/ livestock) □

3 Self-employed (Business) □

4 Private Organisation □

5 Student □

6 Unemployed □

C6. What is your monthly household income in FRW _____

C7. Which area do you live in/ geolocality? 1 Urban □ 2 Rural □

C8. How long have you been with HIV infection? Years: _____

C9. Have you ever disclosed to your partner or somebody else about your HIV status?

1 Yes□ 2 No □

C10. Last recorded HIV Viral Load: _____

C11. Last recorded CD4 count: _____

C12. WHO stage: 1 Stage □ 2 Stage □ 3 Stage □ 4 Stage

C13. What is your ART status? 1 Experienced □ 2 Naïve □

C14. If experienced, how long have you been on ART? MONTHS □□

C15. Adherence to ARV: 1 Very good □ 2 Good □ 3 Poor □

C16. HIV/tuberculosis (TB) co-infection: 1 yes □ 2 No □

Section B: Risk factors and preventive health behaviours

Now I am going to ask you some questions about various health behaviors. This includes things like smoking, drinking alcohol, eating fruits and vegetables and physical activity. Let's start with tobacco use habits.

Tobacco use:

T1. Have you ever smoked tobacco or used smokeless tobacco? 1 YES □ 2 NO □

T2. Do you currently use (smoke, sniff or chew) any tobacco products such as cigarettes, cigars, pipes, chewing tobacco or snuff?

1 YES, DAILY □ 2 YES, BUT NOT DAILY □ 3 NO, NOT AT ALL □

T3. For how long have you been smoking or using tobacco daily?
INTERVIEWER: If less than one month- enter for 00" for years and "00" for months.
YEARS □□ MONTHS □□ DON'T KNOW □, RECORD 77

T4. On average, how many of the following products do you smoke or use each day? Include number below:

T4a. Manufactured cigarettes □□

T4b. Hand-rolled cigarettes □□

T4c. Pipefuls of tobacco □□

T4d. Cigars, cheroots, cigarillos, bidis □□

T4e. Smokeless tobacco □□□ GRAMS/DAY

T5. In the past, did you ever smoke tobacco or use smokeless tobacco daily?

1 YES □ 2 NO □

T6. How old were you when you stopped smoking or using tobacco daily?

YEARS OF AGE □□ DON'T KNOW □, RECORD 77

T7. How long ago did you stop smoking or using tobacco daily?
YEARS □□ MONTHS □□ DON'T KNOW, RECORD 77 □

Alcohol Consumption:

A1. Have you ever consumed a drink that contains alcohol (such as beer, wine, spirits, etc.)?

1 YES □ 2 NO, NEVER □

A2. Have you consumed alcohol in the last 30 days? 1 YES □ 2 NO □

A3. During the past 7 days, how many drinks of any alcoholic beverage did you have each day?

INTERVIEWER: Want respondent to tell you the number of "standard" drinks. Include number below:

A3a. Monday □□ A3b. Tuesday □□ A3c. Wednesday □□ A3d. Thursday □□

A3e. Friday □□ A3f. Saturday □□ A3g. Sunday □□

A4. In the last 12 months, how frequently [on how many days] on average have you had at least one alcoholic drink?

1 LESS THAN ONCE A MONTH □
2 ONE TO THREE DAYS PER MONTH □

3 ONE TO FOUR DAYS PER WEEK □

4 FIVE OR MORE DAYS PER WEEK □

A5. In the last 12 months, on the days you drank alcoholic beverages, how many drinks did you have on average?

NUMBER OF DRINKS □□ DON'T KNOW, RECORD 77 □

Nutrition:

I want to ask you a few questions about your diet about the fruit and vegetables you usually eat.

D1. In a typical week, on how many days do you eat fruit?

NUMBER OF DAYS □□ If Zero days, go to D3rd question

D2. How many servings of fruit do you eat on a typical day?

NUMBER OF SERVINGS □□ DON'T KNOW, RECORD 77 □

D3. In a typical week, on how many days do you eat vegetables?

NUMBER OF DAYS □□ If Zero days, go to D5th question

D4. How many servings of vegetables do you eat on a typical day?

NUMBER OF SERVINGS □□ DON'T KNOW, RECORD 77 □

D5. In the last 12 months, how often did you ever eat less than you felt you should because there wasn't enough food?

1 Every month □

2 Almost every month □

3 Some months, but not every month □

4 Only in 1 or 2 months □

5 Never □

D6. In the last 12 months, were you ever hungry, but didn't eat because you couldn't afford enough food?

1 Every month..... □

2 Almost every month..... □

3 Some months, but not every month □

4 Only in 1 or 2 months .. □

5 Never ..... □

Physical activity:

Next I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be an active person. Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, household chores, harvesting food/crops, fishing or hunting for food, providing care or seeking employment.

In answering the following questions 'vigorous activities' require hard physical effort and cause large increases in breathing or heart rate, 'moderate activities' require moderate physical effort and cause small increases in breathing or heart rate.

P1. Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate, [like heavy lifting, digging, construction or chopping wood] for at least 10 minutes continuously? 1 YES □ 2 NO □

P2. In a typical week, on how many days do you do vigorous-intensity activities as part of your work? □ DAYS

P3. How much time do you spend doing vigorous-intensity activities at work on a typical day? □□:□□

HOURS: MINUTES

P4. Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate [such as brisk walking, carrying light loads, cleaning, cooking, or washing clothes] for at least 10 minutes continuously? 1 YES □ 2 NO □

P5. In a typical week, on how many days do you do moderate-intensity activities as part of your work? □ DAYS

P6. How much time do you spend doing moderate-intensity activities at work on a typical day? □□:□□

HOURS: MINUTES

The next questions exclude the physical activities at work that you've already mentioned. Now I would like to ask you about the usual way you travel to and from places. For example: getting to work, to shopping, to the market, to place of worship.

P7. Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places? 1 YES □ 2 NO □

P8. In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places? □ DAYS

P9. How much time would you spend walking or bicycling for travel on a typical day?

□□:□□

HOURS: MINUTES

The next questions exclude the work and transport activities that you have already mentioned. Now I would like to ask you about sports, fitness, leisure and recreational activities [insert relevant terms].

P10. Do you do any vigorous intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate [like running or football], for at least 10 minutes continuously? 1 YES □ 2 NO □

P11. In a typical week, on how many days do you do vigorous intensity sports, fitness or recreational (leisure) activities? □ DAYS

P12. How much time do you spend doing vigorous intensity sports, fitness or recreational activities on a typical day? □□:□□

HOURS: MINUTES

P13. Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that cause a small increase in breathing or heart rate [such as brisk walking, cycling or swimming] for at least 10 minutes at a time? 1 YES □ 2 NO □

P14. In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities? □ DAYS

P15. How much time do you spend doing moderate intensity sports, fitness or recreational (leisure) activities on a typical day? □□:□□

HOURS: MINUTE

The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent [sitting at a desk, sitting with friends, travelling in car, bus, train, reading, playing cards or watching television], but do not include time spent sleeping.

P16. How much time do you usually spend sitting or reclining on a typical day?

□□:□□

HOURS: MINUTES

Section C: Physical measurement:

Measurements		1st	2nd	Average
PM1	Weight In Centimetres (kg)			
PM2	Height In Kilograms (cm)			
PM3	Body mass index			
PM4	Waist circumference In Centimeters (cm) **Note: pregnant women skip waist**			
PM5	Hip circumference In Centimeters (cm)			
PM6	Waist-to-hip ratio			
PM7	Systolic Blood Pressure: (mmHg)			
PM8	Diastolic Blood Pressure: (mmHg)			

11.7 Appendix H: The Medical Outcome Study HIV (MOS-HIV) questionnaire

Instructions to participant: Please answer the following questions by placing a **"✓"**in the appropriate box.

		Excellent	Very Good	Good	Fair	Poor
Q1.	In general, would say your health is:	1□	2□	3□	4□	5□

		None	Very mild	Mild	Moderate	Severe	Very severe
Q2.	How much **bodily** pain have you generally had during **the past 4 weeks**?	1□	2□	3□	4□	5□	6□

		Not at all	A little bit	Moderately	Quite a bit	Extremely
Q3.	During **the past 4 weeks**, how much did pain interfere with your normal work (or your normal activities including work outside the home and housework)?	1□	2□	3□	4□	5□

Q4. The following questions are about activities you might do during a typical day. Does your **health now limit you** in these activities? If so, how much?

Check **one** box on **each** line		**Yes, limited a lot**	**Yes, limited a little**	**No, not limited**
Q4a.	The kinds or amounts of vigorous activities you can do, like lifting heavy objects, running or participating in strenuous sports	1□	2□	3□
Q4b.	The kinds or amounts of moderate activities you can do, like moving a table, carrying groceries or bowling	1□	2□	3□
Q4c.	Walking uphill or climbing (a few flights of stars).	1□	2□	3□
Q4d.	Bending, lifting or stooping	1□	2□	3□
Q4e.	Walking one block	1□	2□	3□
Q4f.	Eating, dressing, bathing or using the toilet	1□	2□	3□

Q5.	Does **your health** keep you from working at a job, doing work around the house or going to school	1 YES □ 2 NO □
Q6.	Have you been unable to do **certain kinds or amounts** of work, housework, or schoolwork because of your health?	1 YES □ 2 NO □

For each of the following questions, please check the box for the <u>one</u> answer that comes <u>closest</u> to the way you have been feeling <u>during the past 4 weeks</u>.

		All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
Q7.	How much of the time, during the past 4 weeks, has **your health limited your social activities** (like visiting with friends or close relatives)?	1□	2□	3□	4□	5□	6□
Q8.	How much of the time, during the past 4 weeks:						
Q8a.	Have you been a **very nervous person?**	1□	2□	3□	4□	5□	6□
Q8b.	Have you felt **calm and peaceful?**	1□	2□	3□	4□	5□	6□
Q8c.	Have you felt **downhearted and blue?**	1□	2□	3□	4□	5□	6□
Q8d.	Have you been a **happy person?**	1□	2□	3□	4□	5□	6□
Q8e.	Have you been a **happy person? Have you felt so down in the dumps that nothing could cheer you up?**	1□	2□	3□	4□	5□	6□

For each of the following questions, please check the box for the one answer that comes closest to the way you have been feeling during the past 4 weeks

		All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
Q9.	How often, during the past 4 weeks:						
Q9a.	Did you feel full of pep?	1□	2□	3□	4□	5□	6□

Q9b.	Did you feel worn out?	1□	2□	3□	4□	5□	6□
Q9c.	Did you feel tired?	1□	2□	3□	4□	5□	6□
Q9d.	Did you have enough energy to do the things you wanted to do?	1□	2□	3□	4□	5□	6□
Q9e.	Did you feel weighed down by your health problems?	1□	2□	3□	4□	5□	6□
Q9f.	Were you discouraged by your health problems?	1□	2□	3□	4□	5□	6□
Q9g.	Did you feel despair over your health problems?	1□	2□	3□	4□	5□	6□
Q9h.	Were you afraid because of your health?	1□	2□	3□	4□	5□	6□
Q10.	How much of the time, during the **past 4 weeks:**						
Q10a.	Did you have difficulty reasoning and solving problems, for example, making plans, making decisions, and learning new things?	1□	2□	3□	4□	5□	6□
Q10b.	Did you forget things that happened recently, for example, where you put things and when you had appointments?	1□	2□	3□	4□	5□	6□
Q10c.	Did you have trouble keeping your attention on any activity for long?	1□	2□	3□	4□	5□	6□
Q10d.	Did you have difficulty doing activities involving concentration and thinking?	1□	2□	3□	4□	5□	6□

Q11. Please check the box that best describes whether each of the following statements is true or false for you.

Check **one** box on **each** line		Definitely True	Mostly True	Not sure	Mostly False	Definitely False
Q11a.	I am somewhat ill.	1□	2□	3□	4□	5□
Q11b.	I am as healthy as anybody I know	1□	2□	3□	4□	5□
Q11c.	My health is excellent	1□	2□	3□	4□	5□
Q11d.	I have been feeling bad lately	1□	2□	3□	4□	5□

		Very well; could hardly be better	Pretty good	Good and bad parts about equal	Pretty bad	Very bad; could hardly be worse
Q12.	How has the quality of your life been during the **past 4 weeks**? That is, how have things been going for you? (Check One)	1□	2□	3□	4□	5□

		Much better	A little better	About the same	A little worse	Much worse
Q13.	How would you rate your physical health and emotional condition now compared to **4 weeks ago**? (Check One)	1□	2□	3□	4□	5□

11.8 Appendix I: The knowledge assessment questionnaire

Please answer the following questions to the best of your ability

GENERAL KNOWLEDGE			
K1	Have you ever heard of non-communicable diseases	1Yes	☐
		2 No	☐
K 2	Have you ever heard of the following diseases?		
	Stroke	1 yes	☐
		2 No	☐
	Hypertension	1 Yes	☐
		2 No	☐
	Diabetes	1 Yes	☐
		2 No	☐
K 3	Which of the following factors contribute to non-communicable diseases? **Tick as many answers as you think**		
		smoking	1
		physical activity	1
		loud music	
		obesity	1
		balanced diet	
		alcohol	1
		stress	1
		medication	
K 4	Can non-communicable diseases be prevented	Yes	☐
		No	☐
K 5	Have you been taught in health facility about non-	Yes	☐

	communicable diseases	No	☐
K 6	**Tell me how much you agree or disagree with each statement regarding perceptions of risk to non-communicable diseases**		
	Compared to others my age and sex, I am at lower risk of non-communicable diseases	Agree	☐
		Disagree	☐
	I worry about having non-communicable diseases	Agree	☐
		Disagree	☐
	I think my personal effort will help control my risk of having non-communicable diseases	Agree	☐
		Disagree	☐
	I have information on how to prevent NCD	Agree	☐
		Disagree	☐
STATE WHETHER TRUE OR FALSE OR DON'T KNOW			
HYPERTENSION			
K 7	Hypertension is another name for high blood pressure	TRUE	1
		FALSE	0
		Don't know	0
K 8	The following blood pressure is considered to be high 130/80	TRUE	1
		FALSE	0
		Don't know	0
K 9	Hypertension can be treated with medication, exercise and weight loss	TRUE	1
		FALSE	0
		Don't know	0
K 10	Lifestyle changes such as stopping smoking, loss of weight can decrease blood pressure	TRUE	1
		FALSE	0
		Don't know	0
K 11	Damage to the kidney is a sign of high blood pressure	TRUE	1

		FALSE	0
		Don't know	0
		Score	**5**
DIABETES			
K 12	Diabetes is commonly known as "sugar" sickness	TRUE	1
		FALSE	0
		Don't know	0
K 13	The following is normal blood glucose levels 3.8 - 7.7	TRUE	1
		FALSE	0
		Don't know	0
K 14	Eating to much sugar and other sweet foods is a cause for diabetes	TRUE	1
		FALSE	0
		Don't know	0
K 15	Diabetes can be cured	TRUE	1
		FALSE	0
		Don't know	0
K 16	Shaking and sweating are signs of high sugar levels	TRUE	1
		FALSE	0
		Don't know	0
K 17	Kidney produce insulin	TRUE	1
		FALSE	0
		Don't know	0
K 18	The usual cause of diabetes is lack of effective insulin in the body	TRUE	1
		FALSE	0
		Don't know	0

K 19	Diabetes causes poor circulation	TRUE	1
		FALSE	0
		Don't know	0
K 20	Medication is more important that diet and exercise to control diabetes	TRUE	1
		FALSE	0
		Don't know	0
K 21	There are 2 types of diabetes namely Type 1 and Type 2	TRUE	1
		FALSE	0
		Don't know	0
22	Diabetes can damage my kidneys	TRUE	1
		FALSE	0
		Don't know	0
		Score	**11**
	STROKE		
K 23	The most common type of stroke is when the blood supply to the brain is blocked	TRUE	1
		FALSE	0
		Don't know	0
K 24	Another name for stroke is Cerebrovascular (CVA) accident	TRUE	1
		FALSE	0
		Don't know	0
K 25	Signs of a stroke include blurred vision, paralysis on one side of the body and severe headache	TRUE	1
		FALSE	0
		Don't know	0
K 26	You are at risk of getting a stroke if you are obese	TRUE	1
		FALSE	0
		Don't know	0

K 27	The most common known risk factor for stroke is high blood pressure	TRUE	1
		FALSE	0
		Don't know	0
K 28	If you drink lots of alcohol you are less likely to have a stroke	TRUE	1
		FALSE	0
		Don't know	0
K 29	To reduce the risk of stroke you need to eat well and exercise regularly	TRUE	1
		FALSE	0
		Don't know	0
K 30	Right arm paralysis could be a physical disability caused by stroke	TRUE	1
		FALSE	0
		Don't know	0
K 31	If you stop smoking you decrease the risk of harm a stroke	TRUE	1
		FALSE	0
		Don't know	K
K 32	Diabetes and stroke are closely linked	TRUE	1
		FALSE	0
		Don't know	0
		Score	**10**
		TOTAL	**26**

11.9 Appendix J: The Motivators and Barriers of Healthy Lifestyle Scale

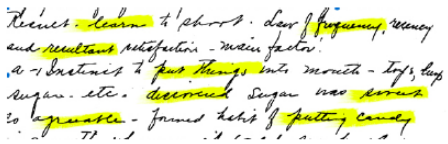
Your answers to all the statements below will help us learn why some people practice healthy lifestyle behaviors: exercise regularly and eat a healthy diet, and others do not. Please read each statement and tick the response below that shows how much you agree with the statement.

1 = Strongly Disagree; 2 = Disagree; 3 = Agree; 4 = Strongly Agree

	Strongly Disagree	Disagree	Agree	Strongly Agree
I practice a healthy lifestyle because I				
MHL 1. May live longer	1	2	3	4
MHL 2. Want to be healthy	1	2	3	4
MHL 3. Believe that God wants me to take care of my body	1	2	3	4
MHL 4. Want to be more energetic	1	2	3	4
MHL 5. Want to manage my weight	1	2	3	4
MHL 6. Have someone to encourage or help me	1	2	3	4
MHL 7. Have seen others get sick from unhealthy behaviors	1	2	3	4
MHL 8. Will reduce my chances of getting sick	1	2	3	4
MHL 9. Can easily get to a place to exercise (sidewalk, park, or exercise facility)	1	2	3	4
I do not practice a healthy lifestyle because I				
BHL 10. Am not motivated	1	2	3	4
BHL 11. Do not have someone to encourage or help me	1	2	3	4
BHL 12. Live in an unsafe neighborhood	1	2	3	4
BHL 13. Have too many things to do	1	2	3	4
BHL 14. Have health problems	1	2	3	4
BHL 15. Do not know what to do	1	2	3	4

BHL 16. Am unable to afford it	1	2	3	4
BHL 17. Am not able to easily get to a place to exercise (sidewalk, park, or exercise facility)	1	2	3	4
BHL 18. Have not been told by my healthcare provider (doctor, nurse practitioner etc) to change my lifestyle	1	2	3	4
BHL 19. I feel stressed	1	2	3	4

11.10 Appendix K: Certificate of Editing



CORPORATE * ACADEMIC * LITERARY EDITING

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23 March 2017

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

CERTIFICATE OF EDITING – Mr Juvenal Biraguma

RE: Editing of Health Policy Brief: Towards Prevention of Risk Factors for Non-Communicable Diseases among People Living with HIV Infection in Rwanda

I hereby confirm that Mr Juvenal Biraguma's dissertation entitled "Health Policy Brief: Towards Prevention of Risk Factors for Non-Communicable Diseases among People Living with HIV Infection in Rwanda" for the University of the Western Cape was edited by me in March 2017.

I have not had final sight of the document accepting or rejecting editorial changes made.

Sincerely

M. I. MORRIS

Isabella Morris

Editor

Associate Member of the South African Professional Editors' Group